Research Article (Araştırma Makalesi)

Anesthesiologist View on Endovascular Aortic Aneurysm Repair; A Single Center Retrospective Study

Endovasküler Aort Anevrizması Onarım Cerrahilerine Anestezist Bakışı; Tek Merkezli Retrospektif Bir Çalışma

Gamze ERTAS[1], Hamiyet Senol CAKMAK[1], Sevda AKDENIZ[1], Ebru POLAT[1], Ilker Hasan KARAL[2], Serkan TULGAR[1]

[1] Samsun University Faculty of Medicine, Samsun Training and Research Hospital, Department of Anesthesiology and Reanimation, Samsun, Turkey
[2] Samsun University Faculty of Medicine, Samsun Training and Research Hospital, Department of Cardiac Surgery, Samsun, Turkey

Özet

Amaç: Minimal invaziv endovasküler stent greftleme yöntemleri olan endovasküler aort onarımı (EVAR) ve torasik endovasküler aort onarımı (TEVAR), aort anevrizmalarının tedavisinde geleneksel ve invaziv açık cerrahiye alternatif olarak uygulanmaktadır. Bu çalışmanın amacı hastanemizde EVAR ve TEVAR uygulanan hastalarda uygulanan anestezi yöntemlerini değerlendirmektir.

Gereç ve Yöntemler: Çalışmamızda 01.01.2015-31.05.2022 tarihleri arasında endovasküler aort onarımı yapılan 95 hastanın dosyaları geriye dönük olarak incelendi. Hastalara ilişkin tanımlayıcı verilerin yanı sıra ameliyat süresi, yoğun bakım ve hastanede kalış süresi gibi veriler toplanarak değerlendirildi.

Bulgular: Endovasküler aortik greftlemenin 14 hastaya genel anestezi (GA) (Grup GA) altında, 67 hastaya sedo-analjezi (SA) (Grup SA) altında yapıldığı belirlendi. 75 hastaya EVAR, 6 hastaya TEVAR uygulandı. EVAR hastalarının 11'inin GA, 64'ünün SA ile tedavi edildiği görüldü. Hastaların yaş ortalaması 68.73±8.31 yıl olup, 75'i erkekti. Hasta komorbiditeleri göz önüne alındığında gruplar arasında anlamlı fark yoktu ($p>0.05$). Yoğun bakımda kalış süreleri hastanede kalış süreleri açısından değerlendirildiğinde gruplar arasında istatistiksel olarak anlamlı fark bulunmadı ($p>0.05$).

Sonuç: Bu çalışmada kliniğimizde EVAR/TEVAR uygulanan hastalarda intraoperatif sıvı gereksinimi dışında anestezi yönteminin üstünlüğünü belirleyemedik.

Anahtar Kelimeler: Genel anestezi, Sedo-analjezi, Endovasküler aort tamiri

Abstract

Objective: Endovascular aortic repair (EVAR) and thoracic endovascular aortic repair (TEVAR), which are minimally invasive endovascular stent grafting methods, are applied as alternatives to traditional and invasive open surgery in the treatment of aortic aneurysms. The aim of this study was to evaluate the anesthesia methods applied in patients who underwent EVAR and TEVAR in our hospital.

Materials and Methods: The files of 95 patients who underwent endovascular aortic repair between 01.01.2015 and 31.05.2022 were reviewed retrospectively. Descriptive data on patients, as well as data such as the duration of surgery, intensive care and hospital stay were collected and evaluated.

Results: It was determined that endovascular aortic grafting was performed under general anesthesia (GA) (Group GA) in 14 patients and with sedo-analgesia (SA) (Group SA) in 67 patients. EVAR was administered to 75 patients and TEVAR to 6 patients. Eleven of the EVAR patients received GA and 64 received SA. The mean age of the patients was 68.73±8.31 years, and 75 of the patients were male. There was no significant difference between the groups with regards to comorbidities ($p>0.05$). When the length of stay in the intensive care unit was evaluated in terms of duration of hospitalization, there was no statistically significant difference between the groups ($p>0.05$).

Conclusion: In this study, GA and SA gave similar outcomes an in patients who underwent EVAR/TEVAR in our clinic, except for the intraoperative fluid requirements.

Keywords: General anesthesia, Sedo-analgesia, Endovascular aort repair

Correspondence: Gamze ERTAS Kisla, Baris Blv. No:199, 55090 Ilkadım/Samsun, Turkiye.

