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ADVANTAGES OF SPINAL ANESTHESIA IN ORTHOPEDIC SURGERY

PREDNOSTI SPINALNE ANESTEZIJE U ORTOPEDSKOJ HIRURGIJI

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Summary

Introduction. Spinal anesthesia is one of the oldest and most commonly used regional anesthesia techniques. It is based on the injection of a local anesthetic into the subarachnoid space, during which there is a transient interruption of impulse conduction in the spinal nerve roots. **Application of spinal anesthesia.** The use of spinal anesthesia depends on the following factors: the site of the surgical procedure, the type and duration of the surgical procedure, the degree of necessary surgical relaxation, and presence of accompanying diseases. **Local anesthetics used in spinal anesthesia.** There are two types local anesthetics used in spinal anesthesia. These are local anesthetics of the ester and amide type. Most frequently applied local anesthetics are those of the amide type. **Orthopedic procedures under spinal anesthesia.** The most common surgical procedures in orthopedic surgery performed under spinal anesthesia are hip, knee and ankle surgeries. **Complications of spinal anesthesia.** The most common complications of spinal anesthesia are hypotension, bradycardia, urinary retention, and postpuncture headache. **Conclusion.** The advantages of spinal over general anesthesia in orthopedic surgery include lower incidence of respiratory and myocardial depression, better peripheral tissue perfusion, minimal coagulation system disorders and prolonged postoperative analgesia. **Key words:** Anesthesia, Spinal; Anesthetics, Local; Orthopedic Procedures; Arthroscopy; Intraoperative Complications; Classification

Sažetak

Uvod. Spinalna anestezija je jedna od najstarijih i najprimenljivih tehnika regionalne anestezije. Zasnovana je na ubrizgavanju lokalnog anestetika u subarahnoidalni prostor pri čemu dolazi do tranzitornog prekida sprovođenja impulsa u spinalnim nervnim korenovima. **Primena spinalne anestezije** zavisi od sledećih faktora: mesta hiruškog zahvata, vrste i dužine trajanja operativnog zahvata, stepena potrebne hiruške relaksacije i propratnih oboljenja bolesnika. **Lokalni anestetici koji se koriste u spinalnoj anesteziji.** Postoje dve vrste lokalnih anestetika koji se koriste u spinalnoj anesteziji. To su lokalni anestetici esterskog i amidnog tipa. Najčešće se primenjuju lokalni anestetici amidnog tipa. **Operacije u ortopediji koje se izvode u spinalnoj anesteziji.** Najčešći operativni zahvati u ortopedskoj hirurgiji koji se izvode u spinalnoj anesteziji su operacije kuka, kolena i skočnog zgloba. **Komplikacije spinalne anestezije.** Najčešćije komplikacije spinalne anestezije su: hipotenzija, bradikardija, retencija urina i postpunkciona glavobolja. **Zaključak.** Prednosti spinalne nad opštom anestezijom u ortopedskoj hirurgiji su: manja učestalost respiratorne i miokardne depresije, bolja periferna tkivna perfuzija, minimalni poremećaji koagulacionog sistema i prolongirana postoperativna analgezija. **Glavne reči:** spinalna anestezija; lokalni anestetici; ortopedske procedure; artroskopija; intraoperativne komplikacije; klasifikacija

Introduction

Orthopedic surgery is a great challenge for anesthesiologists in the context of the patient's general condition, type of surgical procedure, and the patient's position during surgery [1]. Orthopedic surgery includes surgical procedures on the bone and joint system and soft tissues of the extremities. Elderly people make up the largest number of patients who need orthopedic surgery and the majority of them have chronic diseases. Regarding the accompanying diseases in the elderly patients, when choosing the type of anesthesia in orthopedic surgery, anesthesiologists must take into

account the overall patient's condition, not only the part that is significant for surgery. Preoperative assessment and preparation is one of the most important steps in the perioperative process and optimization. Geriatric patients who undergo orthopedic surgery are a high-risk group of patients. As for the high-risk patients, the following factors contribute a lot: accompanying diseases, limited functional capacity, postoperative systemic inflammatory response, massive blood loss, and post-operative pain [1, 2]. Orthopedic surgeries may be performed under general anesthesia, neuraxial block (spinal anesthesia), peripheral or central blocks. The choice of anesthesia depends on chronic diseases, pre-

Abbreviations

SPA – spinal anesthesia

ASA – American Society of Anesthesiologists

vious anesthesiological complications, and potential hemodynamic and respiratory problems [2].

