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Anesthetic Management for Hip Arthroscopy: A Retrospective Study

Kalça Artroskopisinde Anestezi Yönetimi: Bir Retrospektif Çalışma

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ABSTRACT Objective: Hip arthroscopy is a minimally invasive procedure which is most recently introduced in the field of arthroscopic orthopedic surgery. The aim of this retrospective study was to share our five years' experience in the anesthetic management of these patients and discuss within the literature. **Material and Methods:** After obtaining hospital's ethic committee approval, retrospective data were collected from the electronic database, anesthesia records and medical files of patients who underwent unilateral hip arthroscopy between 2015 and 2020. **Results:** Two hundred six patients were included in the study. Mean age was 39.9±7.2 (16-70) years. Ninety four patients were female and one hundred twelve were male. All patients received general anesthesia. Mean operative time was 141.6±14.8 (65-240) minutes. Mean hospital discharge time was 27.1±9.3 (16-68) hours. One hundred twenty seven patients (61.6%) were discharged in an outpatient manner (<24 hours). Thirty six patients (17.4%) suffered from intractable pain that required opioids. Main anesthetic complications were postoperative shivering, nausea and vomiting. Nerve palsy was recorded in 12 patients (5.8%) due to the positioning, traction and compression injuries which resolved spontaneously in postoperative 8 weeks. **Conclusion**: Anesthetic considerations of hip arthroscopy include special attention to positioning in order to prevent traction and compression injuries, hypotensive anesthesia, fluid extravasation, hypothermia, shivering, and postoperative pain management.

Keywords: Anesthesia; arthroscopy; intraoperative complications; pain, postoperative

ÖZET Amaç: Kalça artroskopisi, artroskopik ortopedik cerrahiler arasında en son uygulamaya giren minimal invaziv bir işlemdir. Bu retrospektif çalışmanın amacı anestezi yönetimindeki 5 yıllık deneyimimizi paylaşmak ve literatür eşliğinde tartışmaktır. **Gereç ve Yöntemler:** Hastane etik kurul onamının alınmasını takiben, elektronik veri bankası, anestezi kayıtları ve hasta dosyaları taranarak 2015-2020 yılları arasında uygulanan planlı unilateral kalça artroskopilerine ait veri toplandı. **Bulgular:** Çalışmaya 206 hasta alındı. Ortalama yaş 39.9±7.2 (16-70) yıl idi. 94 hasta kadın ve 112 hasta erkekti. Tüm hastalara genel anestezi uygulanmıştı. Ortalama cerrahi süresi 141.6±14.8 (65-240) dakika ve ortalama hastane taburculuk süresi 27.1±9.3 (16-68) saatti. 127 hasta (%61.6) günübirlik cerrahi uygulamalarına uygun biçimde 24 saatten kısa sürede taburcu edillmişti. 36 hastada (%17.4) şiddetli ağrı nedeniyle opioid analjezik uygulanması gerekti. Anestezi komplikasyonları olarak en sık postoperatif titreme, bulantı ve kusma gözlendi. 12 hastada (%5,8) pozisyon, traksiyon ve bası hasarları nedeniyle sinir felci gözlendi. Bunlar 8 hafta içerisinde kendiliğinden düzeldi. **Sonuç:** Kalça artroskopilerindeki anestezi yönetimi traksiyon ve kompresyon hasarlarını önlemek için pozisyon verilmesine özellikle dikkat edilmesi, hipotansif anestezi gereksinimi, sıvı ekstravazasyonu, hipotermi, titreme ve postoperatif ağrı yönetimini içermektedir.

Anahtar Kelimeler: Anestezi; artroskopi; intraoperatif komplikasyonlar; ağrii postoperatif

Hip arthroscopy (HA) is the most recently introduced arthroscopic procedure in orthopedic surgery. Since the first description by Burman in cadaveric studies in 1931 and the use in clinical practice in 1970's, HA gained a worldwide popularity as well as in our country as a diagnostic and

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therapeutic tool in the management of hip pathology.[1] Indications for HA include a broad spectrum of pathologies related to the hip joint and can be classified as intra and extra-articular abnormalities. Among them, femoro-acetabular impingement (FAI), acetabular labral tears, and chondral injuries constitute majority of current indications. The advantages of HA over open surgery are rapid healing of the tissue, lower complication rate, and earlier discharge from the hospital.[2] HA represents specific considerations in anesthetic management and many anesthesiologists may have limited experience about the procedure. Therefore, we aimed to share our five years' experience and discuss the anesthetic management within the literature.