Phone: +90 5056587914 **e-mail:** gamzertas.md@hotmail.com

ORCID No (Respectively): 0000-0001-6779-6363, 0000-0001-8169-1752, 0000-0002-9284-183X, 0000-0002-0656-2747, 0000-0003-3873-992X, 0000-0003-1996-7505

Submission date: 15.08.2022

Acceptance date: 06.09.2022

DOI: 10.17517/ksutfd.1162380

INTRODUCTION

For decades, aortic aneurysms have been treated using traditional, invasive open surgical procedures. Patients requiring surgery for aortic aneurysm are usually aged >60 years and have multiple comorbidities, which are related to perioperative morbidity and mortality (1). Parodi et al. (2), first introduced the minimally invasive endovascular aortic stent grafting technique in 1990 as an alternative to the traditional open surgical method. As methods such as "endovascular aortic repair" (EVAR) and "thoracic endovascular aortic repair" (TEVAR) shorten hospital stay, decrease hemodynamic fluctuations and endocrine stress response, lower the mortality and/or morbidity rate, lessen the requirement for blood and/or blood transfusions, and decrease risk of blood loss, they have become the preferred option for repair of aortic aneurisms (3,4).

General anesthesia, local anesthesia, sedo-analgesia, regional anesthesia or their combinations are used as anesthesia methods in these procedures. However, each anesthesia technique has advantages and disadvantages when compared to each other (5-9).

The purpose of this study is to retrospectively analyze the anesthetic techniques used in patients who underwent EVAR and TEVAR at our institution and to report our findings in light of literature.

MATERIALS AND METHODS

Study Design

After local ethics committee approval (OMÜEK, Approval No: 2022/145), data of patients undergoing EVAR and TEVAR at Samsun University Faculty of Medicine Training and Research Hospital between 1st January 2015 and 31st May 2022 were retrospectively collected from hospital data systems. The patients were divided into two groups according to the type of anesthetic used in EVAR and TEVAR: general anesthesia (Group GA) or sedo-analgesia (Group SA). In our clinic, these types of surgery are performed under either general anesthesia or sedo-analgesia, with the implementation of standard protocols for both anesthesia management choices. Patients in which anesthesia management was not as described in the "Perioperative Anesthesia" section of this manuscript, were excluded from the study.

Data collection

The following patient data was obtained from written and electronic medical records (FONET hospital information management system, V4.22.6.1 Turkiye Database):

- Age and gender,
- American Society of Anesthesiology (ASA) scores,
- Smoking status,
- Presence/history of hypertension (HT), diabetes mellitus (DM), chronic obstructive pulmonary disease (COPD), kidney failure, and coronary artery bypass grafting surgery,
- Type of anesthesia and its duration,
- Type and duration of surgery,
- Preoperative ejection fraction (EF),
- Preoperative and postoperative complete blood count and biochemistry values
- Intraoperative fluid, inotrope, vasodilator, vasopressor and atropine requirements,
- Additional complications,
- Arterial-central vein catheterization,
- Charlson comorbidity index (CKI),
- Length of stay in hospital and intensive care unit

Perioperative anesthesia and analgesia

In all patients: After the patient was transported to the angiography unit, standard monitoring was carried out. Preoperative antibiotic prophylaxis with 1gr cefazolin sodium IV was performed. Patients were sedated with 0.03-0.05mg/kg midazolam. A urinary catheter was inserted. Invasive arterial monitoring and central vein catheterization were undertaken in select patients.

General anesthesia protocol: After induction of anesthesia with intravenous administration of propofol 1-2 mg/kg, fentanyl 2-5 mcg/kg, and rocuronium 0.6-0.9 mg/kg, anesthesia maintenance was achieved using 1 minimal alveolar concentration (MAC) inhaled sevoflurane and intravenous remifentanil infusion of 0.1-0.3 mcg/kg/min.

Sedoanalgesia protocol: After intravenous administration of fentanyl 1-2 mcg/kg to the patients, a remifentanyl 0.1-0.3 mcg/kg/min IV infusion was administered. The procedure was continued using local anesthetics.

Perioperative care: After anesthesia, 80 U/kg intravenous (IV) heparin was administered to all patients. A Gore-Excluder aortic bi-iliac stent was placed in all patients. In case of a 25% increase in mean arterial pressure (MAP) baseline values, nitroglycerin 100 mcg IV push or 10-100 mcg/min IV infusion was started. In case of a 25% decrease in MAP basal values, ephedrine 5mg IV was administered. Through measurement of the activated coagulation time (ACT), the effect of heparin was neutralized with protamine sulfate over 300 seconds.

