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Original Article

A Retrospective Analysis of Comparison of General Versus Regional Anaesthesia for Endovascular Repair of Abdominal Aortic Aneurysm

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Abstract

Objective: The aim of this study is to compare general anaesthesia (GA) versus regional anaesthesia (RA) for endovascular aneurysm repair (EVAR).

Methods: We analysed the files of 89 patients between August 2010-August 2012 who underwent elective EVAR retrospectively.

Results: We performed RA for 32 patients (36%) and GA for 57 patients (64%). The operations were completed successfully in both groups and did not require conventional surgery. The mean age of the patients was 71.5±7 (range 50-88 years). RA was preferred more than GA in the presence of advanced-stage chronic obstructive pulmonary disease statistically (p=0.032). The usage of vasodilator drug and atropine was found to be higher in the GA group than the RA group in the intraoperative period (p=0.001 and p=0.01, respectively). The intensive care unit (ICU) was necessary for 5 patients in the RA group (16%) and 13 patients for the GA group (23%) postoperatively (p=0.301). The median ICU stay in the RA group was 2 hours and 4.4 hours in the GA group (p=0.114). The median hospital stay was 2.63±1.91 days in the RA group and 2.04±1.16 days in the GA group, with no statistically significant difference between groups (p=0.120). There was no mortality of patients in either group for the peroperative period and the 30-day follow-up period.

Conclusion: Our present study suggests that patient characteristics are more important than the anaesthetic method on the outcomes of EVAR.

Key Words: Abdominal aortic aneurysm, endovascular aneurysm repair, anaesthesia

Introduction

Endovascular repair of aortic aneurysms has been increasingly used over the last 20 years as an alternative to traditional open surgery and has already been accepted as first-line therapy in many centres (1). In addition to being less invasive compared with open surgery, it is suggested that endovascular repair of aortic aneurysms enables decreasing perioperative mortality and morbidity because it is possible to use local or regional anaesthesia especially for high-risk patients (2, 3).

The compatibility of various anaesthesia types has been indicated for endovascular aneurysm repair (EVAR) operation. General anaesthesia (GA), some regional anaesthesia techniques, local anaesthesia (LA) and LA with sedation can be counted among these anaesthesia methods (4-6). Even though some studies have shown the advantages of regional techniques and LA, the general anaesthetic approach is in the direction of GA (7, 8). Whether the chosen anaesthesia type has an impact on operation or not is still controversial. Some studies suggest that GA brings about increased surgery duration, requirement of intensive care unit (ICU) and systemic complications (9, 10). However, the multi-centred *EUROSTAR* study has indicated that no anaesthetic technique has an advantage with regards to intraoperative complications and result (11).

In this study, it is aimed to retrospectively compare GA and regional anaesthesia (RA) results for EVAR operation.

Methods

Patient information: After having obtained the approval of Ordu University Non-invasive Clinical Researches Ethics Committee (Date: 25.07.2013, no: 2013/21), the files of 94 patients who underwent endovascular repair in elective conditions because of aortic aneurysm in Ordu Public Hospital Angiography Unit between August 2010 and August 2012 were ex-

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amined. Three patients operated under LA and monitored anaesthetic care and 2 patients operated because of thoracic aortic aneurysm were excluded from the study. Eighty-nine patients who underwent EVAR because of abdominal aortic aneurysm (AAA) were evaluated.

Properties such as demographic characteristics, scores of The American Society of Anesthesiologists (ASA), hypertension (HT), diabetes mellitus (DM), chronic obstructive pulmonary disease (COPD), smoking, coronary artery bypass grafting (CABG) history and renal failure were recorded. Perioperative mortality and morbidity risk were evaluated by the EUROSCORE scoring system. Additional diseases were scanned by Charlson comorbidity index (CCI) and age-adjusted CCI. The anaesthesia method, fluids managed intraoperatively, vasodilator (nitroglycerine), vasopressor (ephedrine), atropine requirement, arterial and central venous catheter application, operation duration, additional surgical intervention, complications, ICU and hospitalisation durations were recorded. Mortality and morbidity results of the patients were provided for a 1-month follow-up period.

