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Julije Knifer, Apstraktna kompozicija iz 1953. godine
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Josip Juraj Strossmayer University of Osijek
Faculty of Medicine

Julije Knifer (Osijek, 23. april 1924. - Pariz, 7. decembar 2004.), bio je jedan od najznačajnijih hrvatskih slikara 20. vijeka.

Knifer je studirao slikarstvo početkom 1950-ih na zagrebačkoj Akademiji likovnih umjetnosti. Nakon studija bio je jedan od osnivača i istaknuti član neodadaističke grupe Gorgona (Marijan Jevšovar, Julije Knifer, Đuro Seder, Josip Vaništa, Ivan Kožarić, Miljenko Horvat, Dimitrije Bašičević, Matko Meštrović i Radoslav Putar) koja je u Zagrebu djelovala od 1959 do 1966, tad je odlučio da ne će slikati ništa drugo nego meandar, taj prauzorak ljepote iz grčke arhaične umjetnosti. Pozvan je da sudjeluje na prvoj izložbi Novih tendencija u Zagrebu 1961, nakon tog postao je pripadnik toga pokreta i izlagao na njihovim slijedećim izložbama 1963, 1969 i 1973 u Zagrebu. A nakon toga na izložbama tog pokreta po svijetu; Art Abstrait Constructif International u galeriji Denise René (Pariz, 1961-1962), Konstruktivisten u Städtisches Museumu u Leverkusenu (1962) i Oltre l'informale u San Marino 1963. Izlagao je na Bijenalu u Sao Paulu 1973 zajedno s Jurajem Dobrovićem i Vjenceslavom Richterom, u Sao Paolu je izlagao i 1979 i 1981.

Prvi put je izlagao na na Venecijanskom bijenalu zajedno s kiparom Ivanom Kožarićem 1976 kao predstavnik Jugoslavije.

Sedamdesetih je počeo surađivati sa njemačkim galerijama; Keller iz Münchena i Hoffmann iz Friedberga te sa pariškom galerijom Frank Elbaz. Od 1973. do kraja osamdesetih surađivao je s tübingenenskom Galerijom Dacić, koja mu je, među ostalim, 1975. organizirala čuvenu akciju Arbeitprozess, kada je u napuštenu kamenolomu zajedničkom akcijom njegovih njemačkih prijatelja i poštovalaca i materijalnom pomoći njegovog mecene dr. Živojina Dacića izveden divovski meandar dimenzija 30x20 metara (600 m). O akciji Arbeitprozess snimljen je i istoimeni film i izdana monografija.

1991 Knifer se iselio iz Hrvatske i otišao živjeti u Francusku u malo mjesto Sète na Azurnoj obali, 1994 seli se u Pariz u kojem je umro 2004. Komesar hrvatskog nastupa na Venecijanskom bijenalu 2001 Zvonko Maković, odabrao je Knifera da nastupi za Hrvatsku. Iste godine proglašen je počasnim građaninom Osijeka. U Gliptoteci HAZU je 14. maja 2002 priređena promocija Kniferove prve monografije na hrvatskom jeziku koju je napisao prof. Zvonko Maković, na koju je došao i sam Knifer osobno iz Pariza. Ona je izašla, godinu dana kasnije od njegove francuske monografije, koju je napisao Arnault Pierre, ugledni pariški historičar umjetnosti.

Osnovni i prepoznatljiv motiv Kniferove umjetnosti je od 1960-ih meandar, kojeg je Knifer izveo u brojnim varijacijama i u različitim tehnikama; kao crteže olovkom do slika na platnu, kolaža, grafika, murala i skulptura. Kniferovi meandari svedeni su na jednoličan ritam forme i kontrast crnog i bijelog. Vrlo kasno počeo je slikati i meandre u boji, ali se je na kraju vratio svojoj monokromatskoj redukciji.

Za svoj rad Julije Knifer, dobio je 2004 Nagradu za životno djelo Vladimir Nazor[3] U Francuskoj je dobio 2000, nagradu Aurélie Nemours.

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Contents

Original article

Comparison of Modern Surgical Techniques in a Treatment of Myopia

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Abstract

Aim: To examine whether there is a difference in the outcomes of surgical techniques photorefractive keratectomy (PRK), laser in situ keratomileusis (LASIK) and implantable collamer lens (ICL) for: short-term visual outcome after 6 months, long-term visual outcome after 24 months, procedures safety and remaining refractive error after surgery.

Methods: The research was conducted on patients with myopia and myopic astigmatism. Data was collected on the surgical technique performed binocularly: PRK, LASIK or ICL. Visual acuity was measured: before the procedure, 6 months after the procedure and 24 months after the procedure. Data were collected on the occurrence of complications and performed additional corrections.

Results: The research was conducted on 150 patients. The median age was 33 years with an interquartile range of 28 to 39 years. The visual outcome was satisfactory in all three groups during two measurement periods after 6 months and after 24 months after procedures. Complications in this study occurred in 13 patients (8,7 %), mostly in LASIK group with total of 11 patients. Suboptimal refractive result that was corrected by additional correction amounts 1,3 % meaning only 2 of patients underwent the correction procedure due to suboptimal refractive error.

Conclusion: Short-term and long-term visual outcome after binocularly performed PRK, LASIK and ICL showed success in all groups. ICL and PRK showed the highest safety rate, while LASIK had more frequent complications in this study. A suboptimal refractive result occurred rarely and were additionally corrected if needed..

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KEYWORDS: Keratomileusis, Laser In Situ; Myopia; Phakic Intraocular Lenses; Photorefractive Keratectomy; Refractive Surgical Procedure

Introduction

Definition

Myopia is a refractive error in which image of an object is projected in front of the retina which is the result of a discordance of the axial length and refractive power of the eye (1). Myopia can be classified as axial, refractive and accommodative myopia. Axial myopia is the result of stretching the posterior pole of the eye which causes the optical axis to lengthen more than 2,4 centimeters. Refractive myopia is most often caused by too steep cornea, a more curved anterior surface of the lens, sclerosis of the lens nucleus, luxation of the lens in the anterior chamber of the eye and pathological conditions of the cornea such as keratectasia, microcornea and keratoconus. Accommodative myopia is the result of accommodation spasm, in which lens rounds and moves forward and causes nearsightedness (2).

Public health concerns

According to the World Health Organization, a third of the World's population - about 2,6 billion people, suffered from myopia in 2020. It is predicted that by the year 2030 this number is going to reach 3,4 billion. Accordingly, by the 2050 almost half of the World's population or about 5 billion people will suffer from myopia (3).

Refractive surgery

Refractive surgery refers to surgical procedures that change the refractive power of the eye. Cornea and lens account for the majority of the refractive power of eye, so refractive surgery procedures are performed on cornea and lens (1).

Refractive surgery developed dramatically throughout the 20th century. Development of new procedures and platforms continues until today. We are going to mention some of the most significant techniques of refractive surgery throughout history: Incisional procedures that include radial keratotomy, astigmatic keratotomy, and limbal relaxing incisions. Lamellar non-laser procedures that include keratomileusis, automated lamellar keratoplasty and keratophakia. Thermal procedures that include radial intrastromal thermokeratoplasty, laser thermokeratoplasty and conductive keratoplasty (4).

Today we mostly relay on surface and incisional methods: Photorefractive Keratectomy (PRK), Laser in-situ Keratomileusis (LASIK) and Kerato-refractive Lenticule Extraction (KLEx).

PRK is used to correct myopia up to 7 diopters. In this procedure the epithelial layer of the cornea is removed followed by controlled ablation of the corneal surface stroma with an excimer laser (5). The epithelium heals from the periphery to the center within 4 days. After the procedure, the corneal epithelium goes through a hyperplastic phase in which the refractive status of the eye can vary before final stabilization (6).

LASIK is used to correct myopia up to 10 diopters with astigmatism up to 6 diopters. LASIK involves excimer laser ablation of the corneal stroma beneath a corneal flap created with a microkeratome or femtosecond laser. Laser vision correction procedures for myopia thins cornea in controlled manner thus correcting the shape of the cornea by reducing the central curvature of the cornea. Eye tracking devices use infrared tracking or cameras to move the laser ablation beam according to the direction of eye saccades. The flap characteristics, energy and incision direction must be prepared and programmed before the procedure (5).

KLEx, also known as Small Incision Lenticular Extraction (SMILE), is performed with femtosecond laser that creates a lenticle that is then surgically dissected through an entrance incision of 2 millimeters. Lenticular extraction can correct myopia and myopic astigmatism. The advantage of this technique lies in the quick recovery and reduced risk of developing dry eye due to the smaller amount of damage to the corneal nerves (7).

Refractive procedures also include Implantable collamer lens (ICL), posterior chamber phakic

intraocular lens that is implanted behind the pupil, in the posterior chamber between the iris and the lens (8). ICL is approved for correction of myopic astigmatism with spherical equivalent ranging from -3.0D to ≤-15.0D with cylinder of 1.0D to 4.0D (9).

Preoperative examination and planning of the procedure

Preoperative examination consists of a biomicroscope examination of the anterior and posterior segments of the eye and measurement of intraocular pressure using ICARE tonometer. It is necessary to determine the visual acuity for each patient: monocular uncorrected and best corrected distance visual acuity. It is mandatory to record pupillography, topography and corneal tomography with a topographic curvature system, pachymetry, biometry, wavefront aberrometry, tear film assessment, determination of ocular dominance, ocular motility and specular microscopy. Finding dominant eye is also helpful if minimonovision is planned. Considering the collected data clinician is then able to decide on the type of personalized procedure profile. It is also important to discuss the reasons for undergoing refractive surgery in order to identify patients with unrealistic expectations. It is important to explain that refractive procedures primarily serve to reduce dependence on spectacles (10).

Participants and methods

A historical cohort study was conducted including patients with myopia and myopic astigmatism who were treated at the University Eye Hospital Svjetlost Zagreb in a 3-year period (from 2018 to 2021). The total number of subjects was 150 patients. Data collection was performed by reviewing the medical documentation for each individual subject. Basic demographic data of the subjects (age, gender) was collected. Data on the binocularly performed surgical technique were extracted for each subject: PRK, LASIK or ICL. Snellen charts were used to determine corrected and uncorrected distant visual acuity for the right and left eye in three time periods: before the procedure, 6 months after the procedure and 24 months after the procedure. Data of complication, residual refractive error and additional correction has been collected.

Results

The study was conducted on 150 subjects. 50 patients (33.3%) differed according to the binocularly performed surgical technique: PRK, LASIK and ICL. Out of total number of subjects, 63 (42%) were male and 87 (58%) were female, with no significant difference in distribution according to the type of procedure (Table 1).

Table 1. Distribution of subjects by gender and type of procedure

	Number (%) of patients in relation to the performed intervention				*P**
	PRK	**LASIK**	**ICL**	**Total**	
Sex					
Male	20 (40)	21 (42)	22 (44)	63 (42)	0,92
Female	30 (60)	29 (58)	28 (56)	87 (58)	
Total	50 (100)	50 (100)	50 (100)	150 (100)	

*χ^2 test

The median age of the subjects was 33 years (interquartile range 28 to 39 years) ranging from a minimum of 22 to a maximum of 52 years. The subjects who underwent ICL were significantly younger than those who underwent LASIK (median 30 vs. 37 years) (Kruskal Wallis test, P = 0.002) (Table 2).

Table 2. Differences in the age of the subjects by type of procedure

	Median (interquartile range)			P*
	PRK	LASIK	ICL	
Age (years)	32 (28 – 39)	37 (30 – 42)	30 (27 – 35)	0,002†

*Kruskal Wallis test (post hoc Conover)

† at the P < 0.05 level, LASIK vs. ICL are significantly different

Visual acuity of the right eye at all three measurement points was significantly lower in subjects who underwent ICL compared to the other two types of procedure (Kruskal Wallis test, P < 0.001) (Table 3)

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Table 3. Differences in age of subjects in relation to type of procedure

	Median (interquartile range)			P*
	PRK	LASIK	ICL	
Age (years)	32 (28 – 39)	37 (30 – 42)	30 (27 – 35)	0,002†

*Kruskal Wallis test (post hoc Conover)

† at the P < 0.05 level, LASIK vs. ICL are significantly different

In all three groups, with respect to the type of procedure, the visual acuity of the right eye before the procedure was significantly worse compared to the time after 6 or 24 months (Friedman test, P < 0.001) (Table 4).

Table 4. Differences in visual acuity of the right eye at three measurement points in relation to the type of procedure

	Median (interquartile range) of right eye visual acuity (VOD) in relation to the procedure			P*
	PRK	LASIK	ICL	
Before procedure	0,05 (0,05 – 0,10)	0,10 (0,05 – 0,20)	0,03 (0,02 – 0,03)	**<0,001**†
After 6 months	1,0 (1,0 – 1,0) [min 0,9 max 1]	1,0 (1,0 – 1,0) [min 0,9 max 1]	1,0 (0,9 – 1,0) [min 0,3 max 1]	**<0,001**†
After 24 months	1,0 (1,0 – 1,0) [min 0,9 max 1]	1,0 (1,0 – 1,0) [min 0,9 max 1]	1,0 (0,9 – 1,0) [min 0,3 max 1]	**<0,001**†

*Kruskal Wallisov test (post hoc Conover)

† at the P < 0.05 level, ICL vs. (PRK, LASIK) are significantly different

Visual acuity of the left eye was significantly lower at all three measurement points in subjects who underwent ICL compared to the other two types of procedure (Kruskal Wallis test, P < 0.001 for pre-procedure and after 24 months; P = 0.003 after 6 months) (Table 5).

In all three groups, with regard to the type of procedure, visual acuity in the left eye was significantly worse before the procedure compared to after 6 or 24 months (Friedman test, P < 0.001) (Table 6).

Table 5. Differences in visual acuity of the right eye in relation to the measurement points according to the type of procedure

	Median (interquartile range) of right eye visual acuity (VOD) relative to measurement points			P*
	Before procedure	After 6 months	After 24 months	
PRK	0,05 (0,05 – 0,10)	1,0 (1,0 – 1,0)	1,0 (1,0 – 1,0)	**<0,001**†
LASIK	0,10 (0,05 – 0,20)	1,0 (1,0 – 1,0)	1,0 (1,0 – 1,0)	**<0,001**†
ICL	0,03 (0,02 – 0,03)	1,0 (0,9 – 1,0)	1,0 (0,9 – 1,0)	**<0,001**†

*Friedman test (post hoc Conover)

† at the P < 0.05 level, they are significantly different before the procedure vs. (6, 24 months)

Table 6. Differences in visual acuity of the left eye at three measurement points in relation to the type of procedure

	Median (interquartile range) of visual acuity of the left eye (VOS) in relation to measurement points			P*
	Before procedure	After 6 months	After 24 months	
PRK	0,05 (0,05 – 0,15)	1,0 (0,95 – 1,0)	1,0 (1,0 – 1,0)	**<0,001**†
LASIK	0,075 (0,05 – 0,20)	1,0 (1,0 – 1,0)	1,0 (1,0 – 1,0)	**<0,001**†
ICL	0,03 (0,02 – 0,05)	1,0 (0,9 – 1,0)	1,0 (0,9 – 1,0)	**<0,001**†

*Friedman test (post hoc Conover)

† at the P < 0.05 level, they are significantly different before the procedure vs. (6, 24 months)

Complications were experienced by 13 (8.7%) patients. Two patients required additional correction (1.3%). Out of a total of 13 (8.7%) patients with complications, there are significantly more, 11 (22%) of them from the group that underwent LASIK compared to the other two procedures (Fisher's exact test, P < 0.001), while in the correction there is no significant differences in relation to the type of intervention (Table 7).

Table 7. Distribution of patients according to complications and correction in relation to the type of procedure

	Number (%) of patients in relation to the intervention				P*
	PRK	LASIK	ICL	Total	
Complications					
No	48 (96)	39 (78)	50 (100)	137 (91,3)	**<0,001**
Yes	2 (4)	11 (22)	0	13 (8,7)	
Additional correction					
No	49 (98)	50 (100)	49 (98)	148 (98,7)	>0,99
Yes	1 (2)	0	1 (2)	2 (1,3)	
Total	50 (100)	50 (100)	50 (100)	150 (100)	

* Fisher's exact test

Discussion

Refractive surgery is one of the solutions in the treatment of myopia, which affects an increasing number of people globally. This study was conducted on a predominantly young population; the median age of the subjects was 33 years, with an interquartile range of 28 to 39 years. Surgical procedures were approved in individuals older than 18 years who had a stable refractive error during the previous 1–2 years. Although surgery may be indicated in younger patients who otherwise do not tolerate conventional therapy with glasses and contact lenses, caution is needed because refractive error is often unstable at this age. Stable refractive error is generally defined as a change in refraction of 0.5 diopters over the previous 1–2 years. Each patient presenting for screening should be asked to stop wearing contact lenses for one week for soft non-toric lenses, 2 weeks for toric lenses, and at least 3 weeks for rigid lenses, and asked to bring their previous glasses for assessment of refractive stability (5).

In this study, 58% of the subjects were women, although there is no significant record of the influence of gender differences on the induction and outcomes of the procedure. It is important to note that pregnancy and breastfeeding are contraindications for surgical procedures and their performance is not recommended (11).

Visual acuity outcome analyzed in this study was satisfactory in all three groups at two measurement periods, after 6 months and after 24 months after procedure.

Long-term studies with follow-up periods of at least 10 years have shown that PRK and LASIK have a very high level of safety and that late complications occurred rarely (12). A study comparing LASIK and PRK indicates that LASIK allows faster visual recovery and is a less painful technique compared to PRK. These studies also indicate that techniques provide similar results at one year follow-up after surgery, but further studies are suggested (13).

Complications recorded during this study occurred in 13 patients (8.7%), mostly from the LASIK group with overall 11 patients experiencing complications. Specific cases of complications recorded in this study are: dry eye, hypocorrection, corneal erosion at the 6-month follow-up, eye trauma at the 24-month follow-up, vision variation at the 24-month follow-up and amblyopia. In general, the occurrence of postoperative dry eye is a problem with LASIK procedures, which has also been shown in studies where LASIK was compared with other surgical techniques in the surgical treatment of myopia (14). Trauma is a rare complication, but can occur. There are several recorded cases in the literature; one case report showed a patient who had eye trauma with a sheet of paper that caused flap dislocation and subsequent epithelial ingrowth four years after LASIK procedure (15).

There are many types of ICL-related complications, but common intraoperative and postoperative complications mainly include abnormal ICL position, corneal endothelial cell loss and corneal decompensation, high intraocular pressure and secondary glaucoma, and cataract (16). One study showed that ICL in moderate and high refractive error is an effective and relatively safe technique. The most common late complication is the formation of cataracts. This complication can be effectively corrected surgically with good refractive outcomes (17).

Suboptimal refractive result was recorded in 2 patients who required additional correction, one in PRK group and one in ICL group. Therefore, a total of 1,3% of patients underwent a additional correction procedure due to suboptimal refractive error.

Studies point the success of additional correction of primary LASIK with the PRK method as well as performing LASIK re-lift with significantly greater success, but with an increased risk of epithelial ingrowth complication due to manipulation (18). Study that followed PRK outcome after primary LASIK in 4 years period showed favorable results (19). In study that followed long-term outcome of additional correction performed 3 years after

primary LASIK indicated a higher risk of clinically significant epithelial ingrowth (20).

Additional correction after ICL surgery is performed for residual refractive error or astigmatism that was not completely corrected by primary procedure. One study showed that about 4,8% eyes that underwent ICL lens implantation required additional corrective procedures such as LASIK or PRK surgery or rotation of the ICL lens. In cases where additional correction is needed, LASIK or PRK is often used to improve the accuracy of the refractive correction, especially when minor residual errors are present. In most cases, re-corrections are necessary for a small number of patients and often lead to significant improvements in visual outcomes and patient satisfaction.

Conclusion

1. Short-term visual outcome in control 6 months after binocularly performed PRK, LASIK and ICL showed success in all groups.

2. The long-term visual outcome in control 24 months after binocularly performed PRK, LASIK and ICL showed success in all groups.

3. In the study, ICL and PRK showed the highest safety rate while LASIK had more frequent complications.

4. A suboptimal refractive result rarely occurs and can be corrected by additional correction in cases when it is required.

Disclosure

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Competing interests. None to declare.

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Author contribution. Acquisition of data: KB, MJ, AK
Administrative, technical, or logistic support: KB, MJ, AK
Analysis and interpretation of data: KB, MJ, AK
Conception and design: KB, MJ, AK
Critical revision of the article for important intellectual content: KB, MJ, AK
Drafting of the article: KB, MJ, AK
Final approval of the article: KB, MJ, AK
Guarantor of the study: KB, MJ, AK
Provision of study materials or patients: KB, MJ, AK
Statistical expertise: KB, MJ, AK

Usporedba modernih kirurških tehnika u liječenju kratkovidnosti

Sažetak

Cilj: Istražiti postoji li razlika u ishodima kirurških tehnika fotorefraktivne keratektomije (PRK), laserske in situ keratomijelize (LASIK) i ugradbenih fakičnih leća (ICL) za: kratkoročni vidni ishod nakon šest mjeseci, dugoročni vidni ishod nakon 24 mjeseca, sigurnost zahvata i ostatna refrakcijska pogreška nakon operacije.

Metode: Istraživanje je provedeno na ispitanicima s kratkovidnošću i astigmatizmom. Za svakoga ispitanika prikupljeni su podaci o binokularno provedenoj kirurškoj tehnici: PRK, LASIK ili ICL. Vidna oštrina je mjerena: prije zahvata, 6 mjeseci nakon zahvata i 24 mjeseca nakon zahvata. Prikupljeni su podatci o postojanju komplikacija i provedenim dokorekcijama..