All patients were taken to the post anesthetic care unit (PACU) for close follow-up after completion of the procedure.

Statistical Analysis

Statistical Package for the Social Sciences (SPSS) 16.0 program was used for statistical analysis. Descriptive statistics were expressed as mean ± standard deviation, minimum and maximum. Proportional data were compared using the Chi-square test. The Man Whitney U test was used to determine whether there was a difference between the study groups in terms of data such as age, duration of the procedure, need for intensive care and length of hospital stay. $p<0.05$ was considered as being statistically significant.

The ethics committee approval of the study was obtained from Samsun University Faculty of Medicine, Clinical Research Ethics Committee (Date:2022, protocol number: 145).

RESULTS

The data of 95 patients who underwent endovascular intervention for aortic aneurysm in our hospital over a 7-year period were analyzed. Six patients were excluded from the study due to insufficient perioperative data or missing follow-up data, five patients for deviating from defined regular procedures, and three patients for developing complications or the necessity for additional procedures. Therefore, data from 81 patients were analyzed. **Figure 1** depicts the study's flow diagram.

The mean age of the patients was 68.73±8.31 years, and 92.5% of the patients (75 patients) were male and 7.5% (6 patients) were female. There were 41 patients with no or one comorbidity, 23 patients with 2 accompanying comorbidities, and 17 patients with 3 or more comorbidity (**Table 1**).

There were 61 patients with a Charlson comorbidity index of 1-2, 15 patients with an index of 3-4, and 5 patients with an index of >5. The average Charlson comorbidity index was similar between the groups (p=0.48) (**Table 1**).

Fourteen patients (17%) underwent endovascular aortic grafting under general anesthesia (Group GA), while 67 patients (83%) underwent the procedure under sedo-analgesia (Group SA). TEVAR was administered to 6 individuals whereas EVAR was administered

