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Research Article

Comparison Outcomes of Anesthesia and Hospitalization of Endovascular Treatment versus Open Surgery for Infra Renal Abdominal Aortic Aneurysm at Sina Hospital from 2011 to 2019

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ABSTRACT

Background: Two methods of repair are currently available for an abdominal aortic aneurysm (AAA), open aneurysm surgery, and endovascular aneurysm repair (EVAR). The purpose of this article is to investigate and compare the outcomes of all cases of open surgery versus EVAR conducted from2011 to 2019 at Sina Medical Research and Training Hospital, the first EVAR was conducted at Sina Hospital in 2011.

Methods: This research is a retrospective cross-sectional study. The study population consisted of all abdominal aortic aneurysm patients who were treated at Sina Hospital in Tehran from September 2011 to December 2019. All patients who met the inclusion criteria participated in the study. A checklist of required data was prepared and used to extract data from patients' medical case files. Patients' information was completed via telephone contact with patients or their families. Analyses were performed using SPSS software with a 5-percent error rate.

Results: The sample consisted of 194 patients who were divided into two groups. 73 patients (37.6%) underwent open surgery and 121 patients (62.4%) underwent EVAR. All patients (100%) who underwent open surgery received general anesthesia, while only 15 patients (12.8%) who underwent EVAR received general anesthesia, and 102 patients (87.2%) who underwent EVAR received spinal anesthesia. Rates of blood loss and blood transfusion, length of stay in the intensive care unit (ICU), the total length of postoperative hospitalization for patients who underwent open surgery were significantly higher than for those who underwent EVAR (P-value <0.001). The mortality probability of patients with a history of CVA and smoking was3.47 and 2.66 times higher than those with a negative history of these cases, respectively. Although average EF was higher in living patients compared to deceased ones, this difference was not statistically significant (P-value= 0.161).

Conclusion: Surgery duration, length of stay in ICU, length of hospital stay, and rate of blood transfusion of patients undergoing EVAR was reduced in comparison with those undergoing open surgery.

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Abdominal aortic aneurysm (AAA) is a common disease and the 13th leading cause of death in the United States. It affects 1% of males between 55 and 64 years of age and 2-4% of males over the age of 65 [1-2].

AAA occurs with a high frequency in males, smokers, and those with a family history of aortic aneurysms [3-4]. Presently, two methods of repair are available for an abdominal aortic aneurysm (AAA), open aneurysm surgery, and EVAR [5].

For years, open surgery has been considered as a golden standard treatment for those with large or symptomatic AAAs. It is constantly modifying and evolving. And the results of recent open surgeries are excellent, and the aneurysm is completely removed with excision [6]. However, this type of repair can be associated with several morbidities during and after surgery, including the most common morbidities of cardiac ischemia [7], pulmonary complications including pneumonia [8], renal complications [9], colon ischemia [10], thrombosis [11] or acute embolism [12], lower limb ischemia due to technical anastomosis complications [13], and other complications.

EVAR is a minimally invasive technique using two small incisions made in the groin to expose the femoral arteries. In past, EVAR was performed only for high-risk patients who were unfit for open surgery [14], but after stent-grafts are upgraded, indications of EVAR are becoming wider and are chosen as a treatment for patients whose anatomy fits [15].

Numerous reports, including retrospective meta-analysis studies and controlled randomized prospective trials, have compared postoperative mortality rates of EVAR and open surgery [16-18].

The average time of intervention, blood loss rate, need for blood transfusion during surgery, duration of mechanical ventilation, length of hospital stay, and length of stay in ICU were significantly reduced for patients who underwent EVAR [19-20].

Patients undergoing EVAR may receive local or spinal anesthesia which can greatly affect the patient's outcomes compared to general anesthesia that all patients undergoing open surgery have to receive [21-22].

A lot of studies have been conducted in different countries regarding mortality, morbidity, and comparison of these two methods. Studies on morbidities and benefits of EVAR methods that are performed in Iran are limited and on a small scale; therefore, this study tries to fill this gap by examining all early morbidities extensively. The purpose of this article is to compare the outcomes of all cases of EVAR versus open surgery for AAA conducted from2011 to 2019 at Sina Medical Research and Training Hospital, the first EVAR was conducted at Sina Hospital in 2011.