Rezultati: Istraživanje je provedeno na 150 pacijenata. Medijan dobi ispitanika je 33 godine, interkvartilnog raspona od 28 do 39 godina. Vidni ishod je bio zadovoljavajući u sve tri skupine kroz dva perioda mjerenja nakon 6 mjeseci i nakon 24 mjeseca od provedenih zahvata. Komplikacije u ovoj studiji su se javile kod 13 pacijenata (8,7 %), pretežito iz LASIK skupine koja broji 11 pacijenata sa komplikacijom. Suboptimalni refrakcijski rezultat koji je bio ispravljen dokorekcijom iznosi 1,3 % pacijenata koji su zbog suboptimalne refrakcijske greške ponovno podvrgnut zahvatu korekcije.

Zaključak: Kratkoročni i dugoročni vidni ishod nakon binokularno provedenih PRK-a, LASIK-a i ICL-a pokazao je uspješnost u svim skupinama. U istraživanju su najveću sigurnost zahvata, odnosno najmanji broj komplikacija, pokazali ICL i PRK, dok su kod LASIK-a bile češće komplikacije. Suboptimalni refrakcijski rezultat se rijetko javlja te se može ispraviti dokorekcijom u slučajevima koji to zahtijevaju.

Original article

Influence of Phacoemulsification on Intraocular Pressure in the Eye after Trabeculectomy

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Abstract

Aim: The aim of this study was to question whether there is a difference in the change of intraocular pressure (IOP) between three groups of participants, achieved by phacoemulsification after trabeculectomy, considering the height of IOP at beginning. As well as whether there is a decreased necessity for topical antiglaucoma (ATG) medications.

Participants and methods: Study was conducted on 26 participants submitted to cataract surgery after trabeculectomy at the Clinic for Eye Diseases in Osijek (January 2017 - December 2019). IOP values were noted at day zero, seventh day, after a month and six months after patients underwent cataract surgery with phacoemulsification; also, number and type of topical medications.

Results: Historic cohort study included 26 patients (19 women, 7 men). Statistically significant decrease of IOP was noticed from day zero and six months after (Friedman's test, $P < 0.001$). Significant difference was in measured value of IOP at day zero and the first day (Friedman's test, $P < 0.05$). No statistically significant difference was in participant groups according to IOP (Marginal Homogeneity test, $P = 0.06$).

Conclusion: Trabeculectomy alone and trabeculectomy combined with phacoemulsification, are justified procedures to achieve a decrease in the IOP value and its regulation with subsequent possibility of decrease in usage of local ATG therapy. Phacoemulsification after trabeculectomy ensures an additional decrease of the IOP.

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KEYWORDS: glaucoma; intraocular pressure; phacoemulsification; trabeculectomy

Introduction

Glaucoma is the second most common cause of blindness in the world (1). 2 % of the population over the age of 40 suffers from glaucoma leading to diminution of the quality of life of those who have been affected with glaucoma, but it is also an important socio-economic issue. The term glaucoma stands for several diseases with different etiologies, but with the common consequences of the progressive and irreversible deterioration of the eye nerve and retinal nerve fibers, with pertaining visual field loss (2–7). This state needs to be urgently recognized to start, as soon as possible, with the treatment of patients and to prevent irreversible structural changes (1). All types of glaucoma can end up with a complete loss of sight (8).

The diagnostics are being performed with several methods: applanation tonometry, fundus examination, visual field examination (perimetry), and gonioscopy. Glaucoma can be divided into primary and secondary glaucoma, but also open-angle and closed-angle glaucoma. The most common risk factor is increased IOP, but there are numerous other risk factors (2,9).

The treatment depends on the type of glaucoma; nevertheless, the aim is the same – to prevent the progression of the disease, to prevent the damage to the eye nerve. The primary concept is diminution of the IOP because this is the main causing factor which can be achieved by reducing the production of the aqueous humor or by making the draining of the aqueous humor easier (2). Nowadays, numerous methods are used: conservative (local therapy), laser, and surgery. Conservation treatment consists of glaucoma medication, selective laser trabeculoplasty, and Nd: YAG laser iridotomy. Surgical approach is based on creating an alternative passage to drain the aqueous humor – trabeculectomy, implantation of drainage implants or cyclodestructive procedures, which are palliative methods of treatment (2).

Normal IOP values in healthy subjects vary between 10 and 21 mmHg (16 ± 2,5 mmHg). Goldmann applanation tonometry is a gold standard method for measuring the IOP (2).

Cataract describes a medical condition in which the lens, which is usually transparent, becomes opaque (2). It can be congenital or achieved. The most common type of cataract is senile cataract which occurs in elderly patients due to substance exchange (10), especially in those patients with metabolic diseases, i.e., diabetes. Cataract leads to decreased visual acuity, the occurrence of monocular double images, and glare with the appearance of altered refraction (2).

The usual way of treating a cataract is a surgery. This procedure could be performed intracapsular or extracapsular. The consequential state is known as pseudophakia. Methods that could be used are extracapsular extraction of cataract, phacoemulsification (lens extraction using the ultrasound), and "femtosecond" laser (the most recent method where an incision is being performed on cornea followed by capsulorhexis and shredding of lentil masses). Despite all the existing methods, phacoemulsification remains the gold standard and primary surgical approach in the treatment of the cataract (2).

The objectives of this study were to question whether there is any difference in the change of IOP between the groups of study participants, achieved by phacoemulsification after trabeculectomy, considering the height of IOP at the beginning; as well as to question if there is a decreased necessity for topical ATG medications after the phacoemulsification has been performed in those eyes which were precedingly submitted to trabeculectomy and divided into groups.

Patients and Methods

Patients

The historical cohort study (11,12) was conducted at the Clinic for Eye Diseases of the Clinical Hospital Center Osijek in the period from January 2017 to December 2019.

This study was conducted on 26 adult subjects of both sexes who were submitted to phacoemulsification after trabeculectomy in Clinic for Eye Diseases of Clinical Hospital Centre Osijek, 7 of them were men and 19 were women.

All the patients who had intraoperative or postoperative complications, as well as all those who subsequently had any surgical procedure, whether on anterior or posterior segment of the eye, were excluded from the study.

Methods

Goldmann applanation tonometry is the gold standard for measuring of the IOP during ophthalmological check-up, as well as the most common way of measuring of the IOP (2).

Patients were divided into three groups, depending on the values of the measured IOP and whether local therapy had been used or not:
Group A: IOP > 21 mmHg
Group B: IOP > 18 mmHg and IOP ≤ 21 mmHg
Group C: IOP ≥ 15 mmHg and IOP ≤ 18 mmHg

Patients with IOP value < 15 mmHg, which is a normal value, would have also been considered, since they would be a control group.
IOP values, as well as the number and the type of local therapy, were noted at day zero, the seventh day, after a month and six months after the patient underwent cataract surgery with phacoemulsification.
Categorical values had been demonstrated with absolute and relative frequencies. The differences between categorical variables from day zero and after six months were tested with Marginal Homogeneity Test. Normality of the distributions of numerical variables was tested with the Shapiro-Wilk Test. Numerical data were described by the median and limits of the interquartile range. The differences between IOP by measuring were tested with Friedman's Test (Post hoc Conover) (13). All P values were two-sided. The significance level was set to Alpha = 0.05. MedCalc Statistics Software version 19.1.7 was used for statistical analysis. (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2020).

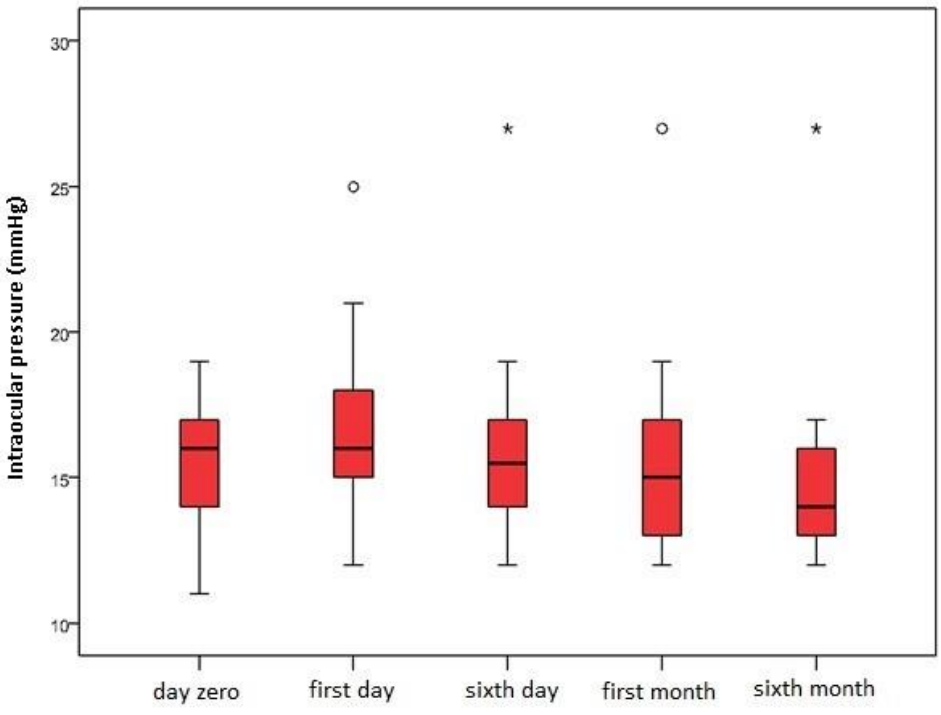

Figure 1. Values of intraocular pressure according to the day of measuring

Results

This study was conducted on 26 subjects who underwent cataract surgery after trabeculectomy at the Clinic for Eye Diseases, Clinical Hospital Centre Osijek, where 7 (27 %) of them were men, and 19 (73 %) were women. The median age of the subjects was 75 years (interquartile range from 71 to 76 years), ranging from 64 to 79 years.

After the surgery, subjects were measured for IOP and a significant reduction was observed from day zero to six months (Friedman Test, P < 0,001).

There are statistically significant differences between the values of the IOP on day zero and the value of the first day and comparing the value of the IOP of day zero with the values after six months. If we compare with the values of IOP on the first day, significantly lower values were observed after one and six months (Figure 1).

The values achieved by IOP after the seventh day are significantly higher than after six months, as well as those values achieved after the first month (Table 1).

Table 1. Intraocular pressure values by measurements

	Median (interquartile range) (mmHg)	Lowest and highest pressure (mmHg)	P*
Day 0	16 (14 – 17) ǂ	11 – 19	
Day 1	15,5 (14,75 – 18) ǂ	12 – 25	
Day 7	15,5 (13,75 – 17,25) §	12 – 27	**<0,001**
Month 1	15 (13 – 17)‖	12 – 27	
Month 6	14 (13 – 16)	12 - 27	

*Friedman test (Post hoc Conover)
ǂat the P < 0.05 level, there is a significant difference in IOP day 0 vs. day 1; day 0 vs. 6 months
ǂat the P < 0.05 level, there is a significant difference in IOP on day 1 vs. month 1; day 1 vs. month 6
§at the P < 0.05 level, there is a significant difference in IOP on day 7 vs. 6 months
‖at the P < 0.05 level, there is a significant difference in IOP 1st month vs. 6 months

According to the values of IOP on day zero and after six months, we divided the subjects into groups according to the pressure value.

There is no significant difference in the distribution of subjects considering the IOP values (Table 2)..

Table 2. Distribution of subjects according to values of intraocular pressure on day zero and after six months

		Number of respondents on day 0					P*
		IOP ≤ 15 mmHg	15 mmHg < IOP ≤ 18 mmHg	18 mmHg < IOP ≤ 21 mmHg	IOP > 21 mmHg	Total	
After 6 months	IOP < 15 mmHg	11	6	0	0	17	0,06
	15 mmHg < IOP ≤ 18 mmHg	0	8	0	0	8	
	18 mmHg < IOP ≤ 21 mmHg	0	0	0	0	0	
	IOP > 21 mmHg	0	0	1	0	1	
	Total	11	14	1	0	26	

*marginal homogeneity test

Local glaucoma medications before surgery were used by 20 (77 %) subjects, and the number of medications did not change after the surgery. One or two medications therapies are used by 8 (31 %) subjects, and three therapies by 4 (15,4 %) (Figure 2).

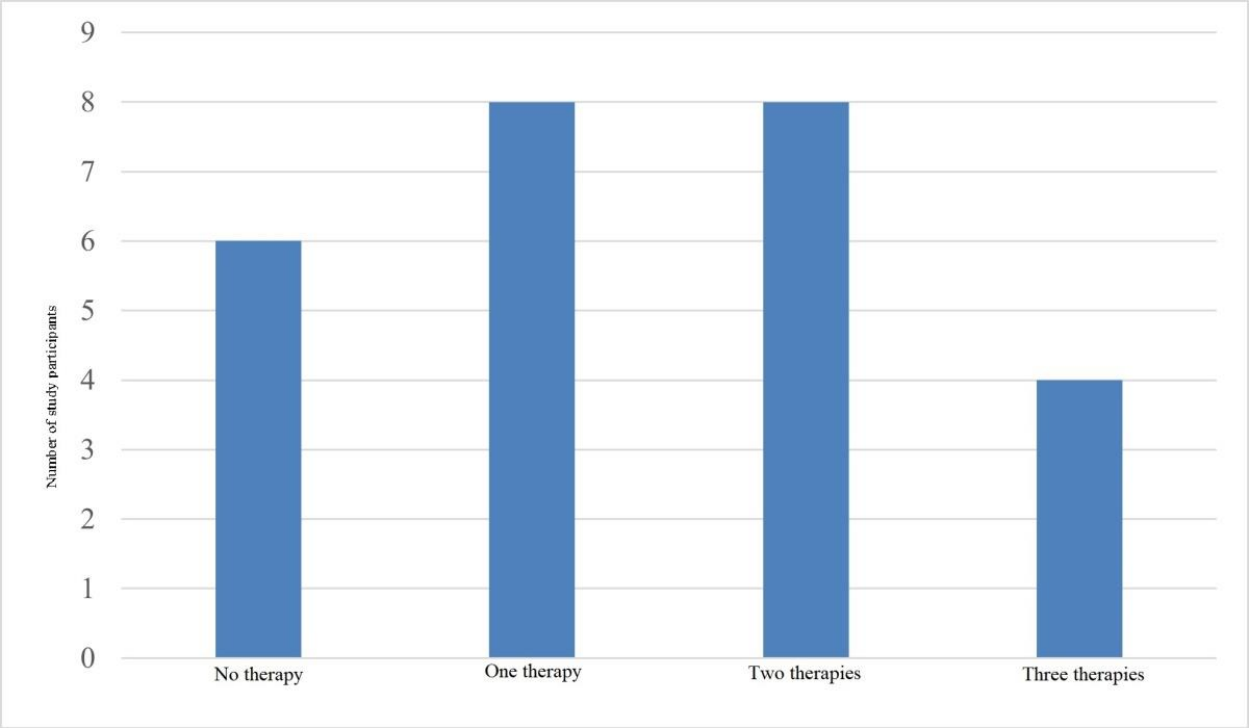

Figure 2. Distribution of subjects according to the number of local ATG medication therapy (before and after the surgery)

Discussion

Glaucoma is a chronic degenerative disease with the possibility of an asymptomatic onset. By studying the influence of phacoemulsification on the IOP in the eye after the trabeculectomy was performed; we can determine the level of efficacy of this kind of therapy on patients who suffer from both cataracts and glaucoma. Nevertheless, this review enables us to achieve certain knowledge about whether this combination leads to a reduction in the quantity of used local antiglaucoma (ATG) therapy.

In 2020, Carolan, Liu, Aleweeff et al. conducted a study about patients who suffered from glaucoma and were submitted to phacoemulsification, which was published in the USA. IOP values were observed and noted after phacoemulsification was performed. IOP values of another group of patients who were not submitted to phacoemulsification, but also suffer from glaucoma, were also followed. The results came back showing a clear reduction in the IOP value in those patients who were submitted to phacoemulsification and were suffering from glaucoma. Although there was a decrease in the values of the IOP one day after the surgical procedure was performed, the greatest difference between the values of the IOP was most clearly recognizable starting from the first month after the surgical procedure was performed. In this case, IOP values have decreased for 0,99 mmHg from 16,50 mmHg in the average patient submitted to surgery and have increased for 0,22 mmHg from 16,49 mmHg in the average non-surgical patient. In comparison to our study, in which we have also noted a decrease in the values of the IOP after phacoemulsification, they clearly described a reduction in the IOP from 1 to 2 mmHg if the preoperative value of the IOP was lesser than 20 mmHg (14).

Another study, in this case conducted by Rodrigues, de Mn Silva, Modesto et al. was published in 2018 and has observed changes in the values of the IOP before and after the

phacoemulsification was performed. Patients older than 18 years, with IOP values lesser than 21 mmHg and without any other ocular disease were included in this study. IOP values were measured right before phacoemulsification was performed and 30 days after the performance. A total of 182 eyes were included. In comparison to preoperative values of IOP, where average values were 16,0 ± 3,3 mmHg, postoperative values have decreased 13,44 ± 3,31 mmHg. Their study concluded with the statement that there was a statistically significant correlation between the preoperative IOP value and the value of the IOP in the postoperative period, due to phacoemulsification as a surgical procedure which is also a correlation to our conclusion (15).

A study conducted in the USA by Wong, Radell, Dangda et al. from 2013 and 2018 and published in 2020 examined the impact of phacoemulsification on the IOP values of patients who were previously submitted to implantation of glaucoma drainage implants. A total of 45 patients (51 eyes) were included. The decrease of the IOP values after the phacoemulsification was performed was statistically significant one week after, P = 0,031 (16). Compared to our study, a decrease in the IOP values was also noted right after the phacoemulsification was performed and was present further on.

Whether the phacoemulsification, as a single procedure, could decrease the level of IOP was examined by Armstrong, Wasiuta, Kiatos et al. in a study conducted in the United Kingdom and published in 2017. They have concluded that the impact of the lowering of the IOP could last up to 36 months. They have observed six studies which followed IOP measurement for three years and reported that in half of these studies a significant decrease in the IOP values was noticed, whereas in the other half there was no lowering of the IOP. They have also reported a statistically significant decrease in the number of used topical ATG medications. The reduction was presented with 0.57, 0.47, 0.38, and 0.16 medications for each patient of glaucoma medication 6, 12, 24, and 36 months after the phacoemulsification was performed (17). When compared to our study, this systematic review has successfully shown the reduction in used ATG therapy as well as decrease in the values of postoperative IOP, whereas our study only provided us with the decrease of postoperative IOP, but the number of medications stayed equal to preoperative state.

A Korean study published in 2019, conducted by Baek, Kwon, Park and Suh reviews the influence of surgical procedures on long-term values of the IOP. IOP values of those patients were followed for at least 12 months. 754 patients were included in this research, whereof 106 suffered from glaucoma, and 648 of them did not have glaucoma in their anamnesis. All included patients were at least 18 years old and were submitted to phacoemulsification combined with the implantation of intraocular lens (IOL). Patients whose preoperative IOP was 22 mmHg, have also been submitted to this surgical procedure. 12 months after the phacoemulsification was performed on patients suffering from glaucoma, diminution in IOP values from 1,08 ± 3,79 mmHg (P = 0,656) was noted. On the other hand, at the same time, after the phacoemulsification was performed on patients who did not suffer from glaucoma, a diminution in IOP was 1,03 ± 3,72 mmHg. A greater decrease was noted in younger patients (P < 0,001), although the mechanism of decrease has still not been cleared out. Generally observed, the greatest decrease in IOP values was noted two weeks after the performance of a surgical procedure and it gradually diminished throughout the next two years. Therefore, they have emphasized the importance of regular check-ups on a long-term basis, as well as, if preoperative IOP is increased in younger patients with glaucoma, phacoemulsification as a proper way for controlling the IOP value in those types of patients (18).

Aside from the mentioned study, Chen, Lin, Junk et al. in 2014 counted in different types of researches which dealt with the impact of phacoemulsification on values of the IOP of those patients who have been suffering from primary open-angle glaucoma (POAG), also including patients with normal IOP values, with the anamnesis of pseudoexfoliation glaucoma (PXG) or primary closed-angle glaucoma

(PACG), who were previously submitted to an ATG therapy. They have been using between 1,5 and 1,9 medications. Patients, who were participants of this study, have not been submitted to surgical procedure to control glaucoma, neither previously nor during this study. A conclusion that has been made has summarized that phacoemulsification leads to a small or moderate decrease of IOP values. Also, there is a decrease in the number of used ATG therapy (referring to patients with POAG, PXG, and PACG, who were using between one and two medications for glaucoma regulation before this study was conducted). At last, it was stressed out that performing trabeculectomy six months or a year after the phacoemulsification was performed, in the following patients, was quite rare (19).

Furthermore, a study conducted in Italy, published in 2015, conducted by Longo, Uva, Reibaldi et al. also points out the long-term effect in the regulation of IOP values in the eye which was previously submitted to trabeculectomy and later to phacoemulsification. The aim was to determine factors that could have an impact on changes in IOP values. This study was conducted on 108 eyes firstly submitted to trabeculectomy and secondly to phacoemulsification. The Control group consisted of 108 eyes which have not been submitted to phacoemulsification. Followed were the IOP values, the necessity of ATG therapy (medications or surgery), and time limitations during which glaucoma was controlled without therapy. ATG therapy has been prescribed if the IOP was higher than 18 mmHg. During a trabeculectomy, mitomycin-C (MMC) was used (20). In contrary to our study, this study has shown a significant increase in average IOP values in the group submitted to phacoemulsification (1,7 ± 4,3 mmHg), but also in the control group (2,3 ± 4,3 mmHg) (in both cases $P < 0,001$). One of the conclusions was that, if MMC is used before trabeculectomy, a higher rate of success is guaranteed followed by lesser usage of ATG medications after the surgery ($P < 0,001$). As well as, if the distance between the trabeculectomy and phacoemulsification is enhanced ($P = 0,007$) and, if the primary IOP value is low ($P = 0,042$) (20).