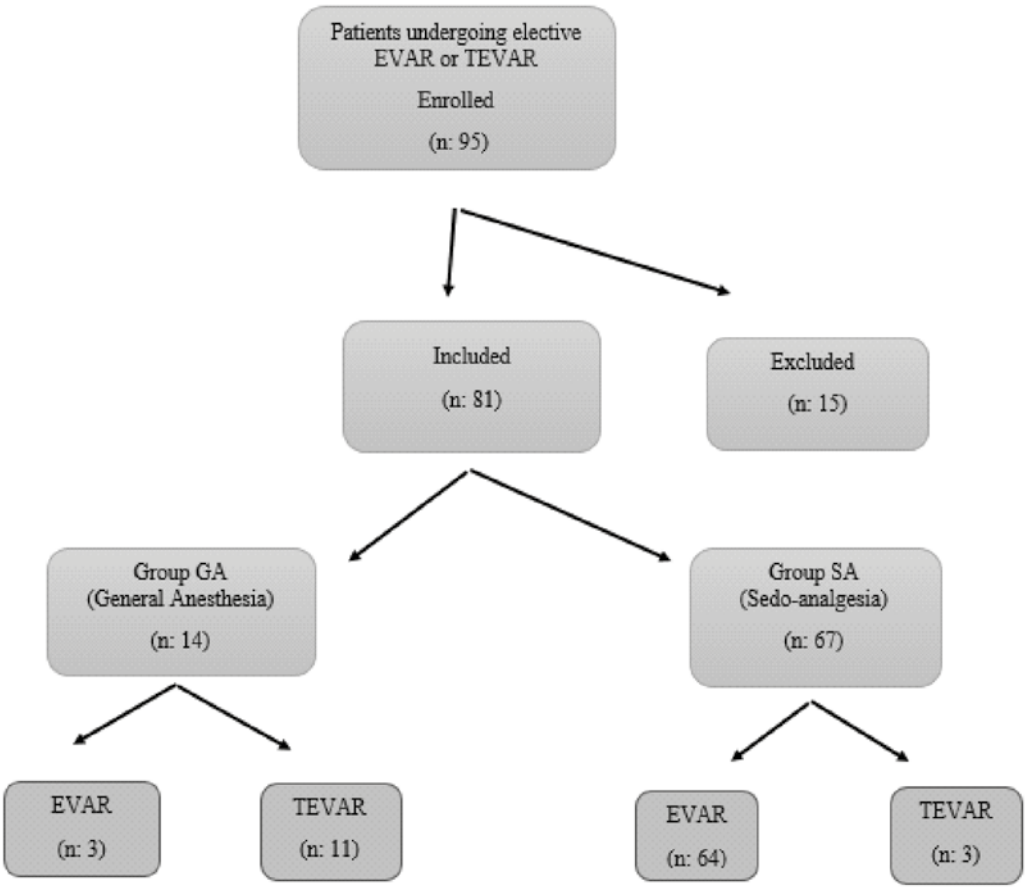

Figure 1. Flow diagram of the study.

Table 1. Descriptive data of all patients and groups. (ASA: American Society of Anesthesiologists, CCI: Charlson Comorbidity Index)

	All patients (n: 81)	Group GA (n: 14)	Group SA (n: 67)	*p*
Age (years)	68.73±8.31	67.28±8.92	69.0±8.22	0.48
Gender (F/M)	6/75	1/13	5/62	0.96
ASA				
II	4	1	4	0.83
III	68	12	55	
IV	9	1	8	
Number of comorbidities (n)				
≤1	41	7	34	0.71
2	23	5	18	
≥3	17	2	15	
CCI				0.48
1-2	61	12	49	
3-4	15	1	14	
≥5	5	1	4	

Abbreviations: GA; general anesthesia; SE: sedo-analgesia.

to 75 patients. For those undergoing EVAR, 11 received general anesthesia while 64 received sedo-analgesia. For those undergoing TEVAR, three received general anesthesia and three received sedo-analgesia.

Table 2 displays the preoperative and postoperative laboratory values of the patients. The patients' preoperative mean ejection fraction was determined to be 55.01±6.52. In terms of preoperative and postoperative EF, Hb, Htc, BUN, and creatinine levels, there was no statistical difference between the groups (p>0.05) (**Table 2**).

Perioperative surgical and anesthetic data and drug/inotropic requirements for all patients and groups is given in **Table 3**.

The duration of surgery was 136.42±37.99 minutes in group GA and 130±57.02 minutes in group SA. Central venous catheter was applied to 1 patient in group GA and 3 patients in group SA. Intraoperative fluid balance was 1625±516.55 mL in group GA and 1238.8±441.91 mL in group SA (p=0.01). Vasodilator was required in nine patients in group GA and in 27 patients in group SA. Vasopressors were used in one patient in group GA and in four patients in group SA. There was no statistically significant difference between the groups in terms of these data (p>0.05) (**Table 3**).

The length of hospital and intensive care unit (ICU) stay are shown in **Table 4**. The average length of stay in

Table 2. Preoperative and postoperative laboratory findings.

	All patients (n:81)	Group GA (n:14)	Group SA (n:67)	*p*
Preop EF	55.01±6.52	56.42±6.33	54.71±6.63	0.37
Preop Hb (mg/dl)	12.93±1.91	12,72±1.09	12.98±2.06	0.5
Preop Htc	38.41±5.97	38.47±3.19	38.40±6.43	0.95
Preop BUN (mg/dl)	38.93±15.47	31.75±16.61	40.42±14.85	0.05
Preop Kreatin (mg/dl)	1.12±0.93	0.89±0.50	1.17±0.99	0.12
Postop Hb (mg/dl)	12.17±9.11	11.11±1.62	12.39±9.93	0.32
Postop Htc	36.15±26.61	33.31±5.23	36.75±28.99	0.36
Postop BUN (mg/dl)	40.16±17.85	35.41±16.53	41.16±18.02	0.27
Postop Kreatin (mg/dl)	1.15±0.96	1.01±0.44	1.17±1.03	0.35

Abbreviations: GA; general anesthesia; SE: sedo-analgesia; EF: Ejection Fraction, Hb: Hemoglobin, Htc: Hematocrit, BUN: Blood Urea Nitrogen.