MATERIAL AND METHODS

STUDY DESIGN

This retrospective study was conducted in a tertiary hospital after obtaining ethics committee approval (University of Medical Sciences, Yıldırım Beyazıt Training and Research Hospital, Date: 22 May 2018; Protocol No: 18/100). Data were retrospectively collected from the hospital's computerized data base, medical files, and anesthesia charts of all adult patients who underwent elective hip arthroscopy under general anesthesia (GA) between January 2015 and January 2020. The inclusion criteria were as follows: American Society of Anesthesiologists (ASA) physical status I-III patients between 16-80 years and unilateral HA performed by a single orthopedic surgeon under GA. Exclusion criteria were urgent surgery, bilateral surgery, previous hip surgery, missing data, and lost to follow-up in the perioperative period. The study followed the strengthening the reporting of observational studies in epidemiology (STROBE) guidelines. The study was conducted in accordance with the Declaration of Helsinki Principles.

ANESTHETIC TECHNIQUE

The routine anesthetic protocol for the HA in our clinic was as follows: The patients were premedicated with 2-3 mg of IV (intravenous) midazolam and 50 mg ranitidine after establishing a peripheral intravenous (IV) access with a large bore cannula (16-20 gauge) on the contralateral hand or on the ipsilateral arm. Tenoxicam (10 mg) was given IV 30 minutes before the anesthesia induction as a preemptive analgesic. Time-out procedures were performed to ensure patient safety. GA was induced using IV propofol (2-2.5 $mgkg^{-1}$) and fentanyl (1μgkg^{-1}) as the patient was positioned supine on the stretcher. Rocuronium was given in a dose of 0.6 $mgkg^{-1}$ for endotracheal intubation or in a dose of 20 mg for the placement of a laryngeal mask airway (LMA). An endotracheal tube (ETT) or a LMA was placed to secure the airway. Anesthesia was maintained either using a total intravenous anesthesia (TIVA) technique based on propofol (3-6 $mgkg^{-1}h^{-1}$) and remifentanil (1-2 μgkg^{-1} h^{-1}) or using a sevoflurane inhalation (2-3 MAC) with 50% oxygen and 50% air mixture in combination with a remifentanil infusion (1-2 μgkg^{-1} h^{-1}). Infusion doses were adjusted to keep the mean arterial blood pressure and heart rate between ±20% of baseline levels. The non-operative leg was wrapped with an elastic bandage or compression stockings were weared to prevent deep vein thromboembolism (DVT). The patient's bilateral feet and ankles were placed into foam-padded boots. The patient was brought down for positioning on a fracture table which is attached to the operating table. The body was lateralized to the contralateral side to facilitate access to the operative hip. A soft perineal post was placed on the lower edge of the table, and the patient was positioned downwards with the perineum against the post. The genitalia were checked to prevent excessive compression by the perineal post. The feet were placed in traction boots that is attached to the traction table (Figure 1, Figure 2). After positioning, the distraction availability of the operative leg was tested in directions of flexion, extension, abduction, and adduction. The ipsilateral arm of the patient was placed in a folded sheet on the patient's abdomen and secured with a safety belt. The pulse oximeter probe was placed on the thumb to check the blood circulation of the hand. The contralateral arm was positioned freely in a standard manner to allow an additional venous access when needed. The non-invasive blood measurement cuff was placed on the

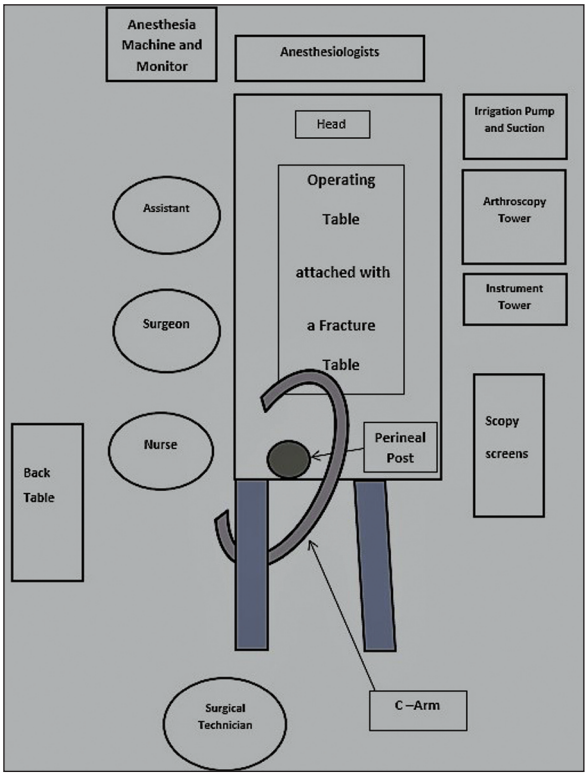

FIGURE 1: Operating room layout.