A study conducted in Switzerland by Töthenberg-Harmsa, Wachtla, Schweier, Funk and Kniestedt published in 2017, considered long-term IOP values, when phacoemulsification and trabeculectomy were performed in one single procedure (which is a difference considering our study), but also when phacoemulsification was used along with the excimer laser during trabeculectomy. The first combination led to the decrease of IOP values from 22,8 mmHg to 13,0 mmHg, along with the usage of two different ATG therapies one year after the surgical procedure. Furthermore, four years after the surgery, IOP value was 14 mmHg and therapy was no longer used. The second combination led to a decrease of IOP values from 19,0 mmHg to 15,0 mmHg. Further usage of two types of ATG medications was needed a year after the surgery was performed, and the value of 14 mmHg was achieved four years after the surgery was performed along with the usage of one ATG medication. Although both combinations are useful in correcting and decreasing the IOP values, they have concluded that, if target values of the IOP are average values, it would be more appropriate to combine phacoemulsification and excimer laser with trabeculectomy. On the other hand, if the targeted values of the IOP are low, it is justified to use the combination of phacoemulsification and trabeculectomy (21). Even during our research, it was clearly noticeable that phacoemulsification combined with trabeculectomy successfully decreases values of IOP, especially six months after. The only difference was that, in our study, there was no decrease in the number of used ATG medications.

A study conducted in the USA and published in 2016 by Song, Ramanthan, Morales et al. was based on determining the IOP value, as well as risk factors in patients with PACG who were submitted to trabeculectomy during which MMC was used, whether they were already submitted to phacoemulsification, or they would be in the future. Out of 33 participants, this study was conducted on 44 eyes submitted to

phacoemulsification. Control IOP value was determined 12 months later. An average value of the IOP was decreasing, starting from 21,3 ± 7,9 mmHg to 12,2 ± 3,9 mmHg 12 months later (P < 0,001). A significant reduction in the number of medications was noted (P < 0,001) (26). On the other hand, even though there was a decrease in IOP values in our study, there was no reduction in the number of ATG medications (22).

In 2002, a study by Klenimann, Katz, Pollack et al. was conducted on 90 patients, and precisely 102 eyes that were submitted to a combination of procedures (phacoemulsification and trabeculectomy), while only 30 patients, or precisely 33 eyes were submitted to trabeculectomy alone. In both groups there was a significant decrease in preoperative IOP values from 21,5 ± 5,8 mmHg to 14,73 ± 3,44 mmHg after the surgery (P = 0,0001). The decrease in IOP values was 31,5 %. In comparison, the group only submitted to trabeculectomy and started with IOP values from 24,2 ± 7,5 mmHg to 12,46 ± 3,86 mmHg after the surgery (P = 0,0001) (23). A significant decrease in IOP was present in our research as well, six months after the phacoemulsification was performed. In a study conducted by DeVience, Chaudhry and Saeedi it was also concluded that, if the preoperative level of the IOP is relatively high (P < 0,001), followed by a lens positioned more anteriorly (P < 0,05) along with a longer phacoemulsification time (P < 0,05), an expected postoperative IOP value should be more successfully decreased (24).

In comparison to our study, some studies have examined results on eyes which were submitted to, not only trabeculectomy, but also the combination of procedures (both phacoemulsification and trabeculectomy). This study was published in Japan by Takihara, Inatani, Ogata-Iwao et al. in 2014, with the aim to determine the effect of trabeculectomy with MMC on the eyes with natural lens and on the eyes earlier submitted to phacoemulsification and insertion of IOL in the posterior chamber. An including criterion was also the IOP ≥ 22 mmHg, three months before trabeculectomy, despite ATG therapy. The total count of participants was 64. This research was concluded with a statement that, trabeculectomy on eyes with artificial lenses and preoperative values of the IOP < 21 mmHg or IOP < 18 mmHg, turned out to be less successful than to be performed on the eyes with normal lenses. Although the IOP was significantly reduced in both cases, after six months it was obvious that the IOP in the eyes with an artificial lens was increased (13,9 ± 5,4 mmHg), in comparison to the normal lens (10,7 ± 4,2 mmHg) (P = 0,03) (25). Other study guided by Vinod, Gedde, Feuer et al. had a goal to examine the most common ways of surgical approaches of the American Glaucoma Society. In addition, it was also confirmed that trabeculectomy along with the usage of MMC was the most used incision surgical technique, no matter if the surgery was performed alone or as a combination with phacoemulsification (26).

In a study conducted by Ahmadzadeh, Kessel, Subhi and Bach-Holm and published in the year of 2021, a comparison of the IOP values after a combined procedure of phacoemulsification and trabeculectomy was presented, as well as values measured when only phacoemulsification was used as a surgical procedure. Their study has shown that, no matter which method was used, the postoperative IOP should decrease, and the value of the postoperative IOP would not differ between the procedures. However, the prevalence of complications which were observed was significantly lower if the combined procedure was used as the main surgical approach (P = 0,01), followed by the improvement of the quality of visual acuity (P = 0,03) (27). The results ended up being similar to results presented in our study, as well as the fact that the number of used ATG medications has not changed after the procedure was performed. In comparison to our study, they have also followed their patients 12 months after the procedure was performed, whereas our study followed the patients six months after the surgical procedure.

A study conducted by Arimura, Iwasaki, Orii et al. published in 2021, has compared whether trabeculectomy followed by phacoemulsification or trabeculectomy combined with phacoemulsification would

result with a better outcome. A total of 141 patients were included in this study, of which 48 were submitted to trabeculectomy followed by phacoemulsification and the rest of patients, 93 of them, underwent a trabeculectomy combined with phacoemulsification. Their study had shown that, depending on the preoperative IOP, a better chance for a successful outcome is when the values of preoperative IOP are higher than 15 mmHg. During their study, patients were divided into three groups – group A (IOP > 21 mmHg), group B (IOP > 18 mmHg) and group C (IOP > 21 mmHg). The results have shown that the prevalence of a successful outcome is significantly higher for those patients submitted to trabeculectomy followed by phacoemulsification and were represented for each group. Statistically significant values have differed depending on the groups - group A (P = 0,02), group B (P < 0,01) and group C (P < 0,01). On the other hand, lower incidence of a successful outcome was noticed when patients were younger, but also when trabeculectomy was combined with phacoemulsification which led to a poorer visual acuity (P < 0,01). Although, directly after the surgical procedure was performed an increase in the visual acuity was noticed – their study has shown that it was only temporary. This improvement in visual acuity has disappeared five years after this surgical procedure was done (28). In comparison to our study, which only observed those patients who were submitted to phacoemulsification, after they were primarily submitted to trabeculectomy and were later on followed in order to collect the IOP values throughout the time of six months, the similarity could be seen in the groups of patients they have observed - precisely their IOP values, where they have also observed successfulness of combined procedures of trabeculectomy and phacoemulsification on those type of patients.

Even though there is a variety of results around the world, until this moment, different studies have pointed out the possibility of using both trabeculectomy alone, as well as combining trabeculectomy with phacoemulsification, with the aim of ensuring the additional decrease and regulation of the IOP value and the possibility of decrease in the number of used ATG therapy. At last, it is important to stress out that, there was no division of patients according to the glaucoma type; moreover, patients who were included were the ones who met primarily set conditions.

Conclusion

Based on the conducted research and obtained results, the following several conclusions can be drawn. There is a significant reduction in intraocular pressure after phacoemulsification surgery. In addition, there is a significant difference in the measured value of intraocular pressure on day zero and the value of the first day, and there is also a significant difference comparing the values of intraocular pressure on day zero with the values after six months. Finally, the values of intraocular pressure are significantly lower if we compare the values of intraocular pressure measured on the first day with the values measured after one month, and after six months.

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Competing interests. None to declare.

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Final approval of the article: MO, DB, IKŠ
Guarantor of the study: MO, DB, IKŠ
Provision of study materials or patients: MO, DB, IKŠ
Statistical expertise: MO, DB, IKŠ

Utjecaj fakoemulzifikacije nakon trabekulektomije na očni tlak

Sažetak

Cilj: Ciljevi istraživanja bili su ispitati postoji li razlika u promjeni intraokularnog tlaka (IOT-a) između tri skupine ispitanika dobivena fakoemulzifikacijom nakon trabekulektomije, s obzirom na visinu početnog IOT-a te postoji li smanjenje potreba za lokalnom antiglaukomskom (ATG) terapijom.

Ispitanici i metode: Istraživanje je provedeno na 26 ispitanika kojima je učinjena operacija katarakte nakon trabekulektomije na Klinici za očne bolesti u Osijeku (od siječnja 2017. do prosinca 2019). Ispitanici su podijeljeni u tri skupine, ovisno o visini izmjerenog IOT-a, s lokalnom medikamentoznom terapijom ili bez nje. Bilježene su vrijednosti IOT-a nulti dan, sedmi dan, nakon mjesec dana i šest mjeseci od operacije te broj i vrsta lokalne medikamentozne terapije.

Rezultati: Povijesno-kohortna studija uključila je 26 bolesnika (19 žena, 7 muškaraca). Nakon provedene fakoemulzifikacije nađeno je statistički značajno smanjenje IOT-a od nultog dana do šest mjeseci (Friedmanov test, $P < 0,001$), značajna razlika u izmjerenoj vrijednosti IOT-a nultog dana i vrijednostima prvog dana (Friedmanov test, $P < 0,05$). Nema značajne razlike u raspodjeli ispitanika s obzirom na vrijednosti IOT-a (test marginalne homogenosti, $P = 0,06$).

Zaključak: Opravdana je uporaba samostalnog zahvata trabekulektomije te kombiniranog zahvata trabekulektomije s fakoemulzifikacijom radi postizanja sniženja i regulacije vrijednosti IOT-a te potom mogućnosti smanjenja broja upotrijebljene ATG terapije. Fakoemulzifikacija nakon trabekulektomije osigurava dodatno sniženje IOT-a.

Case report

Very Early Treatment of Recurrent Strokes with Mechanical Thrombectomy in a Patient with Severe Anemia

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Abstract

Introduction: Recurrent ischemic strokes requiring repeated mechanical thrombectomy (MT) within 24 hours of the initial event are uncommon. This case report describes a 61-year-old woman who underwent two MTs 6 hours apart for ischemic strokes associated with severe anemia due to pure red cell aplasia (PRCA) in different vascular territories.

Case Presentation: The patient, with a history of PRCA presented with left-sided hemiparesis and facial paresis. Neuroimaging revealed a right middle cerebral artery (MCA) M1 segment occlusion. She underwent MT with complete recanalization. Four hours later, new neurological symptoms emerged due to a left MCA occlusion, and a second MT was performed successfully.

Management and Outcome: Alongside MTs, the patient received supportive care, including blood transfusions, analgesics, and anticoagulants. Her neurological status improved significantly two weeks upon discharge with residual left-sided weakness and facial paresis. At 90 days, the patient was able to walk, indicating further functional improvement.

Discussion: This case is notable for the short interval between two MTs and the patient's underlying hematological condition. Severe anemia and PRCA likely contributed to hypercoagulability and increased stroke risk. Despite these unusual risk factors, the patient's outcome was favorable, which is consistent with the effectiveness of repeated MT for early recurrent ischemic strokes.

Conclusion: Early recurrent stroke in different vascular territories, particularly in the context of hematological disorders, is rare but can be managed effectively with timely MT. Further research is needed to evaluate stroke recurrence risk and therapeutic responses in patients with hematological conditions, including PRCA and severe anemia.

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KEYWORDS: anemia; ischemic stroke; thrombectomy

Introduction

Although nearly one quarter of all ischemic strokes develop in patients with a prior history of stroke (1), repeated treatment with mechanical thrombectomy (MT) within the first 24 hours from the initial presentation is uncommon. This paper presents a rare case of repeated MT performed only 6 hours after the first endovascular treatment in a patient with severe anemia, which was the result of pure red cell aplasia (PRCA), a rare disorder characterized by a reduction or absence of red blood cell precursors in the bone marrow.

Case presentation

A 61-year-old female presented to the emergency department with left-sided hemiparesis and left-sided facial paresis which was visible when she woke up. A detailed time-flow chart of patient's symptom onset, imaging and treatment provided is seen in Illustration 1.

Her past medical history included severe anemia with pure red cell aplasia (PRCA) treated with blood transfusions and a degenerative disc disease with lumbar radiculopathy and subsequent paraparetic gait (modified Rankin scale [mRS] score 2).

On admission, the patient's hemoglobin level was 90 g/L, with an erythrocyte count of 3.01 × 10^{12}/L and a hematocrit of 0.264 L/L. The platelet count was 179 × 10^{9}/L. Coagulation studies showed an INR of 0.94 and a fibrinogen level of 3.3 g/L. The thrombin time was 15.8 seconds, and the activated partial thromboplastin time ratio was 0.85. She was previously hospitalized in the intensive care unit 4 years ago due to respiratory insufficiency, pulmonary abscess and sepsis. She had no previous medical history of hypertension, diabetes or stroke.

Upon examination, the patient was conscious and oriented, afebrile and euglycemic. Her blood pressure and heart rate as well as electrocardiogram were normal.

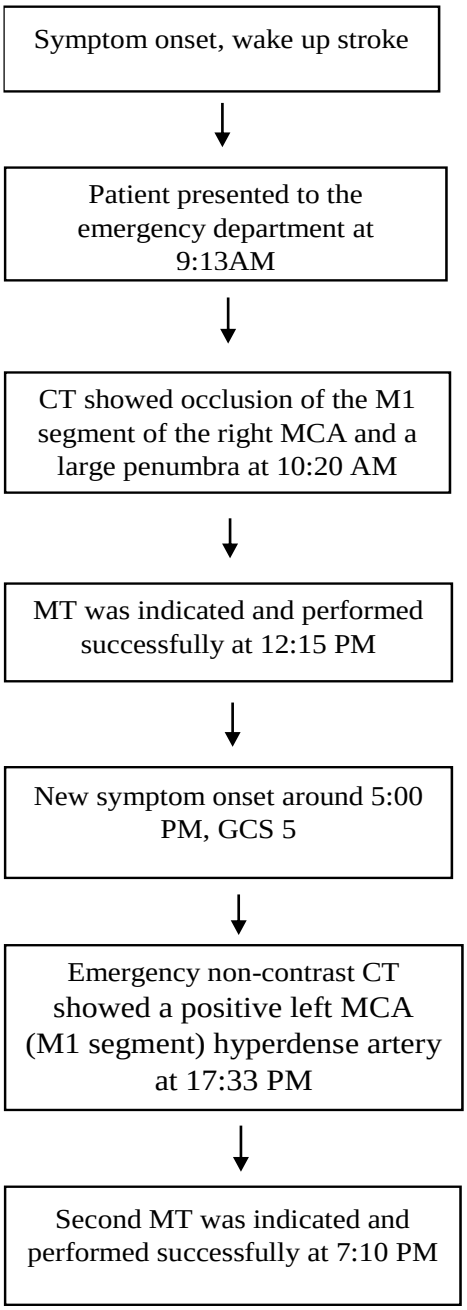
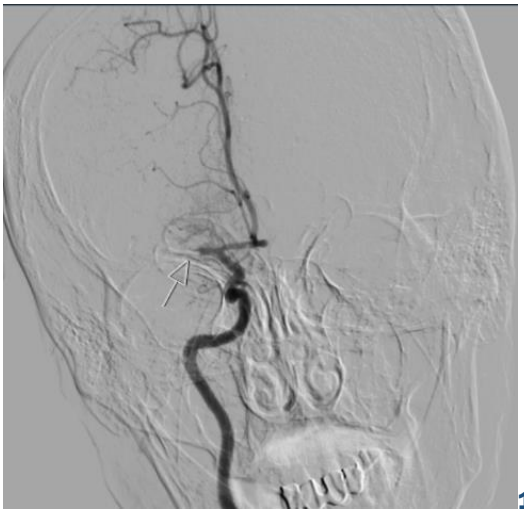


Illustration 1: Detailed time-flow chart since the patient's symptom onset. The patient presented at 9:13 AM with a wake-up stroke. Computed tomography (CT) at 10:20 AM showed right MCA (middle cerebral artery) M1 segment occlusion with a large penumbra; Mechanical thrombectomy (MT) was successfully performed at 12:15 PM. At 5:00 PM, the patient deteriorated [GCS (Glasgow Coma Scale) 5]. CT at 5:33 PM revealed a left MCA (M1) hyperdense artery, and a second MT was indicated and successfully performed at 7:10 PM.

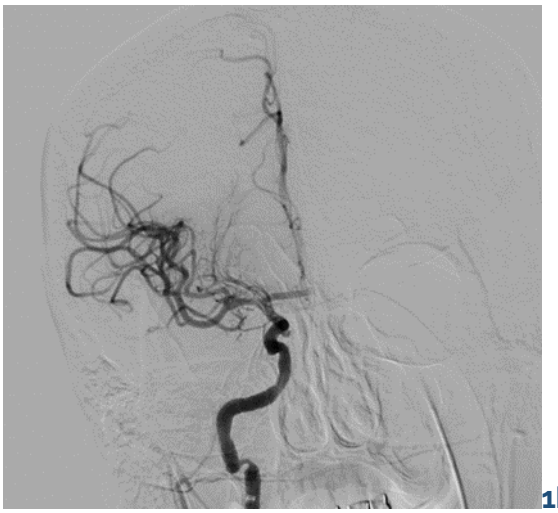
The patient had right-sided gaze deviation, with left-sided supranuclear facial paresis, dysarthria, dysphagia, left-sided hemiplegia and incontinence. Myotatic reflexes were diminished on the left side and the Babinski reflex was positive bilaterally. She had hemihypoesthesia and left-sided visual-sensory neglect without anosognosia. The National Institutes of Health Stroke Scale (NIHSS) score was 12.

Non-contrast computed tomography (CT) revealed hypodensity of the head of the caudate on the right side, consistent with ischemia (Alberta Stroke Program Early CT Score [ASPECTS] of 9) and the positive hyperdense right middle cerebral artery (MCA) sign. CT angiography (CTA) confirmed occlusion of the M1 segment of the right MCA with good collateral flow (collateral score of 2).

CT perfusion confirmed a large penumbra and mechanical thrombectomy was indicated. The procedure was performed in conscious sedation with one-pass complete recanalization (modified Thrombolysis in Cerebral Infarction [mTICI] score 3) 3 hours after admission to the hospital, using contacoaspiration and stent-retriever (Figure 1a and 1b). The patient was transferred to the stroke unit. Partial symptom improvement was noted, with a NIHSS score of 9.



1a



1b

Figure 1a: Digital subtraction angiography before mechanical thrombectomy shows a contrast filling defect of the right middle cerebral artery (arrow), indicating thrombotic occlusion.
Figure 1b: Angiography after mechanical thrombectomy shows complete recanalization of the right middle cerebral artery.

Four hours after the mechanical thrombectomy, the patient became somnolent and subfebrile (37.6 degrees Celsius). Left-sided head deviation with right-sided gaze palsy, sensorimotor aphasia, aphagia and right hemiplegia were noted and a NIHSS score of 27. The patient rapidly progressed to coma, Glasgow coma scale (GCS) of 5, intubated and mechanically ventilated. Emergency non-contrast CT did not show newly demarcated hypodensities but showed a positive left MCA (M1 segment) hyperdense artery. Mechanical thrombectomy in general anesthesia was indicated, with a common femoral artery puncture two hours after the onset of new symptoms. One pass recanalization with contact aspiration was achieved with the mTICI score of 3 (Figure 2a and 2b), with a puncture-to-recanalization time of 35 minutes. The patient was transferred back to the Stroke Unit.


2a

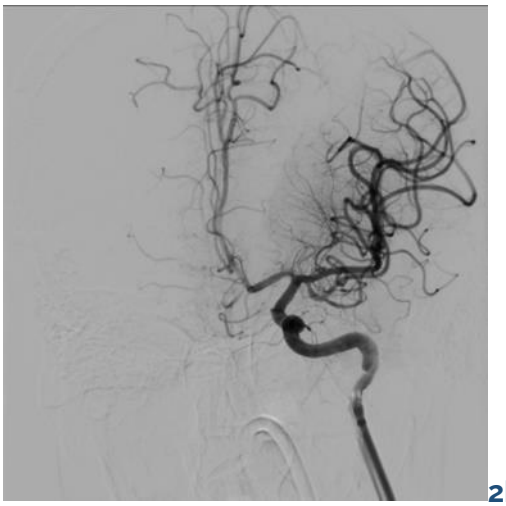

2b

Figure 2a: Digital subtraction angiography before mechanical thrombectomy shows a contrast filling defect of the left middle cerebral artery (arrow), indicating thrombotic occlusion.

Figure 2b: Angiography after mechanical thrombectomy shows complete recanalization of the left middle cerebral artery.

NIHSS was 17 (1 and 8 hours after the second recanalization) and 7 (16 and 24 hours after the second recanalization).

The CT control 24 hours after the second thrombectomy showed bilateral hypodensities in basal ganglia, representing zones of ischemia, with no signs of cerebral oedema or hemorrhagic transformation. During the hospital stay, the patient was treated with red blood cell concentrates, crystalloid fluids, low molecular weight heparin, analgesics, antipyretics and folic acid.

She was discharged to rehabilitation 2 weeks after the stroke with only left-sided facial paresis, and hemiparesis, and an NIHSS score of 7. After 90 days, the patient was able to walk, and the mRS was 2.

Upon discharge, the patient was in hematologic treatment by symptomatic red blood cells transfusions. Three years after the bilateral mechanical thrombectomy the patient's neurological status was unchanged, but the general condition was complicated with urosepsis and hemodynamic instability which resulted in severe hypotension and cardiac arrest.