Table 3. Comparison of perioperative surgical/anesthetic data and drug/inotrope requirements. (m: minutes, ml: milliliter, Y: yes/present, N: no/not present)

	All patients (n:81)	Group GA (n:14)	Group SA (n:67)	p
Duration of anesthesia (minutes)	153.82±55.52	162.14±38.61	152.08±59.33	0.43
Type of Surgery				
EVAR	75	11	64	0.02
TEVAR	6	3	3	
Duration of surgery (mins)	131.11±53.6	136.42±37.99	130.0±57.02	0.6
Central Catheter (Y/N)	4/77	1/13	3/64	0.17
Intraoperatively administered fluid (ml)	1305.55±477.95	1625.0±516.55	1238.8±441.91	***0.01***
Vasodilator (Y/N)	36	9	27	0.1
Vasopressor (Y/N)	5	1	4	0.86

Abbreviations: GA; general anesthesia; SE: sedo-analgesia; EVAR: endovascular aortic repair; TEAR: thoracic endovascular aortic repair.

Table 4. The length of hospital and ICU stay.

	All patients (n:81)	Group GA (n:14)	Group SA (n:67)	p
ICU Stay (days)	2.01±3.51	1.35±0.84	2.14±3.81	0.13
Hospital Stay (days)	10.54±5.50	11.21±5.07	10.40±5.59	0.61

Abbreviations: GA; general anesthesia; SE: sedo-analgesia; ICU: intensive care unit.

the intensive care unit was 1.35±0.84 days in group GA and 2.14±3.81 days in group SA. The average duration of hospitalization was 11.21±5.07 days in the group GA and 10.40±5.59 days in group SA. There was no statistically significant difference between the groups for this data (p>0.05).

DISCUSSION

Our retrospective study has demonstrated that the anesthetic technique used in our EVAR/TEVAR cases had no effect on any parameter except for intraoperative fluid demand. There was no correlation between the type of anesthetic used and surgery time, hospitalization, or ICU stay.

Studies evaluating the anesthesia technique used in EVAR-TEVAR report the use of differing anesthesia management plans, including the use of general anesthesia, neuraxial anesthesia, sedo-analgesia and local anesthesia (10-16). Furthermore, while some studies report predominant use of neuraxial anesthesia (10,11,16), some centers predominantly use general anesthesia (17), and some, like our center, utilize sedo-analgesia (18) as the major anesthetic method.

In our study, a majority of cases were managed using sedo-analgesia. General anesthesia was not required in any of those cases. Although sedo-analgesia is the most commonly used anesthesia method in our center, it should be noted that many factors regarding patient safety effect the selection of anesthesia method in EVAR/TEVAR applications, such as the experience of the surgery and anesthesia team, the physical conditions of the health center, the environment, and equipment. It is therefore rational for each center to decide upon their own anesthesia management plan, in light of the aforementioned factors as well as literature findings.

Our clinic's sedo-analgesia protocol includes midazolam, fentanyl, and remifentanil followed by local anesthetic administered by the surgical team prior to the surgical procedure. There are numerous techniques for sedo-analgesia applications in EVAR/TEVAR, and our protocol has fallen somewhat behind recent practices. New mixes, such as ketamine and propofol (ketafol) and ketamine and dexmedetomidine (ketadex), have become increasingly popular in the last five years (19,20). Also, one of the newer sedatives, Remimazolam, appears to be gaining popularity for procedural sedation, and can be used in these surgeries (21). Studies evaluating protocols that utilize new agents and mixtures for sedo-analgesia in EVAR/TEVAR are required to compare them to more conservative modalities.

In a study of 239 EVAR patients, Verhoeven et al. (22) compared patients that were administered local, regional, and general anesthesia, and found that the length of stay in the hospital and intensive care unit was greater in the group given general anesthesia. Similarly, in the EuroSTAR trial conducted by Ruppert V. et al. (23), time spend in hospital and ICU were found to be longer in the general anesthesia group. In their study of 229 patients, De Virgilio et al. (13) evaluated local and general anesthesia in EVAR patients, and the length of stay in the intensive care unit was shown to be considerably greater in the local anesthetic group. There was no difference between the groups in our investigation. We suspect that this is due to the limited sample size.

Bettex et al. (24) reported that hemodynamic stability was better established in patients who underwent local anesthetic under sedation versus general anesthesia, resulting in decreased vasopressor and fluid demand. In our investigation, we discovered that the group SA required less fluid when compared to group GA. When absolute avoidance of hemodynamic instability is required, sedo-analgesia may be preferable.