Spinal anesthesia: mechanism of action and performance approaches

Spinal anesthesia (neuraxial block) is one of the oldest and most commonly used techniques of regional anesthesia. In the last decade, it became widely used due to good intraoperative and postoperative analgesia as well as faster postoperative recovery of patients [3]. It is based on the injection of a local anesthetic into the subarachnoid space, during which there is a transient interruption of impulse conduction in the spinal nerve roots [4].

The primary sites of action of local anesthetics are the dorsal root ganglia, ventral of spinal nerves, autonomic nerve fibers, and mixed nerve trunk [5]. Distribution and effects of anesthesia are controlled in short time intervals, from two to five minutes. The beginning of the spinal anesthesia is associated with a feeling of warmth in the feet. The motor function is completely blocked at the site of greatest concentration of the local anesthetic. The sensory blockade is usually two to four segments higher, sympathetic blockade involves two to four more segments in cranial position. The most frequent approach for spinal anesthesia is medical approach, whereas the alternative approaches are paramedial and Taylor's approach [6] (Figure 1).

Types of local anesthetics

There are two types of local anesthetics that are used in spinal anesthesia (SPA). These are local anesthetics of the ester and amide type. The most frequently applied local anesthetics are those of the amide type. The most important local anesthetics for hypobaric and isobaric SPA are: 0.5% bupivacaine, 0.5% ropivacaine - local anesthetics that have long-term impact. The group of mid-acting local anesthetics include: 2 - 4% mepivacaine or 2% prilocaine or 2 - 5% lidocaine. Hyperbaric SPA is based on adding glucose (5 - 10%) to the local anesthetic by using the method of baricity in liquor and by adjusting the position of the patient in order to determine the level of anesthesia. In isobaric SPA, the

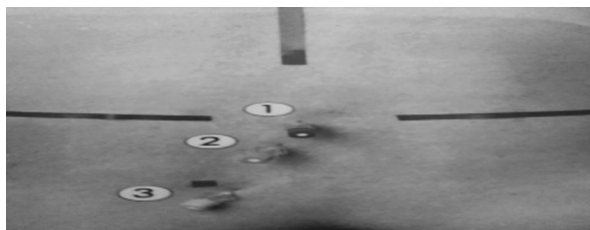


Figure 1. 1) Medial 2) Paramedial 3) Taylor's approach [2]
Slika 1. 1) Medijalni 2) Paramedijalni 3) Tejlorov pristup [2]

patient's position has no significant impact onto the anesthesia distribution. By slow injection, the local anesthetic remains at the site of injection, whereas by faster injection or barbotage, a higher level of anesthesia is achieved. In the United States and England, local anesthetics of the ester group (0.5 - 1% tetracaine) are most frequently used for single blockades.

Unilateral SPA is used in orthopedic surgical procedures on lower extremities, so the front and back nerves are blocked only on the side that is being operated. Spinal nerves on the other side are not blocked. This is especially significant for smaller blockade of sympathetic nervous system and smaller risk from arterial hypotension. Advantages of unilateral anesthesia are hemodynamic stability, quick recovery from anesthesia, convenience for outpatient surgery, and better patient compliance. Application of SPA depends on the following factors: the setting of the surgical procedure, type and duration of surgical procedure, degree of the necessary surgical relaxation, and presence of comorbidities. Advantages of SPA are: lower incidence of respiratory and myocardial depression, better peripheral tissue perfusion due to sympathetic block, less intraoperative bleeding, and minimal disorders of coagulation system [6, 7] (Table 1).

Significance and indications for SPA in orthopedic patients include:

- Patients with a full stomach
- Difficult intubation
- Medical history data of malignant hyperthermia
- Muscle diseases
- Cardiopulmonary diseases
- Metabolic diseases
- Hepatorenal diseases
- High spinal cord injury.

Positive aspects of SPA include technical simplicity, quick effect, good quality, and no systemic toxic-

Table 1. Advantages and disadvantages of local anesthetics used in orthopedic surgery
Tabela 1. Prednosti i nedostaci lokalnih anestetika koji se koriste u ortopedskoj hirurgiji

Advantages/Prednosti		Disadvantages/Nedostaci
Bupivacaine Bupivakain	Faster motor block Brži nastanak motornog bloka	Worse hemodynamic stability with hypotension and bradycardia/Lošija hemodinamička stabilnost-nastanak hipotenzije, bradikardije
Levobupivacaine Levobupivakain	Lower toxicity, better hemodynamic stability Manja toksičnost, bolja hemodinamička stabilnost	Slower block onset Sporiji nastanak bloka
Marcaïn Heavy Marcaïn Heavy	Faster block onset Brži nastanak bloka	Worse hemodynamic stability, hypothesion, bradycardia/Lošija hemodinamička stabilnost, hipotenzija, bradikardija