Discussion

It is estimated that the incidence of recurrent stroke is between 1.2% and 9% (2), and the percentage of recurrent strokes in the total number of strokes is almost 25% per year (1). The highest risk of recurrence is within the first 90 days, with the cumulative rate in the first week after the initial ischemic incidence being estimated at 4.3% (3,4). Early recurrence further increases 90-day mortality to 31.8% in contrast to 2.9% mortality in patients who did not experience recurrent stroke during the first 30 days (5). The risk of recurrent stroke can be reduced with the fast initiation of dual antiplatelet therapy (6) which has led to a temporal decrease in recurrence over the years (7).

It has been shown that "small vessel disease "and hypertension are the leading risk factors associated with the late recurrence (8-10), while large artery atherosclerosis, carotid stenosis, systolic blood pressure, serum glucose, statin therapy and initial stroke treatment are all independently associated with the very early recurrence (9,11).

Repeated endovascular MT has been described in the literature for treating very early recurrent stroke. In a retrospective study by Bouslama et al., out of total 697 patients treated with MT, 15

of them (2%) were treated with repeated MT with a median time interval between interventions of 18 (1-278) days (12). In the aforementioned study, nearly half (7 out of 15) had MT performed on the contralateral cerebral hemisphere, with the shortest time interval between two procedures being 3 days. In another study, 10 out of 200 patients had received repeated MT for acute ischemic stroke, 4 of them for different vascular territory, with a median interval between MTs being 6.7 days (13).

Retrospective analysis of a large nationwide registry in Netherlands showed that 0.7 % out of 3928 patients underwent a repeated endovascular procedure, in 70% of cases in the same hemisphere, with a median of 78 days between thrombectomies (14). A small percentage of repeated MTs compared to other studies have been attributed to the fact that only patients with anterior large vessel occlusions were included in the study.

To our knowledge, the patient presented in our case had among the shortest time intervals (6 hours) between two MTs in different vascular territories ever described in literature. We have found only one case report with a shorter time interval, where 3 hours after MT of the M2 segment of left MCA, another MT was performed due to thrombosis of the M1 segment of right MCA (15). Same site reocclusion is believed to be associated with vessel wall damage during the procedure, as well as intracranial and extracranial atherosclerotic stenosis of treated arteries (16). On the other hand, the explanation for different territory recurrent ischemic stroke is mainly cardioembolic events, which are the main cause for repeated MTs in 43% - 87% of cases across different studies (12, 14, 17, 18).

The patient presented in our case had no major risk factors for acute ischemic stroke development, such as hypertension, hyperlipidemia, diabetes, cardiac arrythmias, smoking or even old age. However, she was severely anemic due to previously diagnosed pure red cell aplasia. Her past medical history, which included pulmonary abscess and sepsis, also suggested immunodeficiency. As a part of her primary hematological disease, she had a coagulation disorder with the tendency of hypercoagulation. Also, she was physically inactive due to her degenerative spinal condition before suffering stroke. Physical inactivity is known to be a risk factor for all non-communicable diseases, including stroke. It also increases stroke severity and post-stroke disability (19).

Anemia is also considered to be a risk factor for the development of ischemic stroke and it increases post-stroke mortality (20). Anemia causes hyperdynamic circulation, which activates inflammatory response in vascular endothelial cells, resulting in thrombus formation. Furthermore, in iron-deficiency anemia, an increase in erythropoietin secretion can stimulate platelet formation and subsequent thrombocytosis and thrombosis. In a study by Chang et al., anemia was found to be a risk factor for ischemic stroke recurrence and composite vascular events (21).

A combination of these factors was the most likely cause of the case-study patient's recurrent strokes, as the remaining diagnostic workup did not identify any other potential causes of hypercoagulability or embolic stroke. This case highlights the importance of considering hematological laboratory findings in the evaluation of acute ischemic stroke, especially in patients with no usual risk factors.

Conclusion

Very early recurrent stroke in a different vessel can be uncommon presentation of severe anemia and might implicate an underlying hematological or coagulation disorder. Endovascular mechanical thrombectomy is a safe and effective treatment option in very early recurrent stroke caused by large vessel occlusion.

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Competing interests. None to declare.

Disclosure

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Analysis and interpretation of data: KL, VK, MM, JHB, TT
Conception and design: KL, VK, MM, JHB, TT
Critical revision of the article for important intellectual content: KL, VK, MM, JHB, TT
Drafting of the article: KL, VK, MM, JHB, TT
Final approval of the article: KL, VK, MM, JHB, TT
Guarantor of the study: VK, MM, JHB, TT,
Provision of study materials or patients: VK, MM, JHB, TT

Vrlo rano liječenje ponovljenih moždanih udara mehaničkom trombektomijom kod pacijentice s teškom anemijom

Sažetak

Uvod: Ponovljeni ishemijski moždani udari koji zahtijevaju ponavljanje mehaničke trombektomije (MT) unutar 24 sata od početnog incidenta nisu uobičajeni. Ovaj prikaz opisuje slučaj 61-godišnje žene koja je podvrgnuta MT-u u dva navrata u razmaku od šest sati zbog ishemijskih moždanih udara s pridruženom teškom anemijom, uslijed čiste aplazije crvenih krvnih zrnaca (PRCA) na različitim vaskularnim područjima.

Anamneza: Pacijentica je imala povijest PRCA-e s hemiparezom lijeve strane i facijalnom parezom. Neuroimaging je otkrio okluziju M1 segmenta desne srednje cerebralne arterije (SCA). Podvrgnuta je MT-u uz potpunu rekanalizaciju. Četiri sata kasnije pojavili su se novi neurološki simptomi uslijed okluzije M1 segmenta lijeve moždane arterije i drugi MT uspješno je proveden.

Terapija i ishod: Uz MT, pacijentica je primila podržavajuću skrb, uključujući transfuzije krvi, analgeziju i antikoagulanse. Njezin neurološki status znatno se poboljšao dva tjedna po otpustu s rezidualnom slabošću lijeve strane i facijalnom parezom. Nakon 90 dana pacijentica je mogla hodati, pokazujući daljnje funkcionalno poboljšanje.

Rasprava: Slučaj je istaknut zbog kratkog razmaka između dva MT-a i postojećeg hematološkog stanja u anamnezi pacijentice. Izgledno je da su teška anemija i PRCA pridonijeli hiperkoagulabilnosti i povećanom riziku od moždanog udara. Unatoč tim neuobičajenim čimbenicima rizika, ishod pacijentice bio je dobar, što se povezuje s učinkovitošću ponovljenoga MT-a za rano ponovljene ishemijske moždane udare.

Zaključak: Rano ponovljen moždani udar u drugom vaskularnom području, pogotovo u kontekstu postojećih hematoloških poremećaja, rijedak je, ali može se uspješno liječiti pravovremenim MT-om. Potrebna su daljnja istraživanja kako bi se procijenio rizik od ponavljanja moždanog udara i odgovori na terapiju kod pacijenata s hematološkim stanjim, uključujući PRCA-u i tešku anemiju.

Original article

Coronary Angiography Optimized by Optical Coherence Tomography in Patients with Coronary Artery Disease

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Abstract

Aim: This study aimed to examine whether there is a difference in the clinical findings of lesions obtained by coronary angiography and OCT, and to examine the association of OCT findings in decision-making regarding additional optimization of PCI.

Respondents and methods: The research was conducted as a cross-sectional study using historical data. The study included patients who underwent OCT at the Department of Cardiovascular Diseases of the Osijek Clinical Hospital Center from 2021 to 2023.

Results: The research involved 62 patients, with a median age of 67. The most common location of the lesion was the LAD, in 52 (84%) cases. Thirty-nine respondents (63%) required additional optimization. Three (5%) patients were recommended for cardiosurgical consultation based on OCT. There was a significant increase in the length of the LAD (Wilcoxon test, $P < 0.001$), LCx (Wilcoxon test, $P < 0.001$), and RCA (Wilcoxon test, $P = 0.006$) as measured by OCT compared to coronary angiography. Regarding proximal width, the values for the LAD (Wilcoxon test, $P < 0.001$) and RCA (Wilcoxon test, $P = 0.03$) were significantly higher.

Conclusion: The research demonstrated the important role of OCT in clinical practice, particularly in the detailed assessment of coronary artery lesions, management of PCI, and assessment of additional optimization in patients with coronary disease.

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Introduction

Coronary artery disease is a chronic progressive condition characterized by an inflammatory process in the arterial wall and the formation of atherosclerotic plaque in the walls of coronary arteries. Invasive diagnostic methods used to confirm the diagnosis and evaluate coronary disease include coronary angiography, near-infrared spectroscopy (NIRS), and newer intravascular imaging techniques such as intravascular ultrasound (IVUS) and optical coherence tomography (OCT) (1). Coronary angiography is currently the gold standard for diagnosing coronary artery disease and guiding percutaneous coronary interventions (PCI). However, angiography provides a two-dimensional view of the lumen of blood vessels, which has certain limitations in assessing vessel wall pathology and lumen stenosis (2).

OCT is an intravascular imaging technique that allows visualization of the structure of coronary artery walls and plaque composition (3). In coronary angiography, OCT has Class 1A recommendations for certain applications, particularly in complex lesions and acute coronary syndromes, including cases involving the left main stem, true bifurcations, and elongated lesions (4). OCT images can reveal almost histological details and changes in the structure of the coronary artery wall (Figure 1.) (5).

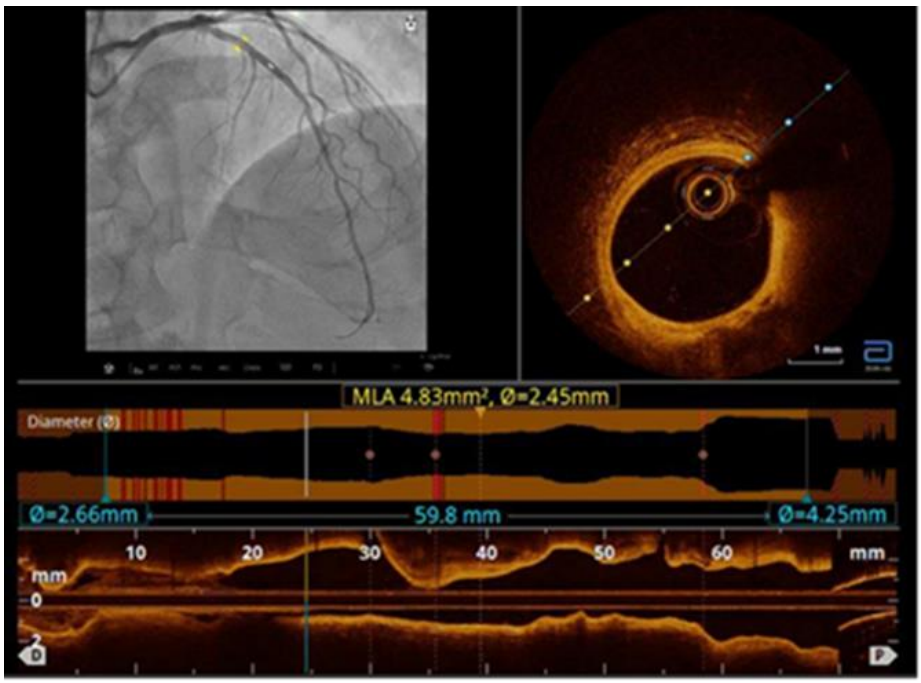

Figure 1. OCT Imaging Display.The image in the upper right shows a cross-section of the artery at the corresponding location. In the upper left corner of the image, there is a representation of the coronary angiography of the same artery. The lower part of the image presents a longitudinal section of the coronary artery (photographed by the author).

In clinical practice, OCT is useful for assessing lesion severity, plaque instability, optimizing PCI, and analyzing inadequately positioned stents (6).

Recent studies confirm the advantages of intracoronary imaging over coronary angiography during PCI (7). OCT, with its high-resolution capabilities, accurately identifies features of plaque instability. By recognizing these plaques, treatment strategies can be implemented to reduce potential future adverse effects (8). Detailed characterization of lesion morphology and accurate measurement of vessel size by OCT can improve procedural

outcomes, guide interventional strategies, and help detect suboptimally positioned stents that may not be identified through coronary angiography (9). The most common reasons for additional optimization after OCT imaging include stent malapposition, inadequate stent expansion, and dissection at the stent edge.

Patients and Methods

This research recived the approval from the appropriate ethics committee. The study was structured as a cross-sectional study using historical dana. It included patients who underwent coronary angiography optimized with OCT at the Department of Cardiovascular Diseases, Clinical Hospital Center Osijek, from 2021 to 2023. Data collection was conducted under the supervision and permission of the mentor, using data stored in the hospital information system. The following data were collected: general information about the participant (age, gender), cardiovascular risk factors (arterial hypertension, dyslipidemia, diabetes mellitus, atrial fibrillation, cardiomyopathy, chronic kidney insufficiency, history of acute myocardial infarction, prior cardiac surgery, valvular disease, smoking). Pharmacological therapy (acetylsalicylic acid, clopidogrel, prasugrel, ticagrelor, warfarin, direct oral anticoagulants, statins, ezetimibe, beta-blockers, calcium channel blockers, renin-angiotensin system medications, amiodarone), echocardiographic characteristics, indication for coronary angiography, characteristics of the performed coronary angiography, characteristics of optical coherence tomography and recommendation for cardiac surgical consultation. Categorical data are presented as absolute and relative frequencies. Differences in categorical variables were tested using Fisher's exact test. The normality of distribution for numerical variables was assessed using the Shapiro-Wilk test. Numerical data are described by the median and interquartile range. Differences in numerical variables between two measurements were analyzed using the Wilcoxon test (with the reported Hodges-Lehmann median difference and 95% confidence interval for the difference). All p-values are two-tailed. The significance level was set at alpha (α) = 0.05. Statistical analysis was performed using MedCalc® Statistical Software version 22.018 (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2024).

Results

The study included 62 participants, 55 (89%) male and 7 (11%) female, with a median age of 67 (range 40-87 years). Among the risk factors, 74% participants had arterial hypertension, 53% had dyslipidemia, and 63% participants had previously undergone PCI. The most common therapies were acetylsalicylic acid (ASA) or beta-blockers. (Table 1). Thirty-six participants (58%) had an ejection fraction greater than 50%, while eight (13%) had an ejection fraction less than 40%. Impaired contractility was observed in 42 participants (68%), and the highest number of participans had Stage I diastolic dysfunction (52%).

The indication for coronary angiography was chronic coronary syndrome in 42 participants (68%), while 13 (8%) had an ST-segment elevation myocardial infarction. In 49 cases (79%), access was via the right radial artery. Multivessel disease was present in 30 cases (48%); triple-vessel disease in 7 (11%), and dual-vessel disease in 23 (37%).

Multiple lesions were found in 9 participants (14%), while 7 (11%) had one vessel with multiple lesions. In 55 cases (89%), there was a single vessel with a single lesion.

The most common lesion location for OCT was the left anterior descending coronary artery (LAD) in 52 cases (84%).

The longest lesion was recorded in the LAD, ranging from 19.8 to 30 mm (median 25 mm). The largest proximal width was found in the LAD, ranging from 2.6 to 3.5 mm (median 3 mm). The highest percentage of stenosis was recorded in the LCx, ranging from 47.5 to 82.5% (median 75%).

Table 1. Distribution of participants according to risk factors and pharmacotherapy

	Number of patients (%)	
RISK FACTORS		
Hypertension	46 (74)	
Dyslipidemia	33 (53)	
Diabetes Mellitus	15 (24)	
Atrial fibrillation	12 (19)	
Cardiomyopathy	23 (37)	
Chronic kidney disease (CKD)	4 (6)	
History of AMI	31 (50)	
Underwent PCI	39 (63)	
Underwent CABG	1 (2)	
Valvular heart disease	16 (26)	
Smoker		8 (13)
Pharmacotherapy		
Acetylsalicylis acid	58 (93)	
Clopidogrel		7 (11)
Prasugrel	12 (19)	
Ticagrelor	34 (55)	
Warfarin	1 (2)	
DOAC´s	11 (18)	
Statins	61 (98)	
Ezetimibe		6 (10)
Beta-blockers	58 (93)	
Calcium channel blockers	24 (39)	
ACE inhibitors/ ARB	54 (87)	
ARNI	1 (2)	
Moxonidine	3 (5)	
Amiodarone	1 (2)	

In 6 participants (10%), the lesion was located ostially, and in 6 (10%), in the bifurcation area. OCT was performed on the LAD in 45 participants (73%), while the fewest OCT procedures were conducted on the left main coronary artery (LMCA). According to lesion morphology, 29 participants (46%) had calcifications, and 19 (30%) had a lipid plaque. The length of the LAD lesion measured by OCT ranged from 27.6 to 41.1 mm (median 33.1 mm). The LCx lesion ranged from 24 to 34.4 mm (median 27.3 mm). The minimal lumen area (MLA) of the LAD ranged from 1.4 to 3.5 mm^2 (median 2.4 mm^2). The proximal width of the LAD ranges from 3 to 3.7 mm (median 3.44 mm). The proximal width of the LCx ranges from 2.4 to 3.9 mm (median 3.46 mm). Malapposition of the LAD was observed in 23 participants (37%), LCx in 6 (10%), and RCA in 4 (6%). Adequate expansion of the LAD was seen in 10 participants (16%), inadequate expansion of the LCx in 2 (3%), and RCA in 3 (5%) (Table 2).

Table 2. Distribution of participants according to OCT results after PCI

	Number of patients (%)
Disection of the LAD	4 (6)
Apposition of the LAD	
good	13 (21)
malapposition	23 (37)
Apposition of the Lcx	
good	3 (5)
malapposition	6 (10)
Apposition of the RCA	
good	3 (5)
malapposition	4 (6)
Expansion of the LAD	
adequate	26 (42)
inadequate	10 (16)
Expansion of the LCx	
adequate	7 (11)
inadequate	2 (3)
Expansion of the RCA	
adequate	4 (6)
inadequate	3 (5)

The MSA for the LAD ranges from 5.4 to 7.7 mm^2 (median 6.81 mm^2) and for the LCx from 4.2 to 8.1 mm^2 (median 5.65 mm^2). Thirty-nine participants (63%) required additional optimization. Stent malapposition was noted in 33 participants (53%) (Table 3).

Table 3. Distribution of participants according to the reason for additional optimization

	Number of patients (%)
Additional optimization	39 (63)
Dilation	40 (64)
dissection at the edge of the stent	4 (6)
stent malapposition	33 (53)
inadequate stent expansion	15 (24)
restenosis in the stent	1 (2)
Stent placement	3 (5)
OMT	10 (16)

Three patients (5%) were referred for cardiothoracic surgery consult. There was a significant increase in the length of the LAD (Wilcoxon test, P < 0.001), LCx (Wilcoxon test, P < 0.001), and RCA (Wilcoxon test, P = 0.006) measured by OCT compared to coronary angiography. Proximal width values were significantly higher values for the LAD (Wilcoxon test, P < 0.001) and RCA (Wilcoxon test, P = 0.03), with no significant differences for the LMCA and LCx (Table 4).

Table 4. Differences in length and proximal width measured by coronary angiography and OCT

	Median (interquartile range)		Difference (95% confidence interval)	*P**
	Coronary angiography	OCT		
Lenght (mm)				
LMCA	18,5 (14 – 23)	15,2 (14,4 – 16,0)	-3,3 (-)	-
LAD	25 (19,8 – 30)	33,1 (27,6 – 40,8)	7,4 (4,8 – 11,2)	**<0,001**
LCx	20 (19 – 23,5)	27,3 (24,2 – 33,5)	6,8 (4,2 – 11,7)	**<0,001**
RCA	18 (14,5 – 20,8)	28,1 (19,8 – 29,9)	6,6 (2,4 – 12,8)	**0,006**
Proximal width (mm)				
LMCA	5,0 (4 – 6)	4,2 (4,2 – 4,3)	-0,79 (-)	-
LAD	3 (2,7 – 3,5)	3,4 (3,0 – 3,7)	0,33 (0,23 – 0,5)	**<0,001**
LCx	3 (2,5 – 3,5)	3,5 (2,5 – 3,9)	0,18 (-0,25 – 1,1)	0,47
RCA	2,7 (2,5 – 3,6)	2,9 (2,8 – 4,0)	0,31 (0,05 – 0,54)	**0,03**

*Wilcoxon test

Significantly higher values were observed for the LAD (Wilcoxon test, P < 0.001), LCx (Wilcoxon test, P = 0.004), and RCA (Wilcoxon test, P = 0.03) for minimum stent area (MSA) compared to minimum lumen diameter (MLD) (Table 5).

Diastolic dysfunction was present in 88% of participants, with 57% classified as grade I. There was no significant difference regarding the need for additional optimization (Table 6).

Table 5. Differences in LMCA, LAD, LCx, and RCA regarding MLA and MSA

	Median (interquartile range)		Difference (95% confidence interval)	P*
	MLA	MSA		
LMCA	2,6 (n = 1)	12,5 (n = 1)	-	-
LAD	1,9 (1,4 – 2,9)	6,8 (5,4 – 7,6)	4,4 (3,7 – 5,1)	**<0,001**
LCx	2,1 (1,6 – 2,8)	5,7 (4,2 – 7,6)	3,9 (2,6 – 5,6)	**0,004**
RCA	2,6 (2 – 3,6)	5,7 (3,8 – 8,6)	3,4 (0,32 – 7,4)	**0,03**

*Wilcoxon test

Table 6. Distribution of participants according to diastolic dysfunction in relation to additional optimization

	Number (%) of patients with additional optimization.			*P**
	No	Yes	Total	
Diastolic dysfunction	17 (81)	35 (92)	52 (88)	0,23
Degree of dysfunction				
Without	4 (20)	3 (8)	7 (13)	0,59
I degree	10 (50)	22 (61)	32 (57)	
II degree	6 (30)	10 (28)	16 (28)	
III degree	0	1 (3)	1 (2)	

* Fisher's exact test

Discussion

The prevalence of coronary artery disease increases with age. According to NHANES (National Health and Nutrition Examination Survey) data, the prevalence is higher in men than in women. Risk factors such as arterial hypertension, dyslipidemia, diabetes, renal dysfunction, and smoking are often present in older patients (10). In a study of 418 patients undergoing coronary angiography with OCT, the median age was 65, with significant risk factors: arterial hypertension in 72%, dyslipidemia in 76%, and diabetes in 37% (11). In this study, 63 patients were analyzed, with a median age of 67 years; 74% had arterial hypertension, 53% had dyslipidemia, and 24% had diabetes.