Owing to the increasing use of ultrasound technology in anesthesia practice, peripheral blocks or fascial plane blocks have become a common component of the anesthetic technique for a variety of surgical operations (25). In EVAR, a combination of ilioinguinal-iliohypogastric block and sedation has been reported as the most common anesthetic technique (26). With the introduction of fascial plane blocks and nerve blocks into anesthesia practice, sedoanalgesia practice has also evolved. In addition, literature will benefit from trials validating the use of sedoanalgesia with novel agents (remimazolam, ketodex, etc.) in EVAR, using established monitoring techniques like the analgesia nociceptive index.

Our study has some limitations. First, the study's retrospective design may predispose to bias, which is our biggest weakness. Furthermore, drugs such as dexmedetomidine, for example, could have been utilized for increased hemodynamic stability. Furthermore, the distribution of cases per year is not uniform. Due to the COVID pandemic in 2020-2021, EVAR/TEVAR was also restricted, as were many surgical procedures. Furthermore, we analyzed a seven-year period in our study, during which time, advances and variances in medical technology could have occurred and influenced the data.

To conclude: In both EVAR and TEVAR, general anesthesia and sedo-analgesia can be employed for anesthetic management, and there is no significant difference in perioperative and postoperative results between these two approaches, according to our retrospective data analysis. However, prospective randomized trials are required.

Ethical approval: The ethics committee approval of the study was obtained from Samsun University Faculty of Medicine, Clinical Research Ethics Committee (Date:2022, protocol number: 145).

Funding: No funding

Declaration of Competing Interest: The authors declare that they have no conficts of interest.

Author Contribution Statement: The authors declare that they have contributed equally to the study.

REFERENCES

1. Greenhalgh RM, Brown LC, Kwong GP, Powell JT, Thompson SG. EVAR trial participants. Comparison of endovascular aneurysm repair with open repair in patients with abdominal aortic aneurysm (EVAR trial 1), 30-day operative mortality results: randomised controlled trial. Lancet. 2004;364:843–8.
2. Parodi JC, Palmaz JC, Barone HD. Transfemoral intraluminal graft implantation for abdominal aortic aneurysms. Ann Vasc Surg. 1991 Nov;5(6):491-9.
3. Elkouri S, Gloviczki P, McKusick MA, Panneton JM, Andrews J, Bower TC, et al. Perioperative complications and early outcome after endovascular and open surgical repair of abdominal aortic aneurysms. Journal of vascular surgery. 2004;39(3):497-505.
4. Köksal C, Özcan V, Sarıkaya S, Meydan B, Zengin M, Numan F. Torakal ve abdominal aort anevrizmalarının endovasküler tedavisi. Turkish J Thorac Cardiovasc Surg. 2004;12:184-7.
5. Franz R, Hartman J, Wright M. Comparison of anesthesia technique on outcomes of endovascular repair of abdominal aortic aneurysms: a five-year review of monitored anesthesia care with local anesthesia vs. general or regional anesthesia. J Cardiovasc Surg (Torino). 2011;52(4):567-77
6. Armstrong RA, Squire YG, Rogers CA, Hinchliffe RJ, Mouton R. Type of anesthesia for endovascular abdominal aortic aneurysm repair. J Cardiothorac Vasc Anesth. 2019;33(2):462-71. doi:10.1053/j.jvca.2018.09.018
7. Bakker EJ, van de Luijtgaarden KM, van Lier F, Valentijn TM, Hoeks SE, Klimek M, et al. General anaesthesia is associated with adverse cardiac outcome after endovascular aneurysm repair. Eur J Vasc Endovasc Surg. 2012 Aug;44(2):121-5. doi: 10.1016/j.ejvs.2012.04.028. Epub 2012 May 22.
8. Karthikesalingam A, Thrumurthy SG, Young EL, Hinchliffe RJ, Holt PJ, Thompson MM. Locoregional anesthesia for endovascular aneurysm repair. J Vasc Surg. 2012;56(2):510-9. doi:10.1016/j.jvs.2012.02.047
9. Edwards MS, Andrews JS, Edwards AF, Ghanami RJ, Corriere MA, Goodney PP, et al. Results of endovascular aortic aneurysm repair with general, regional, and local/monitored anesthesia care in the American College of Surgeons National Surgical Quality Improvement Program database. J Vasc Surg. 2011;54(5):1273-82. doi: 10.1016/j.jvs.2011.04.054. Epub 2011 Jul 1.
10. Kaya S, Turhan Ö, Sungur Z, Sayın ÖA, Alpagut U, Şentürk M. Endovasküler girişimlerde anestezi yönetimi ve klinik sonuçlarının retrospektif değerlendirilmesi. GKDA Derg. 2018;24(4):152-9