FIGURE 2: Positioning of the patient.

contralateral arm. A tympanic temperature probe was placed gently in the external ear canal of the patient and the patient was warmed using a heated air warming wrap. Irrigation fluids were also warmed. Repeated doses of rocuronium (10-20 mg) were given before the traction of the ipsilateral leg and with 30 minutes intervals to maintain muscle relaxation throughout the procedure. Subcutaneous morphine (5 mg) was administered after capsulotomy and IV paracetamol 10 $mgkg^{-1}$ was administered before the wound closure for postoperative pain relief. The irrigation fluid (Ringer's lactate) was given through the arthroscopy portal into the hip joint using a pressure pump. The pump pressure was limited to 40 mmHg. A nitroglycerine infusion was administered to achieve a controlled deliberate hypotension (mean arterial blood pressure between 55-60 mmHg and systolic blood pressure lower than 90 mmHg). Tranexamic acid (20 $mgkg^{-1}$) was also given to reduce perioperative bleeding. At the end of the surgery, GA was discontinued and endotracheal tube or LMA was removed after spontaneous breathing was resumed and sufficient reversal of neuromuscular blockade was achieved using reversal agents including neostigmine (50 μgkg^{-1}) and atropine 20 (μgkg^{-1}). The patients were followed in the postanesthesia care unit (PACU). Patients with a modified Aldrete scoring system >9 was considered to be eligible for the transfer from PACU to the ward.

POSTOPERATIVE FOLLOW-UP PERIOD

An analgesic regimen was used for postoperative pain relief including paracetamol 10 $mgkg^{-1}$ with 8 hours intervals, diclofenac 75 mg oral with 12 hours intervals, and a IV tramadol patient controlled analgesia (IV-PCA, $5mgml^{-1}$, infusion dose 4 mgh^{-1}, bolus: 5 mg, lock-out time:30 minutes, 4 hours limit: 60 mg). Pain intensity was evaluated using a Visual Analogue Scale (VAS). Pethidine 0.5 $mgkg^{-1}$ was given as a rescue analgesic when VAS>3. The patients were discharged from the hospital when hemodynamic parameters were stable, VAS scores <3, and basic physiotherapy exercises were completed under the supervision of a physiotherapist.

DATA COLLECTION

All medical data were reviewed in detail to obtain: a) demographic characteristics, b) operative time (min), c) hospital discharge time (hours), d) postoperative pain and pain treatment including VAS scores, number of patients requiring rescue analgesic, mean time to use of rescue analgesic (min), e) early and late complications related to the surgery and anesthesia.

STATISTICAL ANALYSIS

Statistical analysis was performed using IBM SPSS Statistics version 21 (IBM SPSS Inc., Chicago, IL).

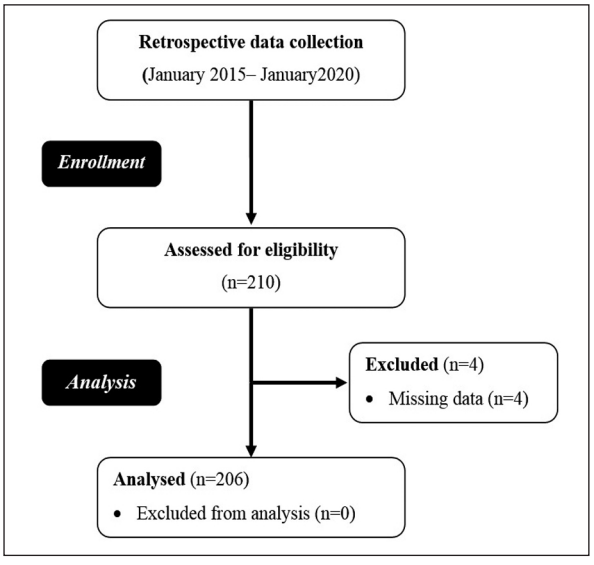

FIGURE 3: Study flow diagram.