Methods

This research is a retrospective cross-sectional study. The study population consisted of all abdominal aortic aneurysm patients who were treated at Sina Hospital in Tehran from September 2011 to December 2019. The inclusion criterion was elective abdominal aortic aneurysm repair. Exclusion criteria were emergency ruptured aneurysm repair, suprarenal and thoracic aneurysm repairs, defects in data, and inability to track the patient via telephone contact. Sampling was performed and all patients who met inclusion criteria were selected. The sample size was calculated based on an article by Frank et al. [23] using G-POWER software. Accordingly, the minimum sample size was set 280 patients considering the 30-day mortality rate of EVAR versus open surgery (3% and 5%, respectively).

Data was collected after confirmation and permission of hospital management and the person in charge of medical records and hospital archives by examining the medical case files of abdominal aortic aneurysm patients. A checklist of required data was prepared and used to extract data from patients' medical case files. Moreover, as much information as possible on the anatomy of aneurysms in EVAR cases was obtained from the relevant companies (i.e. COOK and MEDTRONIC). Variables of this study included the year that repair was performed, demographic characteristics, comorbidities in patients, echocardiographic characteristics, type of surgery performed (i.e. open surgery or EVAR), type of anesthesia, blood transfusion rate, amount of blood loss during surgery and duration of the procedure, EVAR-related graft manufacturer, length of post-procedure stay inward and ICU. Qualitative variables were reported using frequency and percentage, while quantitative variables were reported using mean and standard deviation. T-test was used to compare the means of two groups when the data was normal, while Manwitny Test was used to compare the means of two groups when the data was not normal. All analyses were performed using SPSS software with a 5-percent error rate.

Results

During these nine years of study, a total of 280 patients underwent open surgery or EVAR. However, 86 patients were excluded from this study because their medical case files were incomplete, the type of surgery they underwent was not mentioned, or because it was impossible to track them via a telephone call. Therefore, 194 patients were included in this study and divided into two groups that consisted of73 patients (37.6%) who underwent open surgery and 121 patients (62.4%) who underwent EVAR. The mean age of patients undergoing open surgery was 67.93 years (SD = 9.1) and the mean age of patients undergoing EVAR was 71.20 years (SD = 9.50). Furthermore, 91.9% and 89.3% of patients in open surgery repair (OSR) and EVAR groups were male, respectively. Means of the aortic diameter of patients who underwent open repair and EVAR equaled 73.44 cm (SD = 13.50) and 64.48 cm (SD = 13.14), respectively. The minimum and maximum aortic diameters of the open surgery group equaled47.0 and 105.0, respectively. Moreover, the minimum and maximum aortic diameters of the EVAR group equaled 40.0 and 105.0, respectively. (Table 1) shows the distribution of comorbidities in two groups. The number of patients with heart diseases undergoing open surgery was significantly lower.

The presence of coincidental iliac aneurysms was higher in patients undergoing EVAR compared with those undergoing open surgery. Thus, the presence of left, right, or both coincidental iliac aneurysm in patients undergoing EVAR and open surgery equaled 65.8% and 61.7%, respectively. There was no significant difference in smoking patterns in two groups (P-value = 0.177), so that 74.6% (53 patients) and 65.3% (77 patients) of patients undergoing open surgery and EVAR were smokers, respectively. In terms of different types of anesthesia, 100% of patients undergoing open surgery and only 12.8% (15 patients) of patients undergoing EVAR received general anesthesia, and 87.2% (102 patients) of patients undergoing EVAR received spinal anesthesia.

The need for blood transfusion was significantly higher in patients undergoing open surgery compared with those undergoing EVAR (P-value< 0.001) so that 94.1%of all patients undergoing open surgery and 32.1% of all patients undergoing EVAR received blood transfusions. Moreover, patients undergoing open surgery received more units of blood compared to those undergoing EVAR, so that 64 patients who underwent open surgery received an average of 2.11 units of blood and 34 patients who underwent EVAR received an average of 1.21 units of blood (P-value <0.001). Surgery duration was higher for patients undergoing open surgery compared to those undergoing EVAR, although the difference was not statistically significant (P-value = 0.125) (Table 2).