The first line of treatment for chronic coronary syndrome is pharmacological therapy, except in cases involving lesions on the LMCA or severe left ventricular dysfunction, where myocardial revascularization improves outcomes. If symptoms persist despite therapy, ori f pharmacological treatment is not tolerated, current guidelines support non-invasive or invasive diagnostic procedures to identify ischemic lesions and refer patients for revascularization (12). In the ILUMEN I study, the indication for coronary angiography with OCT was chronic coronary syndrome in 63% of patients (13). In this study, the most common indication was also chronic coronary syndrome, present in 68% of patients.

In the Light Lab study, the most common vascular access method was via the the right radial artery (62%). Multi-vessel disease was present in 12% of cases; multiple lesions in 0.5%, a single vessel with multiple lesions in 13%, and a single vessel with one lesion in 76% (14). In this study, 79% had right radial access, and 48% had multivessel disease.

Multiple lesions were present in 14% of patients, with 11% having one vessel affected by multiple lesions, and 89% with a single vessel with one lesion.

Complex coronary lesions pose challenges during PCI guided by coronary angiography. These include bifurcation lesions, ostial lesions, chronic total occlusions (CTO), left main coronary artery (LMCA) lesions, and in-stent restenosis (ISR). OCT has proven effective in guiding PCI for such complex lesions (15). Bifurcation lesions are the most common complex coronary lesions, reported in up to 20% of all PCIs. OCT enables accurate determination of the main branch and side branch positions, crucial for procedural strategy (16). CTOs are present in about 20% of patients undergoing coronary angiography; OCT is used to confirm correct guidewire placement (17, 18). For ISR, optimizing treatment and considering re-implantation is critical. Inadequate expansion of the old stent, the amount of calcium, and the presence of multiple layers of older stents are significant determinants of the new stent's inadequate expansion. Inadequate expansion of the new stent is associated with unfavorable

long-term outcomes, making optimization as vital as de novo stent implantation. In one study, ISR (17%), bifurcation lesions (9%), and CTO (3%) were present in a minority of all lesions (19). In this study, 10% of patients had ostial lesions, and 10% had lesions located in bifurcation areas. Additionally, 14% of patients had ISR.

Based on pathological and angiographic data, atherosclerotic changes are more common in the left coronary artery, especially in the LAD branch (20). In the Light Lab study, 50% of lesions were in the LAD, 29% in the RCA, and 15% in the LCx (21). In this study, the most common lesion location was the LAD (84%), with lesions in the LCx in 32% and RCA in 39%.

Calcified lesions are associated with advanced atherosclerosis and a higher frequency of inadequate stent expansion (22). Studies like HORIZONS-AMI and ACUITY have shown that calcified lesions are linked to ISR within one year (23). In a study utilizing OCT, calcification was the most common morphological finding (56%) (24). In this study, 46% had calcification.

The results indicate a significant increase in lesion length in the LAD, LCx, and RCA measured by OCT compared to coronary angiography. Proximal diameter values for the LAD and RCA were also significantly higher.

In the ILUMEN III study, there was no significant difference in lesion length and proximal diameter measured by OCT versus coronary angiography (25).

These findings can be explained as follows: the most proximal and distal segments determine reference diameter values for lesion length on coronary angiography, which are visually estimated. OCT allows precise visualization of plaque location and type, leading to more accurate lesion length measurement. According to current protocols, it is recommended to find the largest lumen using OCT to avoid high-risk zones for thrombosis and restenosis, which can result in greater lesion lenght and larger proximal diameter measurments compared to coronary angiography.

There were significantly higher values for LAD, LCx and RCA in terms of minimum stent area (MSA) compared to minimum lumen area (MLA). MLA represents the vessel's minimal lumen area before PCI; the goal is to achieve adequate stent expansion and the target MSA. MSA denotes the minimal lumen area after atent deployment. Studies confirm that MSA is the most critical indicator of thrombosis and restenosis risk (26). The COCOA study confirmed that OCT-guided PCI results in a larger MSA compared to coronary angiography-guided PCI (27). The leading causes of acute stent thrombosis are inadequate expansion and stent malposition. The PESTO study confirmed that these factors can mostly be identified by OCT, particularly in proximal segments, such as the LMCA or proximal LAD. The incidence of stent malposition is higher after interventions on complex lesions like bifurcation lesions. Therefore, intravascular imaging is recommended for complex procedures (28). Stent malposition is more common after interventions on complex lesions like birfucations, so intravascular imaging is recommended for complex procedures.

Stent malposition, inadequate stent expansion, thrombus protrusion, edge dissection, and residual plaque at the stent margins detected by OCT are known risk indicators for adverse cardiovascular events (29). In the ILUMEN I study, OCT after PCI identified stent malposition in 15%, inadequate expansion in 8%, and edge dissection in 3%. Achieving adequate stent expansion is a key objective of PCI (30). In this study, LAD malposition was observed in 37%, LCx in 10%, and RCA in 6%. Inadequate LAD expansion was present in 16%, LCx in 3% and RCA in 5%. When dissection, malposition, or inadequate stent expansion are detected by OCT, additional optimization is required. Malposition and inadequate expansion necessitate further balloon dilation, while stent dissection may require additional stenting (31). In the CLI-OPCI study, 35% of patients needed further optimization after OCT imaging, with 23% undergoing dilation (32). In this study, 63% required additional optimization, with 64% receiving dilation.

Triple vessel disease, complex double vessel disease, significant LMCA stenosis, and LAD stenosis >50% or LCx stenosis >70% are key anatomical indications for CABG. The SYNTAX score assesses coronary artery disease complexity and guide revascularization decisions (PCI vs. CABG) (33). In this study, OCT was used for three patients to evaluate lesion significance, leading to a surgical consult, highlighting OCT's role in assessing lesions for CABG.

Diastolic function is often the first cardiac function impaired in coronary artery disease. Subclinical atherosclerosis may affect diastolic function without significantly impacting systolic function. One study indicated a link between diastolic dysfunction and increased calcification progression (34). This study compared diastolic dysfunction with additional optimization aiming to determine whether patients with diastolic dysfunction require additional optimization more frequently. The results showed no significant differences regarding the need for additional optimization.

It is important to nothe the study's limitations: the sample size is small, it is a cross-sectional study, and data were collected from a single center. These factors may impact the generalizability of the findings.

Conclusion

Based on the conducted research and the obtained results, the following conclusions can be drawn:

- The clinical findings of lesion length and proximal width of the blood vessel obtained via OCT significantly from those obtained through coronary angiography.
- OCT significantly influences decision-making regarding additional optimization of PCI.
- OCT is important for further assessment of lesion significance in multivessel coronary disease intended for surgical treatment
- A significant association between diastolic dysfunction and a higher incidence of inadequate PCI requiring additional intervention based on OCT was not confirmed.

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Koronarografija optimizirana optičkom koherentnom tomografijom u pacijenata s koronarnom bolesti

Sažetak

Cilj: Ciljevi ovoga istraživanja bili su ispitati postoji li razlika u kliničkom nalazu lezije dobivene koronarografijom i OCT-om i ispitati povezanost nalaza OCT-a prilikom odlučivanja o dodatnoj optimizaciji PCI-a.

Ispitanici i metode: Istraživanje je provedeno kao presječna studija s povijesnim podacima. Uključeni su pacijenti podvrgnuti OCT-u na Zavodu za bolesti srca i krvnih žila KBC-a Osijek od 2021. do 2023. godine.

Rezultati: Istraživanje je uključilo 62 pacijenta, medijana dobi od 67 godina. Najčešća lokacija lezije bio je LAD, u 52 (84%) slučaja, dok je 39 pacijenata (63%) trebalo dodatno optimizaciju. Tri (5%) pacijenta dobila su preporuku za kardiokirurški konzilij na temelju OCT-a. Zabilježeno je značajno produljenje LAD-a (Wilcoxon test, $P < 0.001$), LCx (Wilcoxon test, $P < 0.001$), i RCA (Wilcoxon test, $P = 0.006$) mjereno OCT-om u usporedbi s koronarografijom. S obzirom na prosječnu širinu, vrijednosti LAD-a (Wilcoxon test, $P < 0.001$) i RCA (Wilcoxon test, $P = 0.03$) bile su značajno više.

Zaključak: Istraživanje je pokazalo važnost OCT-a u kliničkoj praksi, posebice u detaljnoj procjeni lezija na koronarnim arterijama, upravljanju PCI-om, i procjenu dodatne optimizacije kod pacijenata s koronarnom bolesti.

Review article

Hypodermoclysis in Palliative Care

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Abstract

Introduction: With an aging population and rising rates of chronic and oncological diseases, the need for effective palliative care solutions is growing. In terminal stages, patients often face dehydration and challenges with oral medication intake, making parenteral fluid administration essential. Intravenous access, though standard, presents difficulties in elderly patients due to fragile veins and prior treatments. Subcutaneous infusion (hypodermoclysis) offers a simpler, less invasive alternative, especially suited for home and hospice care settings.

Objectives: By reviewing scientific and professional literature, present the latest findings on the effectiveness, safety, applicability, and current barriers to the wider use of hypodermoclysis in palliative care.

Methods: A systematic literature search was conducted in PubMed, Scopus, and Web of Science databases for articles published between 1995 and 2024. Studies involving adult patients receiving palliative care and reporting on the use, outcomes, and safety of hypodermoclysis were included.

Results: Out of 169 identified records, 13 studies were included. The findings suggest that hypodermoclysis is underutilized despite its proven efficacy, low complication rates (1–4%), cost-effectiveness, and applicability for administration by non-professional caregivers. Common barriers include lack of education among healthcare providers and outdated clinical guidelines.

Conclusion: Previous studies have shown that although supported by decades of evidence, hypodermoclysis remains underutilized, particularly outside of specialized settings such as palliative care. Its proven safety, simplicity, cost-effectiveness, and suitability for home-based administration make it an ideal method for fluid and medication delivery in terminally ill patients.

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KEYWORDS: drug therapy, fluid therapy, parenteral nutrition, subcutaneous infusion

Introduction

With the aging population, the incidence of oncological and other irreversible chronic diseases is progressively rising. Patients in the terminal stage of illness often experience a diminished ability to maintain adequate oral intake of nutrition and hydration. This reduction in oral intake leads to dehydration, and difficulties with swallowing hinder the administration of oral medications. Dehydration is one of the ten most common causes of hospitalization (1).

Infusion is a standard method of fluid replacement and is traditionally administered through an intravenous access (2). However, when discussing patients who require palliative care, it typically involves the elderly population and patients with long-term comorbidities, which results in damaged veins and difficulty in establishing venous access (3–5). The issue of venous access is further exacerbated by unnecessary peripheral venipunctures, leading to additional physical and psychological trauma for the patient, as well as increased treatment costs (4,6–9). In addition to hospitals, intravenous therapy and fluid replacement are administered in mobile palliative teams, home healthcare, hospices, and chronic care facilities (10). Unfortunately, recently developed tools for planning parenteral therapy do not take into account the possibility of subcutaneous access (11,12).

Healthcare professionals must be able to assess a patient's fluid replacement needs, as well as the preferences of the patient and their family, when considering a palliative approach. If hydration is indicated for the patient, and the family and patient believe that fluid replacement will be administered intravenously, the mobile palliative team may consider subcutaneous infusions. The subcutaneous route is the most acceptable method for fluid replacement and medication administration due to its ease of application, low cost, and feasibility in home settings (13).

A review of available literature shows that as early as 1865, the Italian physician Arnaldo Cantani documented the use of subcutaneous infusion as a treatment for dehydration in patients with cholera during an epidemic in the Venice area (14).

Subcutaneous infusion, also known as hypodermoclysis, is a technique that is insufficiently recognized and underused among healthcare professionals. It is defined as a procedure in which fluids are administered into the subcutaneous space (2).

The use of subcutaneous infusions for fluid replacement and medication administration is most common in palliative care (15,16). Decision-making regarding the limitation of medical procedures and the transition from active to palliative treatment is highly challenging, requiring careful and professional management of the patient. It is essential to prepare the family so that, together with the mobile palliative team, they can provide care for the patient. In this context, hypodermoclysis becomes an integral part of palliative care, alleviating symptoms in the terminal phase of illness (17).

The goal of this research is to evaluate the effectiveness, safety, and practicality of subcutaneous infusion (hypodermoclysis) as an alternative method of fluid and medication administration in palliative care. The research aims to analyze whether this less invasive technique can improve the quality of care for terminally ill patients, particularly in home and hospice environments, by reducing complications, enhancing comfort, and increasing accessibility of treatment. Furthermore, the study seeks to identify current barriers to its wider implementation—such as lack of awareness, outdated clinical guidelines, and insufficient training—and to highlight evidence-based recommendations for integrating hypodermoclysis more systematically into palliative care practice.

Methods

A systematic literature search was performed using electronic databases, including PubMed, Scopus, and Web of Science, to identify articles published within the past 30 years, specifically from 1995 onward. The focus was on meta-analyses, review articles, and clinical studies. By including older articles in research, we can gain insight into the historical context in which the method was introduced or reintroduced. This helps define the baseline from which we can observe growth, decline, or renewed interest in its use. The keywords used in the search were: hypodermoclysis, palliative care, and subcutaneous infusion. Boolean operators (AND) were used to narrow the search in the following combinations: Hypodermoclysis AND palliative care, Subcutaneous infusion AND palliative care (Table 1 shows the research findings by type). A total of 169 papers were found using the search query "Hypodermoclysis AND palliative care," No relevant results were found for the search "Subcutaneous infusion AND palliative care". Inclusion criteria were: full text articles published in English or Croatian, studies involving adult patients in palliative care, and research focusing on use, outcomes, and safety of hypodermoclysis. Exclusion criteria included articles published before 1995 and those that did not address palliative care. Before screening we removed duplicate items (n=59) and some of them were not full text articles in English and Croatian (n=25). We screened 85 records and excluded 42. 24 reports weren't successfully retrieved. Six reports did not have adequate data. We summarized our results in Figure 1.

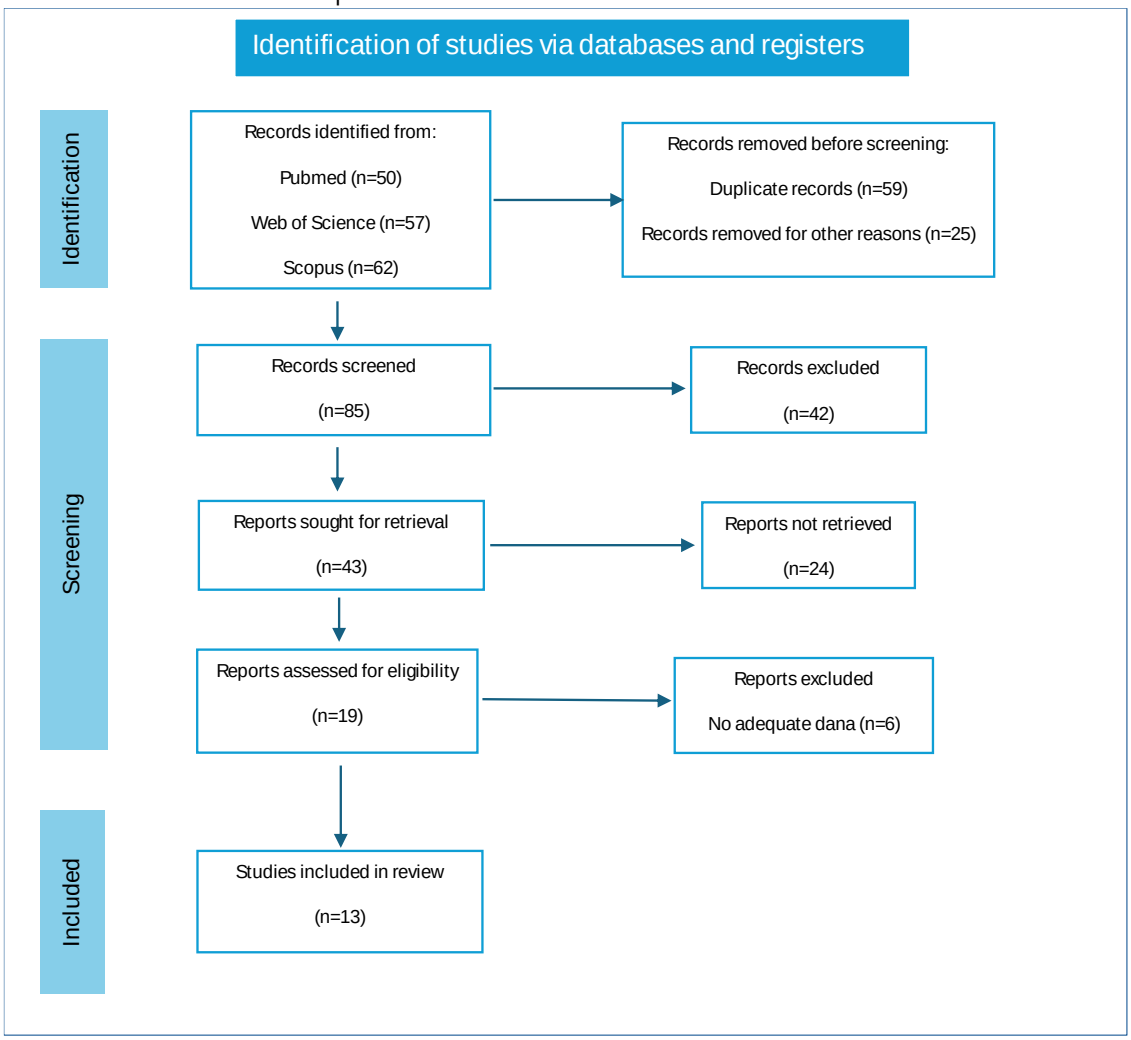

Figure 1. Flow diagram of the literature search process

Palliative care

Palliative care is provided to individuals in the terminal stage of incurable diseases, regardless of age, with the primary goal of enhancing quality of life (18).

Given the aging population and the increasing number of individuals with incurable, chronic, and oncological diseases, palliative care is becoming essential. Historically, palliative care represents progress in the approach to death and dying, where quality of life has become as important as the duration of life. For patients with chronic, progressive diseases in their final stages, the duration of life is no longer the primary concern; rather, the focus is on how the person will live their remaining days, rather than how many days are left. Symptom control, pain reduction, and emotional support become crucial for preserving dignity and maintaining good psychological well-being. In these cases, quality of life, which includes physical, emotional, and social well-being, becomes the priority (19). Patients often wish to spend their final days at home with their family, especially when they know they have only a few days left. By providing care at the patient's home, a sense of security, privacy, confidentiality, and peace can be more easily achieved.

Specialist palliative care at the patient's home improves symptom control, healthcare communication, and psychosocial support. This approach helps patients and their families better prepare for death since the outcome of the disease is certain and unfavourable, and the disease progression is inevitable and severe (20). Initially, palliative care was oriented toward patients with cancer, but it now includes individuals of all age groups with incurable diseases in the terminal stages, such as progressive lung diseases, kidney diseases, chronic heart failure, progressive neurological conditions, and dementia. Its purpose is to effectively reduce pain symptoms and improve quality of life until the very end (21).

When the general condition and progression of the primary disease suggest that the expected life expectancy is no longer than twelve months, this period can be considered the beginning of the end of life (22). Determining the precise onset of the end-of-life phase is challenging, making it difficult to establish a definitive starting point for end-of-life care (22). When death is anticipated within 48 to 72 hours, the patient is considered to be in a state of imminent death (22).

Subcutaneous infusion (hypodermoclysis)

Subcutaneous infusion or hypodermoclysis is a medical procedure in which fluids and medications are slowly absorbed from the subcutaneous tissue (23). It is administered into the hypodermis via a baby system or subcutaneous cannula (22,24,25). The hypodermis, or subcutaneous fat tissue, is the deepest layer of the skin, containing nerves, lymphatic, and blood vessels, which are connected by dense fibers that stretch through the fatty tissue. The entire absorption process of fluids and substances occurs in the capillaries of the blood and lymphatic vessels, which allow diffusion through their walls, enabling the even distribution of substances throughout the body.

This method can be used for the replacement of electrolytes lost due to illness, vomiting, or diarrhea, as well as the administration of certain medications to alleviate symptoms in palliative care. It was first described in 1865 as a rehydration method for patients with cholera (26). This method is increasingly being used as an alternative to intravenous infusions, particularly in patients who have difficulty taking fluids or medications orally. If a patient cannot take medication orally, subcutaneous administration should be considered, as intravenous infusions are invasive, and intramuscular injection is painful, especially in cachectic patients (2,22,27)

The procedure of hypodermoclysis should be performed by a competent nurse or technician in hospital settings or facilities providing 24-hour care and extended treatment (2,27). In home care settings, hypodermoclysis is administered by a home care nurse/technician according to a written order from the attending physician, or it can be performed by a family member, caregiver, or attendant who has received appropriate training and acquired the necessary

knowledge and skills (2,25,27). The mobile palliative team also conducts the full procedure of hypodermoclysis and educates family members.

Recommended locations for placement include the front of the upper arm, abdomen, thigh, scapula (in restless patients), and the upper chest below the clavicle, with special caution in cachectic individuals (Figure 2) (2,19,22,28). It is essential that the patient has at least one centimetre of subcutaneous tissue (2).