Descriptive statistics were expressed as mean and standard deviation (mean±SD) for continuous data, and frequency and percentage (n,%) for categorical data. The normal distribution of the continuous data was evaluated with the Kolmogorov-Smirnov test. The abnormal distribution for continuous variables was analyzed using Mann-Whitney U test. $p<0.05$ was considered as statistically significant.

RESULTS

A total of 210 patient files were evaluated. Four files were excluded due to the missing data (Figure 3). Of the remaining 206 patients, 94 (%45.6) were female and 112 (%54.4) were male. Mean age was 39.9±7.2 years (min. 16-max.70). Demographic data were listed in Table 1. Mean operative time was 141.6±14.8 (65-240) minutes. Mean hospital discharge time was 27.1±9.3 (16-68) hours and 60.8% of the patients were discharged from the hospital in an outpatient manner in less than 24 hours. The mean traction time was 35.5±11.1 minutes (min 15 min- max 75 min). Mean 18.8±3.1 L (min 10-max 50 L) Ringer's lactate were used as arthroscopic irrigation fluid.

A post-extubation laryngospasm was developed in a 28 years-old male patient which was completely resolved after applying continuous positive airway pressure with 100% oxygen through face mask. The most common complications related to the anesthesia were shivering (n=36, %17.4), intractable pain (VAS>3) requiring opioids (n=23; %11.1), and nausea and vomiting (n=11; %5.3). Nerve palsy related to the traction, compression, and surgical injury was observed in 12 patients which resolved spontaneously in 3-8 weeks after the surgery. One patient suffered from a skin necrosis on the scrotum which was completely healed in 6 weeks (Table 2).

DISCUSSION

The results of this retrospective study showed that 61.6% of hip arthroscopies could be successfully performed in an outpatient basis under GA but several anesthetic and surgical considerations should be taken into consideration to prevent complications which may have potential to prevent early discharge from hospital.

The patients undergoing HA are generally young and healthy (35-45 years). Among the patients in this study, only three were in the ASA physical status classification 3. Preoperative anesthetic evaluation should include standard requirements for GA. GA is usually preferred in most of HA procedures due to the capability of increasing the degree of muscle

TABLE 1: Demographic characteristics.

	Patients (n=206)
Gender (Female/male)	94/112 (45.6% / 54.4%)
Age (years)	39.9± 7.2 (16-70)
ASA physical status class I / II / III (n,%)	174/29/3 (84.4% / 14.1% / 1.5%)
Body Mass Index class (n,%) (underweight/normal/overweight/obese)	16 /149 /27 /14 (7.8% / 72.3% / 13.1% / 6.8%)
Duration of the surgery (min)	141.6±14.8 (65-240)
Hospital discharge time (hours)	27.1±9.3 (16-68)
Discharge rate in outpatient basis (discharge time < 24 hours)	61.6% (127/206)

TABLE 2: Perioperative complications.

Perioperative Complications	Number (n,%)
Related to the anesthesia	
Shivering	36 (17.4%)
Intractable pain (Visual Analogue Scale score > 3)	23 (11.1%)
Nausea / vomiting	11 (5.3%)
Hemodynamic instability	2 (0.97%)
Post extubation laryngospasm	1 (0.5%)
Related to the surgery	
Partial lateral femoral cutaneous nerve palsy (sensory)	3 (1.5%)
Instrumentation breakage	2 (0.97%)
Complicated fluid extravasation	0
Bleeding	0
Femoral fracture	0
Infection	0
Thromboembolism	0
Related to the positioning	
Pressure injury (scrotal skin)	1 (0.5%)
Peroneal nerve cutaneous sensory palsy at ankle (temporary)	4 (1.9%)
Pudendal nerve palsy (temporary)	5 (2.4%)

relaxation and variability in the duration of the surgery.[3] Successful use of spinal or epidural anesthesia was also reported in the literature.[4] Regional anesthesia offers advantages over GA by a decrease in the risk of deep venous thromboembolism (DVT) and reducing perioperative blood loss due to the decrease in venous pressure. Approximately two-thirds of HAs are performed in the supine position because it allows better access for arthroscopic instruments into the hip joint, use of a standard or specialized fracture table and easier positioning of patients. Lateral positioning was used in the remaining patients because it offers easier access into joint especially in obese patients due to the thinner hip capsule in the lateral position.[5] The operative times differ between 1-4 hours according to the surgical intervention. It should be also noted that the surgical preparation lasts approximately between 40-60 minutes due to the special positioning and protective interventions including padding and dressing of the patients.