Pre-anaesthetic evaluation: All patients were evaluated in an anaesthesiology outpatient clinic before the operation. In addition to routine laboratory tests (haemogram, glucose, urea, creatinine, liver function tests and electrolytes, INR, aPTT), echocardiography and respiratory function tests with cardiology and pulmonary disease consultations were conducted. The patients provided at least 6 h of pre-prandial period went on their own medications. The medications of the patients taking warfarin and clopidogrel were discontinued one week before the operation, and low molecular weight heparin therapy was initiated in case it was necessary. Preoperative intravenous cefazolin sodium was administered to all patients.

Monitoring: After the patients were taken into the operation room, electrocardiogram (EKG, lead D-II ve V5), non-invasive blood pressure and peripheral oxygen saturation (SpO_2) were monitored (Dash 5000, GE Healthcare, Milwaukee, USA). Two 18G peripheral venous catheters (preferably) were placed, and bladder catheterisation was conducted. Routine arterial cannulation and central venous catheterisation were not performed.

Anaesthetic method: The selection of the anaesthetic method was dependent on the primarily planned surgical intervention (the features of aneurism, iliac access, dissection extending to retroperitoneum, necessity for additional surgical intervention, etc.) and the accompanying systemic pathologies of patient. The preferences of patient and/or anaesthesiologist were other factors.

The GA group consisted of patients who underwent endotracheal intubation. Patients in this group underwent tracheal intubation following induction with propofol or thiopental and rocuronium administration and were switched to the controlled mode (CMV, tidal volume: 6-8 mL kg^{-1}, frequency: 10-12 min^{-1}). They were mechanically ventilated in such a way that the end-Tidal CO_2 level was 30-35 mmHg (anaesthesia device: S/5 Avance, GE Healthcare, Milwaukee, USA). The maintenance of anaesthesia was provided with the administration of sevoflurane in the concentration of 1-3% and remifentanil at the dose of 0.1-0.7 mcg kg^{-1} min^{-1} in 50%-50% O_2-air mixture. In the GA group, neuromuscular blockade (NMB) was reversed with the neostigmine-atropine combination (0.05 mg kg^{-1} and 0.02 mg kg^{-1}, respectively) or sugammadex (2-4 mg kg^{-1}). In the presence of a difficult airway, moderate-severe COPD or cardiac disorder, sugammadex was used in the patients.

The RA group included patients who underwent spinal anaesthesia (Spinocan, B. Braun, Melsungen, Germany), combined spinal-epidural anaesthesia (CSE- Espocan, B. Braun, Melsungen, Germany) and continuous spinal anaesthesia (CSA- Spinocath, B. Braun, Melsungen, Germany). RA applications were performed after routine monitoring in angiography preparation room. In accordance with the recommendation of ASA on RA and heparinisation, intraoperative heparin administration should be carried out 1 h after the regional intervention (12). In our study, RA procedures on our patients were performed approximately 1 h before they were taken to the operation room to reduce the risk of spinal hematoma to the minimum level. Generally, 12,5 or 15 mg 0.5% hyperbaric bupivacaine was used as the local anaesthetic agent. Sedation was provided with intravenous midazolam or propofol. A dose of 2-4 L dk^{-1} O_2 was given through a mask or nasal cannula. In 7 patients in whom spinal anaesthesia was planned but in who the process time was expected to be longer, CSE anaesthesia was preferred. CSA was applied to a patient with severe cardiac and pulmonary pathology.

In case of 25% increase in the basal values of mean arterial pressure (MAP), increases of 0,1 mcg were done in remifentanil infusion rate, and when necessary, nitroglycerine intravenous bolus (0.1 mg) or continuous infusion (10-100 mcg dk^{-1}) was applied. When a decrease was observed at a rate of 25% of the basal value, 100-200 mL rapid intravenous fluid infusion was given. In case of no response, 5 mg ephedrine was applied. When a 25% decrease was found in heart rate, remifentanil infusion was decreased with the presence of increased MAP. However, esmolol (0.5 mg kg^{-1} intravenous bolus and when necessary, 0.05 mg kg^{-1} min^{-1} infusion) was administered in the absence of increased MAP. In case of a 25% decrease in the basal value, remifentanil infusion was decreased, and 0.1 mg kg^{-1} atropine intravenous was applied.