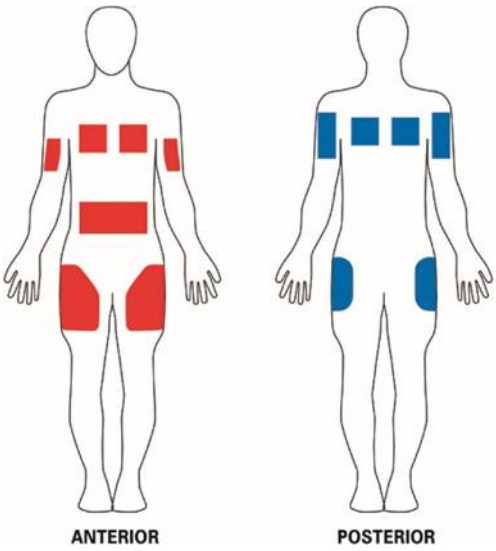

Figure 2. Recommended locations for Hipodermocrysis placement (29)

Subcutaneous cannulas should not be placed on areas of skin folds, breast tissue, regions above tumour formations, limbs affected by lymphedema or edema due to the possibility of reduced absorption, the abdomen in the presence of ascites, bony areas with insufficient soft tissue, skin damaged by radiation due to potential sclerosis and decreased blood flow, areas near joints due to discomfort and increased risk of dislocation, or on infected, damaged skin or bruises (28). In the event of localized reactions, a new cannula should be placed at an alternative location. If the reaction recurs, it may be necessary to dilute the medication. The cannula can remain in place for at least 72 hours, and if there are no signs of reaction, it can remain for up to seven days (24,28).

Subcutaneous infusion is indicated for nausea, vomiting, poor absorption of oral therapy (e.g., in ileostomy patients), dysphagia, diarrhea, dehydration, non-operable gastrointestinal obstruction, poor peripheral venous access, and when the rectal route for medication administration is not applicable (30). Contraindications include emergency situations where rapid fluid replacement is required (shock, severe dehydration, circulatory failure), patients with coagulation disorders, renal failure, cardiac decompensation, ascites, edema, or lymphedema (31).

Subcutaneous drug administration

There are various opinions and data in the literature regarding the use of specific medications through hypodermoclysis (2). In the book by M. Ljubičić (9), it is stated that the use of antibiotics, diazepam, chlorpromazine, and prochlorperazine is prohibited due to the risk of necrosis. However, other sources approve the use of certain antibiotics such as ceftriaxone, teicoplanin, amikacin, cefepime, and gentamicin, as well as antipsychotics (17,22,30,32). Table 1 lists the medications that are permitted for use through hypodermoclysis.

Safety of Subcutaneous Infusion

The most common complications that may occur with subcutaneous infusion are rare, but they should still be considered. These include local reactions (edema, erythema, ecchymosis), infection, hematoma, tissue necrosis, catheter obstruction, and fluid overload (2,17,22,25,30). Pain at the infusion site is rare but possible, especially if the subcutaneous catheter is improperly placed into muscle tissue or there is skin tension caused by administering large volumes of fluid or a solution containing potassium ions (31). The risk of blood vessel perforation is minimal, and bleeding is rare in patients without coagulation disorders (31).

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Table 1. List of medications that are permitted for use through hypodermoclysis (17,22,30,32,33)

Group	Drug	Dose
Pain killers	Buprenorfin*	#
	Diclofenac*	75-150 mg/day
	Dipryone	1g up to every 6 hours
	Fentanyl	100-1000 mcg/day
	Hydromorphone*	50% of oral dose
	Ketorolac*	30-90mg/day
	Methadone*	50% of oral dose
	Morphine*	50% of oral dose
	Naprexen	55-600 mg/day
	Petidin*	#
	Tramadol*	100-600mg/day
Antibiotics	Amikacin*	#
	Ampiciline	500mg/day
	Cefepeme*	1g/day
	Cefotaxime	500mg/day
	Ceftazidime	500mg/day
	Ceftriaxone*	1g/day
	Gentamicine*	#
	Teicoplanin*	#
	Tobramycin	75mg/day
Benzodiazepine and antipsychotics	Diazepam*	#
	Haloperidol*	2,5-10mg7day
	Clonazepam*	5-8mg/day
	Clorazepate*	#
	Chlorpromazine*	#
	Levopromazine*	5-100 mg/day
	Lorazepam*	#
	Midazolam*	10-120mg/day
Antiemetics and muskarine drugs	Atropine*	1.2mg/ once a day
	Butylscopalomine*	#
	Cylizine	25-50mg every 8 hours (max 150mg/day)
	Glycopyrronium*	#
	Granisetron	3-9mg/day
	Levopromazine	5-25 mg/day
	Metoclopramide*	30-120 mg/day
	Ondasetron*	8-24mg/day
	Papaverine*	#
	Promethazine	12-25mg/day
Coritcosteroides	Dexamethasone*	4-40mg/day
	Methylprednisolone*	#

Group	Drug	Dose
	Famotidine	#
	Furosemide*	20-40mg
	Clodronate*	#
	Pamidronate*	#
Other	Octreoide	50-600mcg/day
	Phenobarbital	200mg/day
	Ranitidine	50-150mg/day
	Scopolamine	60-180 mg/day
	Zoledronate*	#

*safe for elderly patients (32)

no information available

Furthermore, since the medications and solutions approved for subcutaneous infusion are also indicated for intravenous use, accidental intravenous administration due to puncturing a blood vessel does not pose a significant safety risk (31). Tissue necrosis can occur if inappropriate infusion solutions (hypertonic, hypotonic, solutions with high concentrations of potassium chloride) are used (34). Inflammatory reactions such as abscesses or cellulitis are rare but possible (23,31,35).

Parenteral fluid administration carries the risk of fluid overload, which may result in peripheral or generalized edema, acute heart failure, and pulmonary edema. (25). The use of hyaluronidase, an enzyme that accelerates fluid absorption and distribution, could potentially heighten the risk of circulatory overload.

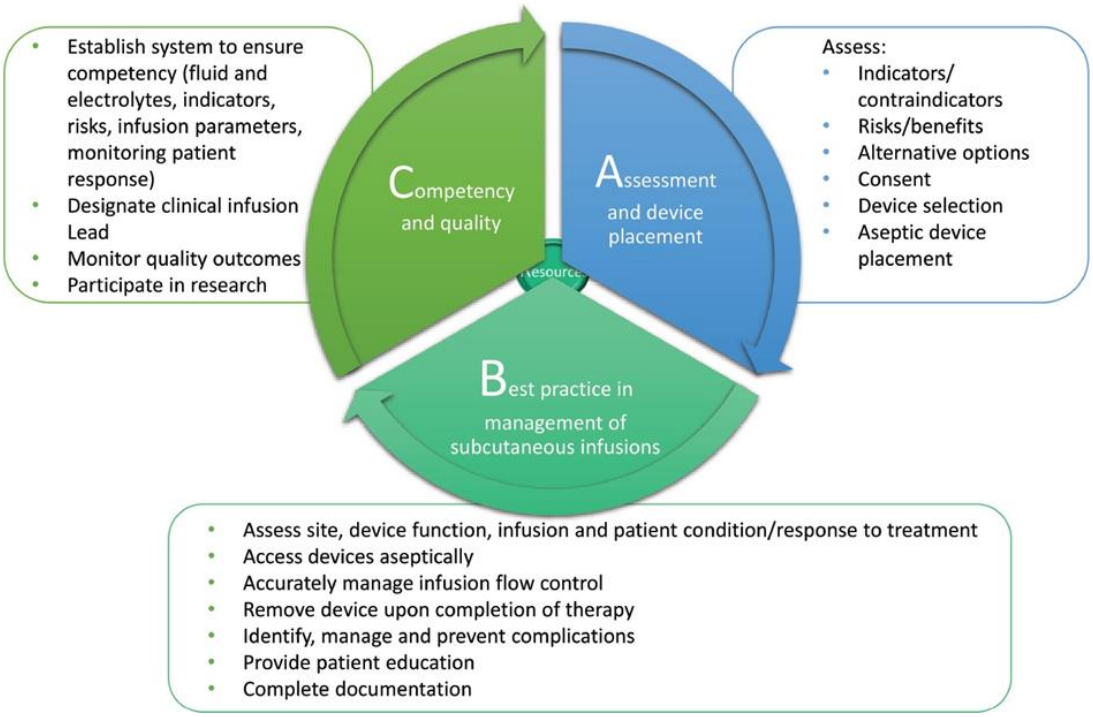

Figure 3. ABC model of subcutaneous route application (38).

However, due to the slower infusion rate, the likelihood of fluid overload with standard subcutaneous infusion remains lower compared to intravenous administration (25,36,37). Besides these complications, bleeding may occur when metal needles (Baby system) are used. An agitated or disoriented patient may accidentally dislocate the metal needle by pulling on the infusion set, so non-metal infusion sets are recommended (25).

Factors contributing to complications range from improper skin preparation before puncture or non-adherence to aseptic technique during the procedure, leading to an increased risk of infection. Frequent application of subcutaneous infusion at the same site leads to tissue damage. A weakened immune system following chemotherapy also contributes to the development of infections (2,17,22,30).

Complications can be prevented by using aseptic technique, rotating the injection site each time the subcutaneous catheter is placed, and educating the patient's family on the signs of infection (1,24). To minimize risks when administering subcutaneous infusion, the ABC model approach is recommended (Figure 3) (38).

The ABC model represents a systematic approach to subcutaneous infusion in any environment. It includes assessing and placing the infusion system, applying the best practice evidence during the intervention, and evaluating the quality of the procedure (32).

Advantages of Hypodermoclysis

Hypodermoclysis offers several advantages over intravenous infusion (Table 2), including ease of administration, cost-effectiveness, and suitability for fluid replacement in patients with challenging venous access. According to studies, it is quicker to set up (1,36,39,40), has a wider range of applications (home, hospital, hospice, institutions for the elderly and disabled) (31,39), reduces the number of hospitalizations due to the need for rehydration (23,40,41), and increases patient mobility and comfort (31,36,39). Subcutaneous infusion can be used at the patient's home, is less painful, and is less likely to result in complications compared to intravenous infusion (36,40).

Discussion

By reviewing sources from 1995 to 2015 (1,4,13,15,36,39) and comparing them to recent publications (2,11,24,25,33,42,43), we can document the consistency or stagnation of clinical practices. In the case of hypodermoclysis, this comparison demonstrates that it has predominantly remained a specialized intervention, primarily utilized in specific patient populations such as those in palliative care or geriatrics. This persistence, despite significant evidence supporting its safety, cost-effectiveness, and ease of administration, highlights a critical issue. The lack of substantial change in its clinical utilization over time raises relevant questions regarding the barriers to its broader adoption. These barriers may include insufficient awareness among healthcare providers, inadequate training in subcutaneous infusion techniques, or a preference for intravenous hydration, which is often perceived as the more conventional or reliable method. Identifying and addressing these barriers is crucial for advancing evidence-based practice and expanding the use of hypodermoclysis in clinically appropriate settings. Only difference noted across research findings is that, initially, hyaluronidase was commonly co-administered with subcutaneous fluids to enhance their absorption into the systemic circulation (44,45). However, more recent literature reviews suggest that routine use of hyaluronidase is often unnecessary. Its declining use in clinical practice is primarily due to concerns about potential allergic reactions, the risk of fluid overload, and the high cost associated with the enzyme (42). As a result, standard subcutaneous infusion without hyaluronidase has become the preferred approach in most palliative care settings, given its safety, simplicity, and sufficient clinical effectiveness.

Table 2. Advantages and Disadvantages of Subcutaneous Infusion Compared to Intravenous Infusion (1,23,25,31,36,39–41)

Advantages	Explanation	Disadvantages	Explanation
Easier placement/maintenance	It is easier to insert the catheter and administer fluid replacement or therapy. Fewer puncture incidents, easier monitoring of the patient's condition, and less time needed. Applicable in almost any setting (at home, in the hospital).	**Administration of large amounts of fluid replacement**	It is not possible to administer large amounts of fluid. The maximum is 1500-2000 ml per application site, with an average rate of up to 1000 ml over 5 hours.
Minimal staff education required	It can be performed by medical professionals with minimal education, as it is much simpler to set up and maintain than intravenous access.	**Use in resuscitation and patients with reduced tissue perfusion**	contraindicated in resuscitation scenarios and in patients with compromised tissue perfusion.
Cost	Cheaper than intravenous access.	**Correction of severe electrolyte imbalances**	Not suitable for correcting severe electrolyte imbalances.
Patient comfort	More comfortable than intravenous access, does not require patient immobilization.		
Risk of thrombophlebitis	None.		
Risk of infection	Minimal.	**Patients with bleeding**	Contraindicated in patients with bleeding or coagulation disorders
Risk of fluid overload	Minimal, slower fluid administration compared to intravenous access. Lower risk of pulmonary edema or hyponatremia than intravenous access.		
Risk of abscess or cellulitis	Minimal, can be resolved with local therapy.	**Hypertonic fluids or solutions without NaCl**	contraindicated for the administration of highly hypertonic solutions or fluids without sodium chloride (NaCl)
Risk of localized edema	Relatively common, occurring in 1-4% of cases but harmless.		
Risk of exposure to bodily fluids	Can occur if an agitated patient suddenly pulls out the needle, though the risk is lower compared to intravenous access. It should not be used if blood appears in the catheter during insertion.		

Recent research underscores the advantages of subcutaneous infusion as a method for parenteral fluid and nutrient administration, particularly in vulnerable populations such as the elderly (46). One study focusing on hospitalized older adults demonstrated that subcutaneous infusion was associated with fewer adverse effects compared to traditional intravenous infusion, making it a preferable option when considering patient safety and comfort (46). Furthermore, in clinical scenarios where the insertion or maintenance of intravenous access is difficult, such as in patients with fragile veins, cognitive impairment, or in home-care settings, subcutaneous infusion presents a safer and more practical alternative for both fluid and medication delivery (2,27).

The simplicity of the technique is well-documented. For instance, Vidal (2016) (47) found that primary caregivers, after receiving only basic training, could effectively and safely administer subcutaneous infusions at home. This finding highlights the potential for broader implementation, particularly in settings with limited access to healthcare professionals or institutional care. Supporting these findings, Rodríguez-Campos et al. (2016) (43) explored subcutaneous infusion administration by non-professional caregivers who were trained by a nurse. This study, conducted with 272 patients, involved a total of 903 subcutaneous catheters being placed. The most common reasons for requiring subcutaneous access were inadequate symptom management (162 cases) and difficulty with oral intake (107 cases). Non-professional caregivers, trained by nurses, administered therapy in 80% of cases, with 2% of patients developing a local infection under non-professional caregiver care, compared to 1.8% of patients under professional nurse care (43). These findings support the simplicity and low risks of administering subcutaneous infusion after appropriate training.

The frequency of subcutaneous infusion use in palliative care is highlighted by a study conducted by Borela et all in 2022 (18). The sample consisted of 160 patients requiring palliative care at two institutions: a general hospital (Hospital Estadual de Ribeirão Preto, HERP) and a specialized cancer treatment facility (Instituto Nacional de Câncer, INCA). In the general hospital (HERP), 384 procedures for fluid replacement (either intravenous or subcutaneous catheter) were performed, with only 52 subcutaneous procedures, representing 13.2% of the total. At the cancer hospital (INCA), 97 procedures were recorded, of which 25 were subcutaneous catheter placements, representing 25.89% (18). This difference in frequency suggests that specialized institutions like INCA may be more familiar with, or more confident in, the use of hypodermoclysis as part of their standard palliative care protocols. There was also a difference in the reasons for selecting intravenous or subcutaneous routes. At HERP, antibiotic therapy (34.7%) and analgesia (34%) were most commonly administered, while at INCA, analgesia (37.7%) and hydration (23.3%) were more prevalent (18). This disparity supports the conclusion that subcutaneous infusion is still underutilized, and that additional education for healthcare providers and students is necessary to encourage wider use. This conclusion is supported by Hayes et al. (2024) who reaffirm that subcutaneous infusion is simpler, safer, and more cost-effective than intravenous administration. These characteristics make it particularly appropriate for palliative care, where comfort and ease of use are essential (25,42).

Lastly, a 2023 study aimed to establish formal guidelines for subcutaneous infusion, resulting in 42 evidence-based recommendations (38). This is especially relevant given that Croatia's current national guidelines date back to 2009, with the last revision in 2011 (30). Additionally, the study defined the ABC model for the application of subcutaneous infusion.

Limitations and recommendations for future studies

Despite the robust body of literature underscoring the advantages and potential of subcutaneous infusion in palliative care, several limitations are evident. The reviewed studies vary widely in methodology, sample size, and healthcare settings, which limits the generalizability of findings across different patient populations and healthcare systems. For

instance, the data from Borela et al. (2022) (18) reveal a significant disparity in the frequency of subcutaneous infusion use between general and specialized institutions, suggesting institutional biases or differing levels of practitioner familiarity with the technique. While advantages over intravenous infusion are well-documented, long-term outcomes and broader comparisons are lacking. Patient and caregiver perspectives are also underexplored. Future research should focus on larger, multicenter studies, evaluate educational interventions, and update outdated national guidelines to support wider adoption of subcutaneous infusion. Further exploration is also needed into educational interventions for healthcare providers and informal caregivers, particularly in countries where subcutaneous infusion remains underutilized.

Conclusion

Although supported by decades of evidence, hypodermoclysis remains underutilized, particularly outside of specialized settings such as palliative care. Its proven safety, simplicity, cost-effectiveness, and suitability for home-based administration make it an ideal method for fluid and medication delivery in terminally ill patients. One would expect that with technological progress and clinical advancements, the use of hypodermoclysis might have either significantly increased or been replaced by more modern alternatives. However, a thorough literature overview indicates that there has been no significant change in its usage in clinical environments over the past several decades.

To fully realize the potential of hypodermoclysis in palliative care, there is a clear need for updated national guidelines, structured training programs, and stronger support within healthcare system. These efforts are vital to normalize hypodermoclysis as a standard, evidence-based practice that prioritizes patient comfort, especially in end-of-life care.

Disclosure

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Competing interests. None to declare.

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Hipodermokliza u palijativnoj skrbi

Sažetak

Uvod: Starenjem populacije raste učestalost onkoloških i drugih neizlječivih kroničnih bolesti, što povećava potrebu za palijativnom skrbi. Pacijenti u završnim fazama bolesti često imaju smanjeni unos hrane i tekućine, što dovodi do dehidracije, a otežano gutanje onemogućuje oralnu primjenu lijekova. Iako je intravenska primjena standard, u starijih osoba često je otežana zbog oštećenih vena i prethodnih terapija. Supkutana infuzija (hipodermokliza) predstavlja jednostavniju i manje invazivnu alternativu, osobito prikladnu za kućnu i hospicijsku skrb.

Cilj: Pregledom znanstvene i stručne literature predstaviti najnovija saznanja u učinkovitosti, sigurnosti, primjenjivosti i trenutnim preprekama šire primjene hipodermoklize u palijativnoj skrbi.

Metode: Provedeno je sustavno pretraživanje literature u bazama podataka PubMed, Scopus i Web of Science za radove objavljene između 1995. i 2024. godine. Uključena su istraživanja koje su se bavila odraslim pacijentima u palijativnoj skrbi i izvještavala o primjeni, ishodima i sigurnosti hipodermoklize.

Rezultati: Od 169 identificiranih radova, uključeno ih je 13. Rezultati sugeriraju da je hipodermokliza i dalje nedovoljno korištena unatoč dokazanoj učinkovitosti, niskoj stopi komplikacija (1–4%), isplativosti i primjenjivosti za administraciju od strane neprofesionalnih njegovatelja. Najčešće prepreke uključuju nedostatak edukacije među zdravstvenim djelatnicima i zastarjele kliničke smjernice.

Original article

Exposure of Physicians to Workplace Violence

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Abstract

Introduction: The main goal of the research was to determine whether the doctors who work at the Clinical Medical Center Osijek are exposed to violence in the workplace, in what form of violence, whether there are differences in exposure between doctors according to age, gender and depending on whether they are specialists or residents.

Participants and methods: This study is organized as a cross-sectional study. 101 doctors employed at the Clinical Medical Center Osijek participated in this research. The data were collected by answering an anonymous online questionnaire.

Results: The majority of respondents who were exposed to violence at the workplace indicated that they had experienced verbal abuse (41.6%), followed by mobbing (21.8%), physical (5%) and sexual abuse (3%).

Conclusion: Due to the small sample of the study, there are no significant differences in the distribution of respondents according to exposure to any form of violence in relation to gender, age or whether they are residents or specialists.

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KEYWORDS: aggression, physicians, workplace violence

Introduction

1.1 Types of violence in the physicians' workplace

Workplace violence is present in almost all working sectors and its workers, but health department holds a significant share of violence especially towards primary healthcare providers such as doctors and nurses (1). Studies show how health department constitutes almost a quarter of all workplace violence and 73% of all non-fatal injuries (2). A physician can experience workplace violence from patients, members of the patient's family or healthcare facilities' visitors, but the perpetrator is mostly patient (3). Healthcare workplace violence can be in a form of physical violence, verbal, sexual, threats and bullying. Mobbing is referred to abuse by colleagues, superiors or bosses. It's usually a consequence of established hierarchy at the workplace which causes imbalance in relationships between colleagues. The high stress levels, heavy workload, and competitive environment in the healthcare sector often led to a lack of administrative support, indirectly encouraging this type of violence (4).