11. Yağan Ö, Özyılmaz K, Taş N, Hancı V. A retrospective analysis of comparison of general versus regional anaesthesia for endovascular repair of abdominal aortic aneurysm. Turk J Anaesthesiol Reanim. 2015;43(1):35-40. doi: 10.5152/TJAR.2014.47450. Epub 2014 Sep 9.
12. Ruppert V, Leurs LJ, Steckmeier B, Buth J, Umscheid T. Influence of anesthesia type on outcome after endovascular aortic aneurysm repair: an analysis based on EUROSTAR data. J Vasc Surg. 2006;44(1):16-21. doi:10.1016/j.jvs.2006.03.039
13. De Virgilio C, Romero L, Donayre C, Meek K, Lewis RJ, Lippmann M, et al. Endovascular abdominal aortic aneurysm repair with general versus local anesthesia: a comparison of cardiopulmonary morbidity and mortality rates. J Vasc Surg. 2002;36(5):988-91. doi: 10.1067/mva.2002.128314.
14. Wax DB, Garcia C, Campbell N, Marin ML, Neustein S. Anesthetic experience with endovascular aortic aneurysm repair. Vascular and endovascular surgery. 2010;44(4):279-81.
15. Noh M, Choi BM, Kwon H, Han Y, Ko GY, Kwon TW, et al. General anesthesia versus local anesthesia for endovascular aortic aneurysm repair. Medicine (Baltimore). 2018;97(32):e11789.
16. Arar C, Sezen Ü, Yüksek A, Sarıkaya H, Turan F, Turan C, et al. Combined spinal-epidural anesthesia or local anesthesia+ sedoanalgesia in abdominal aortic aneurism repair?. Journal of Cardio-Vascular-Thoracic Anaesthesia and Intensive Care Society. 2015;21(2):95-100.
17. Gümüş F, Polat A, Farsak B, Alagöl A. Endovasküler aortik rekonstrüksiyonlarda anestezi yaklaşımı. Koşuyolu Kalp Dergisi. 2013;16(1):25-31.
18. Türktan M, Göçen U. Endovasküler aort tamirinde anestezi yaklaşımları: tek merkez deneyimi. Cukurova Medical Journal. 2019;44(4):1256-61.
19. Güzel A, Doğan E, Karaman H, Aycan İÖ, Çelik F, Çiftçi T, et al. Aort patolojilerinin endovasküler tedavisinde anestezi yönetimi. Dicle Tip Derg 2014;41(2):357-63.
20. Barbosa AP, Palotti AM. Uso de sedação com cetamina+ dexmedetomedina (Ketodex) para reparo endovascular de aneurisma de aorta abdominal–relato de experiência. Braz J of Heal Rev. 2022;5(1):995-1005.
21. Lee A, Shirley M. Remimazolam: A review in procedural sedation. Drugs. 2021;81(10):1193-201. doi: 10.1007/s40265-021-01544-8. Epub 2021 Jul 1.
22. Verhoeven EL, Cinà CS, Tielliu IF, Zeebregts CJ, Prins TR, Eindhoven GB, et al. Local anesthesia for endovascular abdominal aortic aneurysm repair. J Vasc Surg. 2005;42(3):402-9. doi: 10.1016/j.jvs.2005.05.047.
23. Ruppert V, Leurs LJ, Steckmeier B, Buth J, Umscheid T. Influence of anesthesia type on outcome after endovascular aortic aneurysm repair: an analysis based on Eurostar data. J Vasc Surg. 2006;44:16-21.
24. Bettex DA, Lachat M, Pfammatter T, Schmidlin D, Turina MI, Schmid ER. To compare general, epidural and local anaesthesia for endovascular aneurysm repair (EVAR). Eur J Vasc Endovasc Surg. 2001;21(2):179-84. doi: 10.1053/ejvs.2000.1295.
25. Parate LH, Channappa NM, Pujari V, Iyer S. Fascia Iliaca block as the sole anesthesia technique in a patient with recent myocardial infarction for emergency femoral thrombectomy. Saudi J Anaesth. 2015;9(2):199-201.
26. Harlin SA, Grissom RA, Le Croy C, Pouliot SM, Harlin SA. A Novel Anesthetic Technique for PEVAR. Ann Vasc Surg. 2016;34:106-10.