Endovascular technique: All procedures were performed by a team consisting of a radiologist, cardiovascular surgeon and anaesthesiologist in an angiography room after a sterile environment was provided using a C-arm angiography device (INFX-8000C Toshiba Medical Systems, Tokyo, Japan). Gore-Excluder (W.L. Gore & Associates, Inc., Flagstaff, Ar-

izona, USA) aortic bi-iliac stent was used for all patients. At the intervention site, arteriotomy was conducted for both femoral arteries and 7 French sheath was placed. Heparin at the dose of 10000 units was given to the patients. After the confirmation of positioning radiologically with contrast-enhanced imaging techniques, a stent-graft was placed. Guide wires were removed, the arteriotomies were closed and heparin was neutralised with protamine sulphate.

Postoperative period: At the end of the process, following the provision of normal oxygenation with spontaneous ventilation and stable haemodynamics without using vasoactive drugs, the patients were transferred to the service after the follow-up in the recovery room. In the contrary case, the patients were monitored in the ICU. For postoperative analgesia, intramuscular diclofenac sodium, and, when necessary, 1 mg kg^{-1} intravenous tramadole were given twice a day. Furthermore, 1 mg kg^{-1} intramuscular meperidine was administered as a rescue analgesic. In patients who underwent CSA and CSE, the catheter was removed after the appearance of a normal bleeding-coagulation profile [active coagulation time (ACT), INR and PTT values] and at least 2 h after heparin application.

Definitions and statistical analysis: The success of the process was defined according to the reports on endoleak and additional surgical interventions and standard endovascular aortic aneurysm repair. Contrast-induced nephropathy (CIN) was accepted to be an increase of 0,5 mg dL^{-1} or 25% from the preoperative value at the level of serum creatinine after other factors leading to renal dysfunction were ruled out (13, 14). Because the patients who were required to be followed-up through monitoring in the early postoperative period were transferred to the ICU, a follow-up longer than 4 h postoperatively in the ICU was recorded to be a necessity.

Among demographic data, findings for age, EUROSCORE, CCI and age-adjusted CCI were presented as mean±standard deviation. Other variables (gender, ASA, HT, COPD, etc.) were presented in frequency values. The presence of a difference between the study groups (RA and GA) in terms of age, process duration, ICU need, and of hospitalisation duration was investigated through Student's-t test. Whether the parameters examined in the study were dependent on the type of anaesthesia or not was evaluated with Fisher's exact test or chi-square analysis. For all statistical analyses, Statistical Package for the Social Sciences, (SPSS IBM Statistics, Chicago, IL, USA) 15,0 for Windows was used and a value of $p<0.05$ was accepted to be statistically significant.

Results

In the 2-year period specified in this study, 89 patients underwent EVAR because of AAA under elective conditions in our clinic. RA was applied in 32 (36%) patients, and GA was applied in 57 (64%) of them. With both anaesthetic techniques, EVAR was performed successfully, and open surgery was not needed. In no patient RA was switched to GA. The mean age of the patients was 71.5±7 years (50-88 years). Seventy-four patients were male (83%) and 15 were female (17%). The most common comorbid disease was HT at a rate of 79%. Of the patients, 44% had COPD. The mean EUROSCORE in the GA group was 6.9, whereas that in the RA group was 6.1. The difference between them was not significant (p=0.201). Similarly, no significant difference was found between the groups with regard to CCI (RA: 2.38; GA: 1.88; p=0.08). Preoperative data are given in Table 1. Of these data, there was a relationship only between patients with severe COPD and the type of anaesthesia. In the presence of severe COPD, RA was preferred at a significantly higher level (p=0.032).

Although no statistically significant difference was found between the groups in terms of process duration, it was detected that process duration was shorter in the RA group than in the GA group (84 min and 96 min, respectively) (p=0.057). In patients who underwent GA, induction was performed with propofol in 42 patients (74%) and with thiopental in 15 patients (26%). In all patients, NMB was provided with rocuronium, and the blockade was reversed with sugammadex in 18 patients (32%) and with the neostigmine–atropine combination in 39 patients (68%).

Additional surgical intervention was performed in 3 patients in the RA group and in 14 patients in the GA group, and there was no significant difference between the groups (p=0.067). In the RA group, coil embolisation was applied to the internal iliac arteries of 3 patients because of endoleak.