Table 2. American Society of Anesthesiologists (ASA) classification**Tabela 2.** ASA klasifikacija - Klasifikacija Američkog anesteziološkog društva

ASA I – a healthy patient without organ disease with a localized pathological process
ASA I – zdrav bolesnik bez organskog oboljenja sa lokalizovanim patološkim procesom
ASA II – a patient with mild systemic disease without functional limitations
ASA II – bolesnik sa blagom sistemskom bolešću bez funkcionalnih ograničenja
ASA III – a patient with moderate to severe systemic disease causing functional limitations
ASA III – bolesnik sa umerenom do teškom sistemskom bolešću koja dovodi do funkcionalnih ograničenja
ASA IV – a patient with severe systemic disease which is a constant threat to life making life functions difficult
ASA IV – bolesnik sa teškom sistemskom bolešću koja ugrožava život i otežava životne funkcije
ASA V – a moribund patient with little possibility for survival with or without surgery
ASA V – moribundni bolesnik sa malom verovatnoćom za preživljavanje sa operacijom i bez nje

ity. In orthopedic surgery, SPA has a great significance due to good postoperative analgesia, increased intestinal motility, thromboembolism prophylaxis due to sympathetic blockades and advantages for surgery in outpatient clinics, and positive economic impact. Upon the surgical procedure performed under SPA, the following data are entered in the protocol and in the check-up list: general data on the patient, aim of the blockade, patient's position, applied local anesthetic, patient's opinion during the blockade, and complications if they occurred [7].

Orthopedic surgical procedures under spinal anesthesia

Hip, knee and ankle joint surgeries are the most frequent procedures in orthopedic surgery which are performed under SPA.

Arthroscopic surgery of the hip, knee, shoulder, ankle, and elbow is a procedure that is more and more performed in outpatient clinics. The final decision on patients that will undergo surgery at outpatient clinics and the type of anesthesia is brought by an anesthesiologist. According to the American Society of Anesthesiologists (ASA) patients are divided into five groups and those with comorbidities who belong to the ASA classification III/IV cannot be candidates for surgery in outpatient clinics (**Table 2**) [8, 9].

Arthroscopic knee surgery may be performed under SPA. In order to provide good surgical conditions and prevent postpuncture headache, it is necessary to use thin Quincke needles or pencil point needles. The SPA is suitable for performing ligament reconstruction surgery. Sports injuries are the most common causes of anterior cruciate ligament injury [10, 11].

Hip arthroplasty is performed in anterior and lateral position. Obese patients and patients with arthritis are a high-risk group and they need to be in lateral position. Patients in lateral position are inclined to obtain less oxygen, which results in altered ventilation-perfusion relation. There are controversial data regarding the origin of respiratory complications when it comes to anesthesia type [12].

Knee arthroplasty is the most common orthopedic procedure in the elderly population. The SPA has an advantage regarding the postoperative pain, respiratory and myocardial depression, and better peripheral

perfusion of tissues due to sympathetic block. Multimodal analgesia is applied in order to provide better postoperative pain control as well as early mobilization, but periarticular infiltration analgesia is also more and more frequent. The SPA is especially significant in patients with estimated difficult intubation [13].

Regarding the fact that in the scope of orthopedic surgery most patients are elderly, ASA III/IV patients with ischemic heart disease, with ejection fraction under < 40% and lung hypotension should undergo orthopedic surgery under general anesthesia [14, 15].

Complications of spinal anesthesia

Beside the positive aspects of SPA, complications that may occur are: complications during the blockades (vasovagal syncope), complications immediately upon injecting and during the phase of fixation of the local anesthetic (hypotension, high and total SPA), and complications in early postoperative period (urinary retention), complications in the late postoperative period (postdural puncture headache) and neurological complications [16]. Neurological complications are very rare; if there is any doubt regarding the neurological complication, it is necessary to consult the neurologist as soon as possible. Neurological complications are manifested as arachnoiditis, myelitis, spinal or epidural abscess, cauda equina syndrome, and anterior spinal artery syndrome [17].

Conclusion

Spinal anesthesia has a wide range of applications in orthopedic surgery. The advantages of this type of anesthesia include excellent muscle relaxation and postoperative analgesia, increased intestinal motility, prophylaxis of thromboembolism, convenience in outpatient surgery, and economic and reliable monitoring. The decision on the choice of anesthesia is made by anesthesiologists who take into account the patient's general condition based on the American Society of Anesthesiologists classification, including the patient's age and previous anesthesiological complications. Beside the advantages, the frequency of potential complications is also taken into consideration, as well as the absolute and relative contraindications.

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