1.2 Risk factors and consequences of workplace violence

Risk factors for violence against physicians have been identified and are categorized into groups depending on whether they are related to the patient, the physician, the organization of the work environment, or society, including patients with mental illnesses, addictions, or behavioral disorders, as well as healthcare system overload (1, 5, 6, 7). Prolonged time in the waiting room and the feeling of neglect can lead to patient's frustrations and mistrust worsening their relationship with physicians (8). Stress and administrative tasks lower the quality of provided healthcare while lack of physician's communication skills and empathy can trigger patients' negative reactions (9). Social factors include lack of respect, language and cultural barriers and distrust exacerbated by the negative media portrayals. Experienced violence can adversely affect a doctor's physical and mental health, it can cause depression, insomnia, PTSP, anxiety, burn-out syndrome. It can limit physician's work efficiency, job satisfaction and even result in leaving medical profession. Over a longer period of time, it can result in disruption of the overall functioning and efficiency of the health system (10, 11, 12, 13).

1.3 Epidemiology of violence in the healthcare sector

World Health Organization has estimated that between 8% and 38% of health workers experience some form of workplace violence but it must be taken into consideration that most of the time workplace violence is unreported. Studies have shown how the most common type of workplace violence in healthcare is verbal abuse (61.2%), then psychological (50.8%), threats (39.5%), physical (13.7%) and sexual abuse (6.3%) (2). In the last few years there has been an increase in violence toward the physicians which correlates with the COVID-19 pandemic (14, 15). Physicians were faced with the additional challenges such as lack of personal protective equipment, pressures to diagnose and treat patients with COVID-19, communication issues between patients, their families, and physicians, and fear of the unknown disease and its consequences (14). European countries which have the biggest increase in healthcare workplace violence are Germany, Spain, United Kingdom and Italy (14, 15, 16, 17). Violence against physicians is also not uncommon in Croatia. In 2016, the Croatian Medical Chamber conducted a survey on violence against doctors during their working hours, revealing that 93% of the surveyed physicians experienced some form of verbal or physical violence at work. Physical attacks on doctors occurred in 22% of healthcare institutions in Croatia (18).

Aims of this study are to determine whether physicians are exposed to violence during working hours, to investigate potential differences in exposure based on gender and age of the participants, to assess disparities in exposure between residents and specialists, and to determine physicians' perceptions of workplace safety.

Participants and Methods

The study was structured as a cross-sectional study (19). The participants were physicians employed at the Clinical Hospital Center Osijek and a total of 101 participants took part. The survey was conducted from July to June 2023 via an anonymous online questionnaire which was sent to the participants' email addresses. It was distributed officially through the administration of each hospital department; however, the exact number of employees who received it is unknown. The questionnaire was based on the WHO's free survey intended for wide use published in 2003 (20) and was compound of six parts: sociodemographic data (including the questions about concerns related to workplace violence and whether they are familiar with the procedure for filing a report), questions about physical violence, verbal, sexual, mobbing and employer's strategies regarding health and safety. Categorical data were presented as absolute and relative frequencies. Differences in categorical variables were tested using Fisher's exact test. Normality of the distribution of numerical variables was tested using the Shapiro-Wilk test, and due to non-normal distribution, data were described using median and interquartile range. All P-values are two-sided. The significance level was set at Alpha = 0.05. Statistical analysis was performed using MedCalc® Statistical Software version 22.006 (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2023).

Results

The study was conducted on 101 participants, of which 37 (36.6%) were men and 64 (63.4%) were women. The median age of the respondents is 41 years, ranging from a minimum of 25 to a maximum of 64 years. Out of the total number of participants, 84 (83.2%) are specialists. Considering how long have they been employed at the Clinical Medical Center Osijek, 36 (35.6%) participants have been working between 10 and 20 years. Due to working in a demanding job, 9 (8.9%) respondents regularly or occasionally take tranquilizers. On a scale of 1 to 5, where a higher number indicates a higher level of concern about workplace violence, 44 (43.6%) respondents are not concerned (marked 1 or 2 on the scale), and 26 (25.8%) are concerned (marked 4 or 5 on the scale). 69 (68%) respondents claim that there are standard procedures for reporting workplace violence, and 38 (37.6%) are familiar with how to initiate the procedure. Regarding the method of reporting workplace violence, 23 (22.8%) respondents informed themselves, while 13 (12.9%) stated that they were informed by their superior. The majority of respondents who were exposed to workplace violence indicated that they were verbally abused (41.6%), followed by mobbing (21.8%), physically abused (5%) and sexually harassed (3%).

Three (3%) respondents stated that physical violence was committed by a patient or a patient's family member, and one respondent each stated that it was committed by a staff member or the supervisor. 21 (20.8%) respondents reported that verbal abuse was committed by a patient's family member, 16 (15.8%) indicated it was the patient, and 15 (14.9%) respondents reported that a staff member committed the abuse. Mobbing was mostly experienced by respondents from a staff member (12.9%). Sexual harassment was most frequently experienced from a staff member (2.0%) and from a patient (1.0%).

After the occurrence of physical violence, 3 (3.0%) respondents officially reported the incident, 2 (2.0%) asked the perpetrator to stop or confided in a colleague, and one attempted to physically defend themselves and initiated criminal proceedings against the perpetrator. After a verbal incident, only 3 (3.0%) respondents officially reported it, while the majority (19.8%) asked the perpetrator to stop, confided in their colleagues (17.8%) and close ones (14.9%). Following mobbing, 12 (11.9%) respondents stated that they asked the perpetrator to stop or confided in a colleague. No sexual harassment incidents were officially reported; the perpetrator was asked to stop (2.0%), and 1.0% of respondents did not react to the harassment. The psychological consequences of physical, verbal, sexual harassment, and mobbing are summarized in Table 1, and the actions of supervisors/employers after the incident are summarized in Table 2.

Table 1 Psychological consequences of violence

	Number of respondents (%)			
Mark how often the following occur with you:	**PHYSICAL**	**VERBAL**	**MOBBING**	**SEXUAL**
Repeated, disturbing memories, thoughts, or images of the attack?				
Never	**3 (3.0)**	**20 (19.8)**	**8 (7.9)**	**2 (2.0)**
Rarely	1 (1.0)	13 (12.9)	5 (5.0)	1 (1.0)
Sometimes	1 (1.0)	7 (6.9)	6 (5.9)	-
Often	-	2 (2.0)	3 (3.0)	-
Almost always	-	-	-	-
Avoiding thinking or talking about the attack or avoiding having feelings related to it?				
Never	**4 (4.0)**	**20 (19.8)**	**7 (6.9)**	**2 (2.0)**
Rarely	1 (1.0)	13 (12.9)	6 (5.9)	-
Sometimes	-	6 (5.9)	4 (4.0)	1 (1.0)
Often	-	2 (2.0)	5 (5.0)	-
Almost always	-	1 (1.0)	-	-
Being "super-alert" or watchful and on guard?				
Never	**3 (3.0)**	**15 (14.9)**	4 (4.0)	1 (1.0)
Rarely	-	14 (13.9)	3 (3.0)	1 (1.0)
Sometimes	1 (1.0)	10 (9.9)	**10 (9.9)**	1 (1.0)
Often	1 (1.0)	3 (3.0)	5 (5.0)	-
Almost always	-	-	-	-
Feeling like everything you did was an effort?				
Never	1 (1.0)	8 (7.9)	2 (2.0)	-
Rarely	1 (1.0)	10 (9.9)	3 (3.0)	**2 (2.0)**
Sometimes	1 (1.0)	**15 (14.9)**	**11 (10.9)**	-
Often	**2 (2.0)**	7 (6.9)	6 (5.9)	-
Almost always	-	2 (2.0)	-	1 (1.0)

Table 2. Superior'/Employer's approach

	Number of respondents (%)			
	PHYSICAL	VERBAL	MOBBING	SEXUAL
Did your superiors take certain measures against the perpetrator after suffering violence at the workplace?				
Yes	1 (1.0)	2 (2.0)	3 (3.0)	2 (2.0)
I don't know	1 (1.0)	24 (23.8)	14 (13.9)	-
No	**3 (3.0)**	**16 (15.8)**	**5 (5.0)**	**1 (1.0)**
Did your employer or supervisor offer to provide you with				
Opportunity of psychological counseling				
Yes	-	2 (2.0)	-	-
No	**5 (5.0)**	**40 (39.6)**	**22 (21.8)**	**3 (3.0)**
Opportunity to speak about/report it				
Yes	1 (1.0)	9 (8.9)	2 (2.0)	-
No	**4 (4.0)**	**33 (32.7)**	**20 (19.8)**	**3 (3.0)**
Other support?				
Yes	1 (1.0)	6 (5.9)	4 (4.0)	-
No	**4 (4.0)**	**36 (35.6)**	**18 (17.8)**	**3 (3.0)**

Doctors who decided not to report the incident mostly did not report it because they considered it useless (physical violence 3.0%, verbal 22.8%, mobbing 10.9%, and sexual 2.0%). Doctors did not report mobbing also due to fear of negative consequences (5.9%) or because they did not know whom to contact (5.0%).

Differences in the distribution of exposure to violence in relation to gender, age, and whether the respondent is a resident or a specialist were statistically analyzed using Fisher's exact test, and for all characteristics, the P value was above 0.05, indicating no statistically significant differences between the mentioned characteristics.

The participants were asked which measures used for dealing with workplace violence exist in their work environment and 57 (56.4%) respondents mentioned security measures, 18 (17.8%) protocols for patients, 14 (13.9%) advanced controls at the hospital entrance, and 37 (36.6%) stated that they have none of the above. The most useful measure in the work environment for 62 (61%) respondents is an increase in the staff number, and for 59 (58%) respondents, it is security measures, while changes in shift work or schedules or reduced periods of working alone are not useful at all. Changes that have occurred in the workplace and their impact on daily work are summarized in Table 3.

Table 3 The changes that took place in the workplace and their impact on daily work

	Number of respondents (%)
Which of the following changes, if any, have occurred in the workplace/health care setting in the last 2 years?	
None	**35 (34.7)**
Restructuring / reorganization	8 (7.9)
Decreased staff numbers	**13 (12.9)**
Increased staff numbers	5 (5.0)
Restriction of resources	**18 (17.8)**
Additional resources	1 (1.0)
I don't know	21 (20.8)
In your opinion, what impact have the above changes had on your daily work?	
None	**26 (25.7)**
Work situation for staff worsened	**24 (23.8)**
Work situation for staff improved	9 (8.9)
Situation for patients worsened	9 (8.9)
Situation for patients improved	2 (2.0)
I don't know	26 (25.7)
Other	5 (5.0)

Discussion

This study questioned whether the physicians employed at the Clinical Medical Center Osijek were exposed to violence during their working hours and their perception of the safety in the workplace. Previous research shows that young, female physicians are more likely to experience workplace violence (21). This is confirmed by data from countries like the USA, where 30% of women in the healthcare sector have experienced sexual harassment in the workplace compared to only 4% of men, and data from South Korea, where 64% of female healthcare workers experienced verbal abuse and 42% experienced threats of physical violence in 2019 (22). Although female doctors at Clinical Medical Center Osijek have more frequently experienced physical, verbal, and sexual harassment at work compared to their male counterparts, due to the small sample size, these data are not statistically significant. Women are likely more often exposed to violence due to gender stereotypes that portray them as more passive and less prone to conflict, making them more vulnerable targets and weaker authorities, thus less likely to report violence. The underreporting of violence can be a consequence of economic risks, as women often work under more insecure conditions with lower compensation and fewer benefits (22). The most frequent perpetrators of violence were consistently reported to be the patient and/or the patient's family across all forms of violence. This data aligns with a study from India, which found that in 97% of cases, the attacker was a family member of the patient, and in five cases, it was the patient themselves (8). These findings also correspond with data from the 2016 Croatian Medical Chamber survey, where the most common perpetrators of violence were patients (76%) and their family members (74%) (18). The underlying cause of their attitude and behavior is most often emotional stress and a sense of vulnerability arising from illness or injury (2). The psychological consequences of violence are often not immediately noticeable. Most participants stated that they often feel strained and exhausted but rarely have recurring distressing memories of the attack. The severity of the consequences depends on the individual, the frequency, and the intensity of the incidents (9). A stressful work environment can cause

sleep disorders, depression, anxiety, and deterioration of physical health. A small number of respondents reported using medications like alprazolam due to work-related stress. In 2016, 62% of Croatian physicians reported that they occasionally or constantly feel fear of becoming victims of violence at work. Many respondents also indicated increased stress, decreased motivation, and feelings of insecurity in their daily work, accompanied by emotional exhaustion. Such consequences lead physicians to adopt a more distant approach toward patients in an effort to protect themselves from potential conflicts, which negatively affects the quality of care. In some cases, physicians even consider leaving their jobs (18). Employers should provide support such as psychological counseling, but according to the survey, not a single doctor was offered counseling after an incident. Workplace violence has many causes, so there is no simple solution. The role of the employer is important in reducing the risk of abuse and improving the handling of violent incidents. The employer should inform doctors about standard procedures for reporting violence, but most respondents obtained this information on their own. The employer must take action against the perpetrators, but most respondents stated that this was not done. This lack of standard procedures discourages victims and encourages abuse (9). Many hospitals do not have procedures to prevent violence, making the safety of doctors a lower priority. This is confirmed by survey data where most respondents expressed dissatisfaction with how any incident was resolved, as in most cases, there were no consequences for the attacker. Doctors who decided not to report the incident mostly did not report it because they considered it useless, feared negative consequences, or did not know whom to contact. This correlates with the data from 2016, where as many as 72% of physicians who experienced some form of violence did not file an official report for the same reasons (18). The employer must ensure an environment where employees feel safe to report violence, as fear of reporting increases the risk of errors, results in poorer care, and decreases individual performance, teamwork, and communication (23, 24). Mobbing is common amongst the physicians, particularly directed towards younger residents by their older colleagues, and this behavior is often normalized, leading to underreporting (1). Underreporting poses challenges in identifying and addressing violence and hinders research efforts on the topic (25). Physicians often downplay violence, considering it part of the job, especially those who work with psychiatric patients, despite the psychiatrists being the most often exposed to workplace violence (26, 11).

Although most respondents mention the presence of security measures such as alarms and phones, some emphasize that their workplaces lack adequate protective measures. This can leave physicians feeling unprotected. Respondents believe that increasing the number of staff would reduce the workload and improve individual patient care. However, the majority state that no changes have occurred in their workplaces, and in fact, the number of staff has decreased and resources have been limited. Most respondents react to violence by asking the perpetrator to stop, confiding in loved ones, or not reacting at all. It is possible that for this reason, most respondents suggest that useful measures would include training for medical staff to alert and prepare them for workplace violence, familiarizing them with useful coping strategies and communication skills. Skills used to calm situations and patient tension can be both verbal and non-verbal, aimed at building trust with the patient and mitigating violent actions (27, 28). Investing in communities that aid addicts can also reduce the risk of violence (5, 6). Protecting healthcare workers also requires engagement from governmental bodies, as seen in Italy where monetary fines and imprisonment are introduced for violence against healthcare workers, while India imposes prison sentences of up to seven years, especially for incidents related to COVID-19 patients (15, 17). In Croatia, a physician does not have the status of a public official, and therefore violence against a physician is not prosecuted as such under criminal law. It wasn't until January 2019 that a new criminal offense called "Coercion against a healthcare worker" was

introduced into the Croatian Penal Code. This offense criminalizes the behavior of perpetrators who, by force or threat of immediate use of force, prevent a medical doctor, dental doctor, or other healthcare worker performing their duties as a public service from carrying out their healthcare activities. The penalty for this offense can be imprisonment of up to three years. In more severe cases, such as causing injury or endangering the life of the healthcare worker, the sentence can be up to five years of imprisonment (29). The Croatian Medical Chamber records all cases of violence against physicians to monitor its frequency and provide legal assistance. Physicians can report attacks or violence in writing, either by mail or email, to the Croatian Medical Chamber (30).

Conclusion

Based on the conducted research and the obtained results, we can conclude that physicians at the Clinical Hospital Center Osijek are exposed to violence during working hours, with verbal violence being the most frequently experienced, followed by workplace bullying (mobbing), physical, and sexual abuse. There are no significant differences in the distribution of respondents based on exposure to any form of violence concerning gender, age, or whether they are residents or specialists. Physicians at the Clinical Hospital Center Osijek are moderately concerned about any form of violence in the workplace, with only 37.6% of physicians being familiar with how to initiate the violence reporting process. Physicians consider increasing the number of staff to be the most useful security measure. This study acknowledges the limitation of its small sample size, which restricts the generalizability of the findings. Due to the low statistical power, the results should be interpreted with caution. Further research with larger sample sizes is necessary to validate these preliminary findings. Additionally, the study may not have had sufficient power to detect statistically significant effects, indicating the need for more robust studies to confirm the observed trends. Furthermore, the lack of recent national data on the topic limits the contextualization of our findings.

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Conception and design: MM, APE
Critical revision of the article for important intellectual content: MM, APE
Drafting of the article: MM, APE
Final approval of the article: MM, APE
Guarantor of the study: MM, APE
Provision of study materials or patients: MM, APE
Statistical expertise: MM, APE

Izloženost liječnika nasilju na radnom mjestu

Sažetak

Cilj: Glavni je cilj istraživanja bio odrediti jesu li liječnici Kliničkog bolničkog centra Osijek izloženi nasilju na radnome mjestu, kojem obliku nasilja, postoje li razlike u izloženosti između liječnika prema dobi, spolu te ovisno o tome jesu li specijalist ili specijalizant.

Ispitanici i metode: Istraživanje je ustrojeno kao presječno istraživanje. U istraživanju je sudjelovao 101 liječnik zaposlen u KBC-u Osijek. Podaci su prikupljeni rješavanjem anonimnog online upitnika.

Rezultati: Većina ispitanika koji su bili izloženi nasilju na radnome mjestu je označilo da su doživjeli verbalno zlostavljanje (41,6 %), zatim zlostavljanje na radnome mjestu (mobbing) (21,8 %), fizičko (5 %) pa spolno zlostavljanje (3 %).

Zaključak: Zbog malog uzorka studije nema značajne razlike u raspodjeli ispitanika prema izloženosti bilo kojem obliku nasilja u odnosu na spol, dob ili po tome jesu li specijalizanti ili specijalisti.

Original article

Attitudes and Activities of Primary and Secondary School Pupils and Medical Students in Relation to Social Networks, Sport, Friends and the Use of Mobile Phones

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Abstract

Aim of the study: The aim of the work is to find out what primary and secondary school pupils and medical students think and talk about most often, how they use mobile phones and social networks, and to identify possible interventions that could promote socialising with friends and sporting activities.

Methods. The attitudes and behaviours of primary school pupils (N = 51), high school pupils (N = 69), and medical students (N = 108) were compared using a questionnaire on the frequency of activities during the long breaks between lectures. Answers were provided on a 1 to 5 Likert scale.

Results. The topic most frequently discussed by all respondents was school (median 4 [IQR 3-5], P = 0.77), while primary school students most frequently discussed and thought about sport (3 [2-4]). High school pupils and medical students discuss and think about food (4[3-4]) and love (4[3-4]) as well. Primary school pupils rarely use social networks (1[1-2]), while high school pupils and medical students use them frequently (4[3-5]) and often search in the networks (4[3-5]) (P<0.001 between primary school pupils and older pupils and students). All respondents believe they should spend more time with friends in person (5[4-5] for all, P = 0.485, ns).

Conclusion. Primary school children have the greatest interest in sport and it is at this age that systematic educational programmes should be implemented to encourage participation in sport. Older respondents are more likely to think about having fun. Leisure activities can be a more effective motivator to stimulate their interest in sport and build personal bonds.

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KEYWORDS: education; leisure activities; exercise; friends; mobile phone use

Introduction

The long break in schools and the break between lectures at universities are traditionally served to establish personal contacts between pupils and students, make new acquaintances, and exchange information about the educational institution they attend. During these breaks, conversations are held not only about lessons but also about current social and personal issues. With the development of digital technologies and the increasing popularity of social networks, the way people spend their free time during school and study breaks has undergone significant changes. On the one hand, social networks enable faster and more comprehensive communication, and facilitate contact with peers. On the other hand, they reduce the time spent on direct, personal interaction. Instead of talking to friends, people are increasingly surfing the internet, playing video games, or shopping online (1).

Leisure is a time of active rest, entertainment, positive development, socialization, humanization and creative affirmation of personality. Its essential characteristics are freedom, voluntariness, creativity, individuality, amateurism, self-realisation, self-activity (1).

Long breaks in primary and secondary education, as well as breaks between lectures for students, play a crucial role in the physical, social, and academic development of students. They are not only an opportunity for a short break from school obligations but also an important part of the learning process, socialization, and maintaining mental health.

In primary and high schools, long breaks have several functions. They allow children and adolescents to engage in physical activity, which is essential for their health and the development of motor skills. Exercise during breaks helps reduce to stress, improves concentration, and has a positive effect on further learning after the break. In addition, a long break provides the opportunity to socialize and build social relationships, which in turn contributes to the development of communication skills and emotional intelligence. Although technology is increasingly becoming an integral part of students' lives, it is recommended to encourage activities that involve direct interaction with peers, rather than relying exclusively on digital content. Free time is a part of everyone's life that exists every day and in every environment and is used for rest, entertainment, acquiring new knowledge and experiences, and cultural enrichment. It differs according to age, gender, occupation, place of residence, level of development of the environment, interests, goals of the social order, and its possibilities. (2)

For students, the breaks between lectures have a similar function, but also additional academic and professional aspects. They enable reflection on the acquired material, preparation for upcoming teaching activities, and organization of obligations. Breaks are also an opportunity for informal networking with colleagues, exchange of ideas, and development of professional contacts. In addition, breaks between lectures help to reduce cognitive fatigue and improve the ability to absorb new information.

In the modern digital age, both pupils and students are increasingly using breaks to browse social networks, play games, or shop online. Although technology can facilitate communication and information sharing, excessive digital engagement can diminish the quality of direct social interaction. Therefore, it is essential to strike a balance between the use of digital tools and direct communication, ensuring that long breaks and breaks serve their primary purpose: physical and mental rest, regeneration, and quality socialization.