Table 1. Characteristics of patient

		RA (n:32) n (%)	GA (n:57) n (%)	Total (n:89) n (%)
Gender:	Male	29 (90.6)	45 (78.9)	74 (83.1)
	Female	3 (9.4)	12 (21.1)	15 (16.9)
ASA	II	11 (34.4)	22 (38.6)	33 (37.1)
	III	17 (53.1)	33 (57.9)	50 (56.2)
	IV	4 (12.5)	2 (3.5)	6 (6.7)
HT		24 (75.0)	46 (80.7)	70 (78.6)
DM		4 (12.5)	7 (12.2)	11 (12.3)
COPD:	Mild	3 (9.3)	7 (12.2)	10 (11.2)
	Moderate	8 (25.0)	12 (21.0)	20 (22.4)
	Severe	7 (21.8) *	2 (3.5)	9 (10.1)
Smoking:	Still smokes	11 (34.3)	21 (36.8)	32 (35.9)
	Has quit	5 (15.6)	7 (12.2)	12 (13.4)
History of CABG		5 (15.6)	8 (14.0)	13 (14.6)
Renal failure		3 (9.3)	2 (3.5)	5 (5.6)

RA: regional anaesthesia; GA: general anaesthesia; ASA: American Society of Anesthesiology; HT: hypertension; DM: diabetes mellitus; COPD: chronic obstructive pulmonary disease; CABG: coronary artery bypass grafting

* Significant compared with the GA group (p=0.032)

On the other hand, in the GA group, the Chimney technique was applied because of suprarenal aneurysm in 1 patient; fem-femoral bypass was performed because of peripheral artery disease in 2 patients, and coil embolisation was applied to the internal iliac artery because of endoleak in 9 patients. Other intraoperative features are presented in Table 2.

CIN was seen in 4 patients (12%) in the RA group and in 6 patients (10%) in the GA group, and there was no significant difference between the groups (p=0.51). Wound site infection developed in a patient from the GA group. Intravenous tramadole was used for postoperative analgesia in 35 patients (61%) in the GA group and in 3 patients in the RA group (9%). The difference between them was statistically significant (p<0.01). With regard to the need for intramuscular meperidine as a rescue analgesic, no significant difference was found between the groups (5 patients in the GA group and 1 patient in the RA group).

After the process, ICU follow-up longer than 4 h was needed in 5 patients (16%) in the RA group and in 13 patients (23%) in the GA group. However, the difference between them was not statistically significant (p=0.30). Hospitalisation duration in the ICU (monitoring over 4 h) was approximately 2 h in the RA group and 4.5 h in the GA group. The difference was not significant (p=0.11). Hospitalisation duration was 2.63±1.91 days in the RA group and 2.04±1.16 days in the GA group, and no significant difference was found between the groups (p=0.12). In patients from both groups, no mortality was observed during the perioperative period and 1-month follow-up period.

Discussion

It has been reported that endovascular repair is performed with less haemodynamic fluctuation, endocrine stress response, blood loss and postoperative pain because it is minimally invasive compared with open surgery (5). Moreover, EVAR is associated with decreased cardiac complications (3.1% vs. 21.8%) and a lower rate of perioperative mortality (1.7% vs. 4.7%). Therefore, EVAR is an attractive treatment strategy for aortic aneurysm repair, particularly in high-risk patients (15-18).

Table 2. Surgical features

	RA (n:32) n (%)	GA (n:57) n (%)	Significance p
Additional surgical intervention	3 (9.3)	14 (24.5)	0.067
Use of ephedrine	7 (21.8)	15 (26.3)	0.422
Use of nitroglycerine	1 (3.1)	18 (31.5)	0.001
Use of atropine	-	9 (15.7)	0.010
Arterial catheter	1 (3.1)	10 (17.5)	0.043
CVC	1 (3.1)	5 (8.7)	0.293

RA: regional anaesthesia; GA: general anaesthesia; CVC: central venous catheter

In the multicenter EUROSTAR study (3) that included 5557 patients and investigated the effect of anaesthetic technique on EVAR results, although the RA group involved high-risk patients, it was reported that less complications were observed, and hospitalisation duration in the ICU and hospital was shorter in this group compared with that in the GA group. It was specified that LA could be used in selected patients and less complicated processes.

In the prospective and non-randomized study of Verhoven et al. (19), in which they shared their EVAR experience under LA, they stated that they applied GA or RA in patients with high body mass index and previous inguinal operation, for whom retroperitoneal access or additional surgical intervention had been planned and that they used LA in other cases. Although they found no difference between the groups in terms of mortality, they detected a lower rate of pulmonary and renal complications in the LA group. However, their preference of GA or RA in high-risk patients is a randomization problem, as in other studies on this topic. Therefore, the results are controversial.