Although the surgery is associated with a reduced blood loss compared to open surgery, a deliberate hypotension is often required to increase the visibility of the joint. We generally use a continuous infusion of vasodilators to achieve a mean arterial blood pressure between 55-60 mmHg. Adding diluted epinephrine to the irrigation fluid was also reported in the literature to reduce perioperative bleeding in the joint, but we did not require this method in our practice.

PERIOPERATIVE COMPLICATIONS

The rate of complications associated with hip arthroscopy varies in the literature with an incidence between 1% and 8%.[6] The majority of complications were non-life or limb threatening and can be simply classified as complications related to the anesthesia, surgery, and positioning.[7] Postoperative shivering was the most common complication (17.4%) related to the anesthesia in our study. It is well-known that hypothermia is associated with shivering and may lead to hemodynamic instability, bleeding, infection, and delayed wound healing. These complications depend on the operative times, the number and temperature of the irrigation fluids, and lack of effective warming of patient's body and irrigation fluids.[8] Although patients were warmed with air warming blankets and warmed irrigation fluids (up to 35º C) were used, a significant number of patients suffered from cold sensation and shivering. Shivering was resolved in all patients after active warming and administration of 20 mg IV pethidine.

Postoperative pain was the second common complication in our study. %11.1 of the patients required opioid rescue analgesics due to VAS scores higher than 3 that might also be partly responsible for the postoperative nausea and vomiting (%5.3). The integrity of the postoperative pain was reported from mild to severe in the literature. VAS scores ranged between 2.4 and 8.[9,10]

The predisposing factors for postoperative pain were described as preoperative opioid use, younger age, prolonged surgery, high irrigation pump pressure (50> mmHg), high body mass index, and surgical intervention including femoral chondo-osteotomy and labral repair, and using active range of motion as a part of physiotherapy.[11]

We used a multimodal analgesic pharmacological treatment including preoperative tenoxicam, intraoperative subcutaneous morphine

and IV paracetamol, and postoperative IV- tramadol PCA, regular diclofenac, and paracetamol. Pethidine was used as rescue analgesic. The first time to use rescue analgesic was 125.3± 33.1 minutes. We did not use regional anesthetic techniques as an adjunct to the GA due to potential complications of nerve blocks which may mask nerve injuries related to the surgery and traction. Additionally, the nerve blocks have also a potential for reducing the muscular strength after surgery which may limit early mobilization. But, contrary to our opinion, there are numerous studies in the literature that reported successful and safe pain relief after HA using epidural analgesia and peripheral nerve blocks in adjunct to the GA.[12]

There were a wide variety of peripheral nerve blocks described including femoral nerve block, fascia iliaca block, paravertebral block at L1 and L2 levels, and lumbar plexus block. Peripheral nerve blocks were found very effective in alleviating pain with lower incidence of complications, especially in the first 24 hours after surgery.[13]

Extravasation of the irrigation fluid into the extracapsular tissues is the most severe complication following the HA which requires immediate diagnosis and treatment due to the potential risk for development of abdominal compartment syndrome. The incidence of complicated fluid extravasation was 1.6% in the literature.[14] A study revealed that 10% of infused volume was extravasated in uncomplicated HA which was measured by computed tomography scanning.[15] In another study, it was reported that 9.7-33.5 L of the irrigation fluid was used and an average of 1.1 L was extravasated.[16] Clinical signs and symptoms are abdominal distension, subcutaneous edema of the thigh and on the abdomen, hypothermia, hypotension, metabolic acidosis and abdominal pain. It is essential to monitor the airway pressure for a potential abdominal distention in patients under GA. Abdominal pain may be an indicator in patients under regional anesthesia. The preventive measures are limiting the arthroscopic pump pressure under 40 mmHg, reducing operative time, regular observations, urinary catheter placement, and diuretics.