Activities during the long break for students should be organized in advance. In this way, playing computer games, the possibility of straying into socially unacceptable forms of behavior and other unwanted passive activities that inadequately affect their physical health may be avoided. Education and training are powerful factors in the process in which society's "desirability" influences the development of individual "desirability"(2). Accordingly, the decisive factors in children's development are the educational environment and the quality of education in individual

activities. Therefore, the main role in organizing and implementing activities during the long break for students is played by teachers and the school (3).

The activities that students engage in during breaks between lessons have a significant impact on their physical and mental wellbeing, academic performance, and social skills. Free time provides an opportunity to rest, recharge, and improve concentration, but the way it is used can vary depending on individual preferences and the environment. The way in which breaks are used significantly impacts productivity and overall wellbeing. Encouraging physical and social activity during breaks can contribute to better concentration, reduced fatigue, and improved quality of learning, while excessive use of digital devices can reduce face - to - face social interactions and physical activity (4).

Since a sedentary lifestyle represents one of the challenges of modern society, education systems have a responsibility to promote healthy exercise habits and physical activity, especially during leisure time, as a source of positive emotions and general wellbeing. A study of students' activities during long school breaks and breaks between lectures is useful for several reasons:

Changes in leisure activities – Traditionally, long breaks were used for social interaction, physical activity and relaxation. With the development of digital technologies, personal communication is often replaced by virtual interactions, which can have various effects on the social skills, emotional state and physical health.

Effect of a sedentary lifestyle – Increased screen use and reduced movement lead to an increase in problems such as obesity, poor posture and reduced physical fitness. Analysis activity during school and study breaks can provide insight into how active young people are and whether there is a need to promote physical activity.

Developing social skills and interpersonal relationships – Breaks between lessons are an opportunity to make friends and develop communication skills. As time is increasingly spent online, there is a need to explore how this impacts the quality of peer relationships and whether activities that support direct interaction can be encouraged.

Impact on academic performance and mental health – Breaks between lessons play an important role in rest and regeneration of cognitive abilities. Activities such as physical activity, chatting with friends, or simply taking a break can have a positive effect on concentration and motivation to continue working, while excessive screen use can have the opposite effect.

The opportunity to shape educational policies and school programs – Understanding how students use their free time during the school day can help make decisions about structuring breaks, introducing organized activities, or limiting screen time.

This study aims to analyse how primary and secondary school pupils and medical students, use their time during long breaks and breaks between lectures. The aim is to analyze their habits, determine how they perceive themselves online, and assess the extent to which social networks are integrated into their leisure time. The aim is to analyse how much physical activity is carried out during these breaks and whether there is a need for greater promotion of exercise and sport. Researching this phenomenon can provide valuable data that can help primary and high school leaders to create a more supportive environment for students, and promote a balance between the digital world, social interactions, and physical activity (5).

Methods

Before the study commenced, informed consent was obtained from the parents of primary school children at Šećerana Primary School, Beli Manastir (Supplementary file 1). The consent of the Chairperson of the Šećerana Primary School, Beli Manastir, Technical School and Science High School Ruđer Boškovića Osijek was obtained. The Ethics Committee of the Medical Faculty Osijek granted permission

for the preparation of the scientific paper for the study on March 19, 2025, No 602-04/25-08/07 (UR. No. 2158-61-46-25-66) approved by chairperson Prof. Suzana Mimica, MD.

The subjects were pupils from grades 5 to 8 of the Šećerana Primary School, high school graduates of the Ruđer Bošković High School, and students of the Faculty of Medicine of the University of J.J. Strossmayer in Osijek. Therefore, a sample of students was selected to examine the difference between students, high school and primary school pupils. The study included 51 primary school children, 69 secondary school pupils and 108 students.

A printed questionnaire was used for primary school pupils, and the same online questionnaire was used for high school pupils and medical students. Secondary school pupils and medical students accessed the questionnaire online, via their mobile phones. The answers were given on a Likert scale from 1 never to 5 always, which was analysed as an ordinal scale. The study was conducted during the academic year 2024/25. Statistical analysis was performed using the analysis of variance (Kruskal-Wallis test) (6) using IBM SPSS 20.0 Statistics for Windows, manufactured by IBM, USA. A p-value of less than 0.05 was considered statistically significant Significance values for intergroup comparisons have been adjusted by the Bonferroni correction.

Results

A total of 228 respondents completed the questionnaire. Of these, 51 were primary school children (27 male, 24 female), 69 were secondary school pupils (10 male, 59 female), and 108 were students of the Faculty of Medicine (38 male, 70 female). Among primary school pupils, the majority were boys (53%), whereas girls comprised most of the secondary school population (85%) and students (65%) (P < 0.001).

The responses to the questions about what they discuss during the long break or between lectures are shown in Table 1. Statistically significant differences were observed between groups in the frequency of conversations about sports, music, love, books, and travel (Table 1).

Table 1. Responses to questions about how often they discuss certain topics during the long break or break between lectures.

Conversations during the long break / between lectures about	Primary: high school, *P*ǂ	Primary vs. students, *P*ǂ	High school: students, *P*ǂ	*P*
Sport(s)	3[2-4]: 2[2-3], 0.976ǂ	3[2-4]: 2[2-3], 0.012ǂ	2[2-3]: 2[2-3], 0.286ǂ	**0.012**
Music	2 [1-3]: 3[2-3], 0.120ǂ	2 [1-3]: 3[2-3], 0.120ǂ	3[2-3]: 3[2-3], 0.603	**0.014**
Food	2.5 [2-3]: 4[3-4], 0.000ǂ	2.5 [2-3]: 4[3-4], 0.000ǂ	4[3-4]: 4[3-4], 1.000	**0.000**
Films	3 [1-3]: 3[2-3]*	3 [1-3]: 3[2-3]*	3 [2-3]: 3[2-3]*	0.634
Love	2[1-4]: 4[3-4], 0.000ǂ	2[1-4]: 4[3-4], 0.559ǂ	4[3-4]: 3[2-3.5], 0.002	**0.000**
School	4[3-5]: 4[3-5]*	4[3-5]: 4[3-5]*	4[3-5]: 4[3-5]*	0.772
Books, school reading	3[2-4]: 3[2-3], 1.000ǂ	3[2-4]: 1[1-2], 0.000ǂ	3[2-3]: 1[1-2], 0.000ǂ	**0.000**
Travels	2[1-3]: 3[2-3], 0.071ǂ	2[1-3]: 3[3-4], 0.000ǂ	3[2-3]:3[3-4], 0.163ǂ	**0.000**

Differences between groups were analyzed using the Mann-Whitney test for independent samples. ǂSignificance values for intergroup comparisons have been adjusted by the Bonferroni correction. *Multiple comparisons are not performed because the overall test does not show significant differences across groups. Statistically significant differences are in bold.

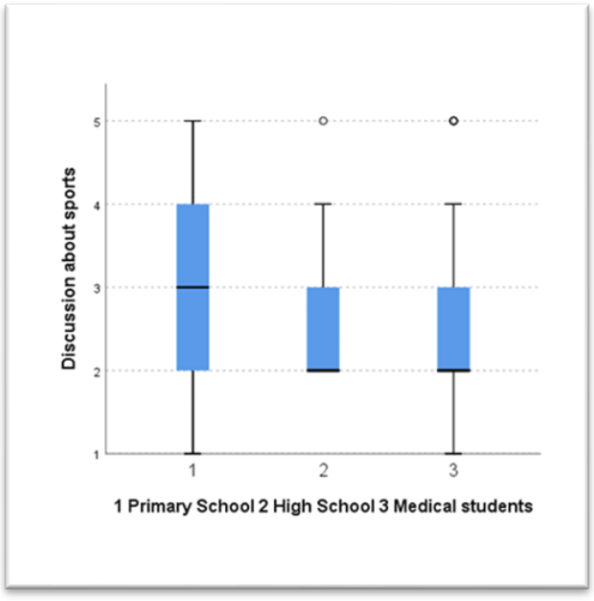

Figure 1. Frequency of conversations about sports as reported by primary school, high school and medical students. Boxes represent medians and interquartile ranges.

Primary school children reported talking about sports the most compared to their older peers. There were significant differences between groups with a median of 3[2-4] for primary school children, 2[2-3] for high school children, and 2 [2-3] for medical students, respectively (P=0.012) (Figure 1).

The responses to the questions about what they think about during the long break / between lectures are shown in Table 2. Responseds from all groups did not differ in their thoughts about school or college, while statistically significant differences in the frequency of responses were recorded for other questions. The most significant statistical difference in responses was observed in the question about thinking about sports, where primary school children reported thinking about sports significantly more often than high school pupils and medical students. In contrast, high school pupils and medical students think significantly more about social networks and love than primary school children (Table 2).

Table 2. Statements about the topics discussed during the long break or breaks in between lectures.

Thoughts during the big break / between classes	Primary: high school	Primary vs. students	High school : students*	*P*
Sport(s)	3[2-4]: 1[1-2]	3[2-4]: 2[1-3]	1[1-2]: 2[1-3]	**0.000**
	0.000	0.000	0.239	
Music	2[1-4]: 2[1-3]*	2[1-4]: 3[2-3]*	2[1-3]: 3[2-3]*	0.132
Films	2[1-3]: 2[1-3]	2[1-3]: 2.5[2-3]	2[1-3]: 2.5[2-3]	**0.020**
	0.348	1.000	0.016	
Love	2[1-3]: 3[2-4]	2[1-3]: 3[2-4]	3[2-4]: 3[2-4]	**0.009**
	0.017	0.018	1.000	
School /Medical faculty	3 [3-4]: 3 [2-4]*	3[3-4]: 3.5 [3-4]*	3[2-4]: 3.5 [3-4]*	0.240
Travels	2[1-3]: 3[2-4]	2[1-3]: 3[2-4]	3[2-4]: 3[2-4]	**0.002**
	0.444	0.002	0.126	
Pets	2[1-3]: 3[2-4]*	2[1-3]: 2[1-4]*	3[2-4]: 2[1-4]*	0.057
Social networks	2[2-3]: 3[2-4]	2[2-3]: 3[2-4]	3[2-4]: 3[2-4]	**0.001**
	0.000	0.015	0.413	

The answers are presented on a Likert scale from 1 to 5, where 1 represents the answer "never" and 5 "always". Differences between groups were analyzed using the Mann-Whitney test for independent samples. ǂSignificance values for intergroup comparisons have been adjusted by the Bonferroni correction. *Multiple comparisons are not performed because the overall test does not show significant differences across groups. Statistically significant differences are in bold.

The activities for which pupils and students use mobile phones during breaks at school are shown in Table 3. Differences were noted in the frequency of all activities examined, except for posting content on social media (Table 3).

Table 3. Responses about the types of activities they do using their mobile phones during breaks between lectures.

Cell phone use during the big break / between classes	Primary : high school*	Primary vs. students*	High school : students*	Difference all
Mobile phone search	1[1-2]: 4[3-5] 0.000	1[1-2]: 4[3-5] 0.000	4[3-5]: 4[3-5], 0.573	**>0.001**
Using social networks	1[1-2]: 4[3-5] 0.000	1[1-2]: 4[3-5] 0.000	4[3-5]: 4[3-5] 0.833	**>0.001**
- for relaxation	1[1-1]: 3[2-4] 0.000	1[1-1]: 4[3-4.25] 0.000	3[2-4]: 3[2-4] 0.204	**>0.001**
-to keep up with the news	1[1-3]: 3[2-4] 0.000	1[1-1]: 4[3-4] 0.000	3[2-4] : 4[3-4] 0.068	**>0.001**
- to stay connected with friends	1[1-3]: 4 [3-5] 0.000	1[1-3]: 4 [3-5] 0.000	4 [3-5]: 4 [3-5] 0.503	**>0.001**
-for fun	1[1-3]: 4 [3-5] 0.000	1[1-3]: 4 [3-5] 0.000	4 [3-5]: 4 [3-5] 1.000	**>0.001**
- Look at friends' posts on social media	1[1-2]: 3[2-4] 0.000	1[1-2]: 3[2-4] 0.000	3[2-4] : 3[2-4] 0.436	**>0.001**
- watch videos on social media	1[1-1]: 3[2-4] 0.000	1[1-1]: 3[2-4] 0.000	3[2-4]: 3[2-4] 1.000	**>0.001**
- post on social networks	1[1-1]: 1[1-2]*	1[1-1]: 1[1-2]*	1[1-1]: 1[1-2] *	0.154
- Comment and send messages to friends.	1[1-2.5]: 3[3-5] 0.000	1[1-2.5]: 4[3-5] 0.000	3[3-5]: 4[3-5] 0.209	**0.000**
- playing games	1[1-1.5]: 2[1-3] 0.012	1[1-1.5]: 2[1-3] 0.024	2[1-3] : 2[1-3] 1.000	**0.008**

The answers are presented on a Likert scale from 1 to 5, where 1 represents the answer "never" and 5 "always". Differences between groups were analyzed using the Mann-Whitney test for independent samples. ǂSignificance values for intergroup comparisons have been adjusted by the Bonferroni correction. *Multiple comparisons are not performed because the overall test does not show significant differences across groups. Statistically significant differences are in bold.

Table 4. Responses on the impact of social media on their lives and their desires related to the listed activities.

	Primary : high school*	Primary vs. students*	High school : students*	Difference all
Social media affect my real-life socialization	2[1-3]: 2[1-3]*	2[1-3]: 2[1-3]*	2[1-3]: 2[1-3]*	0.965
I want to play games more	3 [2-5]: 1 [1-3]. 0.000	3 [2-5]: 3 [2-3.5] 0.000	1 [1-3]: 3 [2-3.5] 0.032	**0.000**
I want to join the workshops	3 [2-4]: 1 [1-3]. 0.000	3 [2-4]: 1 [1-3]. 0.023	1 [1-3]: 2 [2-3]. 0.007	**0.000**
I want to read books more	3 [2-4]: 1 [1-2] 0.000	3 [2-4]: 2 [1-3] 0.164	1 [1-2]: 2 [1-3] 0.000	**0.000**
I want to use cell phone more	2 [1.5-3.5]: 4 [3-5] =.000	2 [1.5-3.5]: 3 [2-4] 0.132	4 [3-5]: 3 [2-4] 0.020	**0.000**

The answers are presented on a Likert scale from 1 to 5, where 1 represents the answer "never" and 5 represents "always". Differences between groups were analyzed using the Mann-Whitney test for independent samples. ǂSignificance values for intergroup comparisons have been adjusted by the Bonferroni correction. *Multiple comparisons are not performed because the overall test does not show significant differences across groups. Statistically significant differences are in bold.

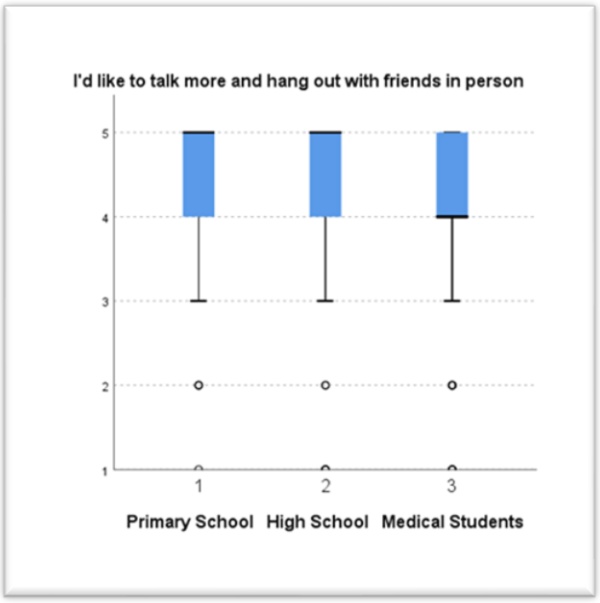

Figure 2. Students' responses to the question of whether they would like to talk and hang out with friends more in person. The answers are presented on a Likert scale, ranging from 1 to 5, where 1 represents "never" and 5 represents "always".

All groups reported that they rarely felt social media affected their in-person communication with friends (Table 4).

They also responded in all groups that they would like to communicate with friends in person more (5[4-5] in all groups, P=0.485) (Figure 2). There were no differences between the groups regarding these responses (Table 4).

Discussion

In this study, significant differences were found between primary school pupils, secondary school pupils and university students in terms of leisure activities and thinking about activities during the long break. We confirmed that primary school students think significantly more about sport than secondary school pupils and university students. Although all respondents think that they should spend more time with friends, older groups use their mobile phones and communicate via social networks most often in their free time.

Although it is expected that schoolchildren and students spend more time in front of screens and on social networks when they are at home, our study confirmed that they also spend a a lot of time on their mobile phones at school. Results on the high frequency of using video games and spending time in front of various screens were also obtained by the authors Balantoni et al. (5). In their paper, they confirmed that the longest time spent in front of a screen is on weekends, with a median of 3.7 ± 2 hours on weekends (5).

The authors Baldwin and colleagues identified the possibilities of influencing the use of free time based on the personal characteristics of students. Students who are withdrawn, peer influenced, and unmotivated are expected to have poorer intervention outcomes and are more likely to engage in unacceptable behaviours such as drug and other substance use. Additionally, secondary school students are encouraged to consider the impact of organizing their free time on their own wellbeing (7).

Activities related to leisure, sports, and recreation can be successfully carried out in the school as a center of socialization and a methodical and systematic education. According to the author, the officially adopted ways of behaving and creating free time for primary school pupils have better success if principals support them (8).

Health reasons, including the increased incidence of myopia with increased screen use, could also be a reason to motivate students to improve personal communication, reduce screen time, and engage in sports activities (9).

A statistically significant result of this study is that all respondents believe that mobile devices do not affect their communication. On the contrary, all of them equally believe and want to socialize more with their peers. This is the answer with the highest response strength (median 5). The solution offered could be sports, games, folk dances, board games, and quizzes.

Primary school children are the only ones of the three groups surveyed who talk and think about sports. They are the only group for whom active interventions could bring lasting success, in a way that enables them to maintain their attitudes. Their orientation to selected sports activities should be encouraged as early as possible during primary school. Schools have a key role in inspiring students, parents, and the entire community to support youth, healthy activities and social connections. Schools directly encourage students to participate in sports, improve physical fitness, strengthen self-confidence and develop social skills. In this sense, schools should offer children and introduce them to sports that would best suit their desires and abilities. This education already exists in the curriculum of physical education and health education. In this sense, it would be desirable to go beyond the framework of the curriculum provided so far and offer children presentations of sports that are not provided for in it. This would be possible in physical education classes in high school and at university.

A disadvantage of this study is the relatively small number of respondents and the potential unrepresentativeness of the sample. The population of rural schoolchildren may not share the same habits as their urban counterparts. Furthermore, since the questionnaire covered a wider range of topics, it was not focused on any one particular topic. It would also be useful to see what the teachers of the same students think about the same issues and how they see the possibility of influencing the free time of school children. These are questions to which future targeted studies can provide better answers.

The motivation that schools can enable to encourage activities are e.g. running, concerts, quizzes, and education on sports and healthy lifestyles. For older groups, such as students who will soon enter the workforce, the motivation may be to appear attractive and secure employment more easily (10). This can be achieved by being well and preventing or treating obesity, which has become a global pandemic. Promoting physical activity and healthy living may also contribute to the reduction of insurance premiums for the working population that prioritizes their health (11, 12).

Conclusion. This study has confirmed that there are significant differences in the self-assessment of leisure time between primary school and university students. We expect that the research results will enable interventions in the behavioural patterns of young people in the context of modern digital technologies. Based on these findings, recommendations can be made to improve school policies and educational programmes that promote a balanced approach to the use of social networks, the development of social skills and participation in sports activities.

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Provision of study materials or patients: SKG, AP, SK
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Stavovi i aktivnosti učenika osnovne i srednje škole i studenata medicine u odnosu na društvene mreže,sport, prijatelje i upotrebu mobilnih telefona

Sažetak

Cilj istraživanja: Cilj rada je ispitati o kojim temama najčešće razmišljaju i razgovaraju učenici osnovnih i srednjih škola te studenti, kako koriste mobitele i društvene mreže, i identificirati moguće intervencije koje bi mogle potaknuti druženje s prijateljima i bavljenje sportskim aktivnostima.

Metode: Stavovi i ponašanja učenika osnovne škole (N = 51), srednje škole (N = 69) i studenata medicine (N = 108) uspoređeni su pomoću upitnika o učestalosti aktivnosti tijekom velikih odmora između predavanja. Odgovori su davani na Likertovoj ljestvici od 1 do 5.

Rezultati: Najčešća tema o kojoj svi ispitanici razgovaraju je škola (medijan 4 [IQR 3–5], P = 0,77), dok učenici osnovne škole najviše razgovaraju i razmišljaju o sportu (3 [2–4]). Učenici srednjih škola i studenti medicine također često razgovaraju i razmišljaju o hrani (4 [3–4]) i ljubavi (4 [3–4]). Učenici osnovne škole rijetko koriste društvene mreže (1 [1–2]), dok ih učenici srednjih škola i studenti medicine koriste učestalo (4 [3–5]) i često pretražuju sadržaje na mrežama (4 [3–5]) (P < 0,001 između osnovnoškolaca i starijih ispitanika). Svi ispitanici smatraju da bi trebali više vremena provoditi s prijateljima uživo (5 [4–5] za sve, P = 0,485, nije značajno).

Zaključak: Učenici osnovne škole pokazuju najveći interes za sport, stoga bi u toj dobi trebalo provoditi sustavne edukativne aktivnosti usmjerene na poticanje bavljenja sportom. Stariji ispitanici skloniji su razmišljanju o zabavi. Slobodne aktivnosti mogu biti učinkovitiji motivator za njihovo uključivanje u sport i razvijanje osobnih odnosa.