Güneş et al. (20) stated that among patients who underwent EVAR because of AAA, they used RA or LA in patients with ASA III-IV risk scores and GA in patients with ASA I-II risk scores.

In our study, there was no significant difference between the groups with regard to ASA risk classification. However, even though the EUROSCORE and CCI scores evaluating the preoperative medical conditions of patients were not statistically significant, they were higher in the RA group. We thought that this was a result of using RA rather than GA with increased comorbid medical disorders.

The duration of process was longer and the need for additional surgical intervention was higher in the GA group, which was statistically insignificant. This may be explained by the biased selection of patients because the preference was towards GA in complex aneurysms and anatomically existing difficulties (obesity, previous lower abdominal surgery, etc.). In similar studies, this is stated as GA indication (3, 21, 22).

The rate of nitroglycerine and atropine use was lower in the RA group, which was statistically significant. This can be explained by having avoided haemodynamic fluctuations during intubation and extubation by means of RA. In the studies conducted, it was reported that these positive effects of RA and use of intraoperative vasoactive drugs decrease with LA and RA (5, 23).

The most common complication encountered in the postoperative period was CIN. It was reported that the prevalence of renal failure after EVAR ranged from 3% to 20% (24). Risk factors include DM, preoperative dehydration, advanced age, contrast agent volume and nephrotoxic drug use in the perioperative period. In our study, CIN developed at a rate of

10% in the GA group and 12% in the RA group. One patient having received renal replacement treatment (RRT) in the preoperative period undergone RRT was administered again. Except this patient, the clinical pictures of patients improved with hydration.

There are some studies which reported that LA is suitable for EVAR in selected cases (3, 19, 25-27). This is also supported by the European Society for Vascular Surgery (28). Moreover, it was remarked that technical difficulties encountered in processes under LA is not uncommon and this can create a potential danger while placing the graft (21). Similarly, it was specified that the breath-holding manoeuvre of patient during the placement of stent is less satisfying under LA than under GA and that increased intestinal peristalsis can disrupt intraoperative monitoring (21, 28). Patient's movement because of some reasons such as ischemic leg pain and prolonged intervention increases technical difficulties.

In a study comparing GA, RA, and LA techniques for EVAR and including 13459 patients (28), no significant difference was observed between the groups with regards to 30-day mortality. They reported that patients undergoing LA and RA had advanced age, high ASA score and cardiopulmonary load and that the LA group displayed shorter operation duration, less need for ICU, shorter hospitalisation time and decreased postoperative complications. However, they specified that these results were statistically significant but clinically insignificant (for instance, the difference in hospitalisation time was less than half a day). Additionally, they stated that shorter operation duration and decreased complication rate in patients undergoing LA and RA may have resulted from the differences in patient selection. For instance, GA was applied to patients with obesity, anxiety, previous inguinal surgery and complex and difficult anatomy. They also detected that the difference in major morbidity rate was because of comorbidities of patients rather than the anaesthesia technique (28).

In our study, the number of patients needing ICU and ICU follow-up duration was lower in the RA group, which was statistically insignificant. No difference was found between the groups in terms of hospitalisation time. Virgilio et al. (29) compared the results of GA and LA for EVAR and found no difference between cardiac and pulmonary mortality and morbidity rates, but they found that hospitalisation duration in ICU was longer in the LA group. They noted that these results were because of patient features.

In the study by Geisbüsch et al. (25) in which LA was the first choice for EVAR, they reported no difference between the LA, RA and GA groups in terms of mortality, ICU and hospitalisation duration.

The main limitations of our study are the low number of patients, unclearly defined features of aneurysm and not being a prospective and randomized study.

Conclusion

The number of patients who are candidates for EVAR is increasing day-by-day, and this patient group is under anaesthetic risk because of comorbid diseases. Although prospective randomized studies are needed for recommending an anaesthetic technique, it is obvious that the decision on anaesthetic technique should be different for each patient. Patient's choice, patient compliance and surgery-related factors should be taken into consideration when determining the anaesthetic technique. In our study where we presented GA and RA practices for EVAR, no significant difference was detected between the groups with regards to the need for ICU and durations of hospitalisation in the ICU and hospital. We suggest that patient features are more effective than anaesthetic technique on EVAR results.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Ordu University Faculty of Medicine (25.07.2013-21).

Informed Consent: Due to design of our study was retrospective, informed consent was not obtained from patients.

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