Another important complication of HA is deep vein thromboembolism with an incidence between 1.4-3.7%.[17] The predisposing factors are described as prolonged traction (>1 hours), compression of femoral and gluteal veins by the perineal post, oral contraceptive use, and history of DVT. A case of fatal pulmonary embolism has also been described.[18] For this reason, prompt diagnosis and treatment is extremely important. We used compressive stocking, limited traction times, and administered anticoagulant prophylaxis (enoxaparin sodium 4000 anti Xa IU; subcutaneously 12 hours before the surgery, and once a day at the postoperative period) as preventive measures. Surgery related injuries are mainly observed as lateral femoral cutaneous nerve injury (four patients in our study) which was reported as a consequence of suboptimal portal placement. This complication may also be precipitated by the prolonged compression of the medial thigh by the perineal post. The palsy may be permanent or temporary and affects generally sensory distribution of the nerve.[18,19]

Traction injuries damage mostly femoral or sciatic nerves due to the extreme traction force with a prolonged duration. The injuries generally resolve within 4-8 hours after surgery. Limiting the traction force to 50 lb (22.7 kg) and to maximum 1 hour is recommended.[6,7,18,19] We did not observe a femoral or sciatic nerve injury. In our practice, we record the traction time in practice and discontinued traction after 45 minutes. When the surgery necessitated a longer traction, we started a second traction after a 5 minutes period.

Compression injuries include pudendal nerve palsy and scrotal necrosis / labia majora hematoma and necrosis that typical occur due to the pressure by the perineal post on the contacting tissue. We observed pudendal nerve palsy in five patients and peroneal nerve cutaneous sensory palsy at ankle in four patients that resolved spontaneously in three and eight weeks, respectively. One patient suffered from a scrotal skin necrosis that was limited in a 1x2 cm area which healed in six weeks with wound care. Limiting the traction force and adequate padding of peroneal post thicker than 10 cm, and padding of boots are the recommended preventive measures.[19]

Positioning injuries may occur both at ipsilateral and contra-lateral sides and generally caused by improper padding and prolonged pressure on the tissue. Brachial plexus palsy on the axilla, radial nerve palsy around the elbow, and peroneal nerve injury due to fibular head-operating table contact were reported. Those injuries generally require physiotherapy and pharmacological interventions.[20]

This study has several limitations. Retrospective studies may suffer from selection and recall bias. Therefore, we used the same inclusion and exclusion criteria and multiple data sources including an electronic medical records database, patient files, and anesthesia charts. The second limitation was that the study included only GA as the main anesthetic management.

CONCLUSION

In conclusion, we reported our five-year experience in the anesthetic management of hip arthroscopy. The key points can be summarized as follows:

a. HA is a minimally invasive procedure that often requires GA due to the necessity for muscle relaxation and variability of the operative procedures.

b. The blood loss is minimal but deliberate hypotension is generally required for the optimal visibility of the surgical area.

c. Patients should be closely monitored for extravasation of irrigation fluids which is the most serious complication that may lead to abdominal compartment syndrome. Irrigation pump pressure should be limited to 40 mmHg.

e. Proper padding of the patients should be taken into consideration seriously due to the potential traction and compression injuries.

f. Perioperative hypothermia is common and monitoring of body temperature and effective warming of patients are important.

g. Postoperative pain is mild to moderate and can be managed with multimodal analgesic regimen. Peripheral nerve blocks are recommended.

h. Compressive stockings and use of anticoagulants are preventive measures for DVT.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Mehmet Anıl Süzer; Mehmet Özgür Özhan,* ***Design:****Mehmet Anıl Süzer; Mehmet Özgür Özhan,* ***Control/Supervision:*** *Mehmet Anıl Süzer; İlkay Baran Akkuş,* ***Data Collection and/or Processing:*** *Mehmet Burak Eşkin; Ceyda Çaparlar,* ***Analysis and/or Interpretation:*** *Bülent Atik;* ***Literature Review:****İlkay Baran Akkuş; Ceyda Çaparlar,* ***Writing the Article:****Mehmet Özgür Özhan; Mehmet Anıl Süzer,* ***Critical Review:*** *Metin Polat,* ***References and Fundings:*** *Mehmet Özgür Özhan; Mehmet Anıl Süzer,* ***Materials:*** *Metin Polat; Mehmet Özgür Özhan.*

REFERENCES

1. Burman MS. Arthroscopy or the direct visualization of joints: an experimental cadaver study. 1931. Clin Orthop Relat Res. 2001;(390):5-9. [Crossref] [PubMed]
2. Bekmez Ş, Kayaalp A, Tandoğan RN. [Complications of Hip Arthroscopy]. Aşık M, Kayaalp A, Tuncay İ, Beyzadeoğlu T. Kalça Artroskopisi. 1. Baskı. Ankara: BAYT Bilimsel Araştırmalar Basın Yayın ve Tanıtım Ltd. Şti; 2016. p.241-8.
3. Bolia IK, Briggs KK, Matheny L, Philippon MJ. Survey results from an international hip course: comparison between experts and non-experts on hip arthroscopy clinical practice and post-operative rehabilitation. Knee Surg Sports Traumatol Arthrosc. 2020;28(4):1270-5. [Crossref] [PubMed]
4. Kraus M , Foley B , Misra L, Hartigan D , Girardo M, Seamans D. A retrospective study of anesthetic considerations in hip arthroscopy: regional versus general. Open J Anesthesiol. 2018;8(12):295-304. [Crossref]
5. Griffiths EJ, Khanduja V. Hip arthroscopy: evolution, current practice and future developments. Int Orthop. 2012;36(6):1115-21. [Crossref] [PubMed] [PMC]
6. Nakano N, Khanduja V. Complications in hip arthroscopy. Muscles Ligaments Tendons J. 2016;6(3):402-9. [Crossref] [PubMed] [PMC]
7. Kowalczuk M, Bhandari M, Farrokhyar F, Wong I, Chahal M, Neely S, et al. Complications following hip arthroscopy: a systematic review and meta-analysis. Knee Surg Sports Traumatol Arthrosc. 2013;21(7):1669-75. [Crossref] [PubMed]
8. Yu HC, Al-Shehri M, Johnston KD, Endersby R, Baghirzada L. Anesthesia for hip arthroscopy: a narrative review. Can J Anaesth. 2016;63(11):1277-90. [Crossref] [PubMed]
9. Baker JF, Byrne DP, Hunter K, Mulhall KJ. Post-operative opiate requirements after hip arthroscopy. Knee Surg Sports Traumatol Arthrosc. 2011;19(8):1399-402. [Crossref] [PubMed]
10. Lee EM, Murphy KP, Ben-David B. Postoperative analgesia for hip arthroscopy: combined L1 and L2 paravertebral blocks. J Clin Anesth. 2008;20(6):462-5. [Crossref] [PubMed]
11. Tan CO, Chong YM, Tran P, Weinberg L, Howard W. Surgical predictors of acute postoperative pain after hip arthroscopy. BMC Anesthesiol. 2015;15:96. [Crossref] [PubMed] [PMC]
12. Kay J, de Sa D, Memon M, Simunovic N, Paul J, Ayeni OR. Examining the role of perioperative nerve blocks in hip arthroscopy: a systematic review. Arthroscopy. 2016;32(4):704-15.e1. [Crossref] [PubMed]
13. Bech NH, Hulst AH, Spuijbroek JA, van Leuken LL, Haverkamp D. Perioperative pain management in hip arthroscopy; what options are there? J Hip Preserv Surg. 2016;3(3):181-9. [Crossref] [PubMed] [PMC]
14. Ekhtiari S, Haldane CE, de Sa D, Simunovic N, Ayeni OR. Fluid extravasation in hip arthroscopy: a systematic review. Arthroscopy. 2017;33(4):873-80. [Crossref] [PubMed]
15. Hinzpeter J, Barrientos C, Barahona M, Diaz J, Zamorano A, Salazar A, et al. Fluid extravasation related to hip arthroscopy: a prospective computed tomography-based study. Orthop J Sports Med. 2015;3(3):2325967115573222. [Crossref] [PubMed] [PMC]
16. Stafford GH, Malviya A, Villar RN. Fluid extravasation during hip arthroscopy. Hip Int. 2011;21(6):740-3. [Crossref] [PubMed]
17. Alaia MJ, Patel D, Levy A, Youm T, Bharam S, Meislin R, et al. The incidence of venous thromboembolism (VTE)--after hip arthroscopy. Bull Hosp Jt Dis (2013). 2014;72(2):154-8. [PubMed]
18. Contreras MEK, Hoffmann RB, de Araújo LCT, Dani WS, José Berral F. Complications in hip arthroscopy. Rev Bras Ortop. 2015;45(1):61-6. [Crossref] [PubMed]
19. Swiontkowski M, Resnick L. Preventing and treating complications after hip arthroscopy. JBJS Case Connect. 2014;4(3):e69. [Crossref] [PubMed]
20. Papavasiliou AV, Bardakos NV. Complications of arthroscopic surgery of the hip. Bone Joint Res. 2012;1(7):131-44. [Crossref] [PubMed] [PMC]