Average ejection fraction (EF) equaled 48.96 (SD= 10.05) in all patients and it equaled 46.83 (SD = 11.8) and 49.86 (SD= 9.1) in deceased and living patients, respectively. Although average EF was higher in living patients compared with deceased ones, this difference was not statistically significant (P-value= 0.161). Furthermore, no significant difference was observed in terms of EF for patients undergoing open surgery and EVAR and also for living and deceased patients (P-value> 0.05).

The logistic regression model showed that in both groups, the mortality probability of patients with a history of CVA and smoking was 3.47 and 2.66 times higher than patients with a negative history for these cases, respectively (Table 3).

Table 1- Frequency distribution of comorbidities in two groups under open surgery and EVAR following AAA

Postoperative complications		EVAR (percentage)	open surgery (percentage)	P value	percentage in all patients
Diabetes	Yes (n=21)	(12.4) 15	(8.3) 6	0.381	10.9
	No(n=172)	(87.6) 106	(91.7) 66		89.1
High blood pressure	Yes (n=111)	(57.0) 69	(58.3) 42	0.859	57.5
	No(n=82)	(43.0) 52	(41.7) 30		42.5
Heart disease (IHD)	Yes (n=96)	(55.4) 67	(40.3) 29	0.043	49.7
	No(n=97)	(44.6) 54	(59.7) 43		50.3
Chronic Kidney Disease (CKD)	Yes (n=25)	(12.4) 15	(13.9) 10	0.765	13.0
	No(n=169)	(87.6) 106	(86.1) 62		87.0
Pulmonary Disease (COPD)	Yes (n=23)	(14.0) 17	(8.3) 6	0.236	11.9
	No(n=170)	(86.0) 104	(91.7) 66		88.1
Stroke History (CVA)	Yes (n=18)	(9.1) 11	(9.7) 7	0.884	9.3
	No (n=175)	(90.9) 110	(90.3) 65		90.7
hyperlipidemia	Yes (n=47)	(26.4) 32	(20.8) 15	0.380	24.4
	No(n=146)	(73.6) 89	(79.2) 57		75.6
Deep Vein Thrombosis (DVT)	Yes (n=6)	(3.3) 4	(2.8) 2	1.0	3.1
	No(n=187)	(96.7) 117	(97.2) 70		96.9

Table 2- Mean (standard deviation) duration of operation, bleeding rate and duration of hospitalization in two groups under open surgery and EVAR following AAA

	EVAR (SD)	Open surgery (percentage)	P value	all patients (SD)
Duration of operation (hours)	(61.0) 145.8	(190.2) 182.2	0.125	159.9 (128.3)
Bleeding rate (CC)	(259.3) 238.2	(628.8)870.4	<0.001	489.6 (538.0)
Duration of hospital stay in the ICU (day)	(1.16) 1.64	(3.69) 3.87	<0.001	2.47 (2.65)
General duration of hospitalization after surgery (day)	(2.36) 3.80	(5.90) 7.30	<0.001	5.10 (4.38)

Table 3- The odds ratio of comorbidities in patients treated with AAA

Comorbidities	Odds ratio (95% confidence limit)	P value
Diabetes	(2.85- 0.29) 0.91	0.870
High blood pressure	(2.60- 0.61) 1.26	0.537
Heart disease (IHD)	(1.48- 0.36) 0.73	0.379
Chronic Kidney Disease (CKD)	(4.0- 0.57) 1.51	0.406
Pulmonary Disease (COPD)	(2.10- 0.23) 0.70	0.520
Stroke History (CVA)	(10.38- 1.16) 3.47	0.026
History of hyperlipidemia	(1.79- 0.32) 0.75	0.517
DVT	(4.78- 0.05) 0.50	0.546
Smoking	(6.05- 1.17) 2.66	0.019

Discussion

This study compared different variables of early outcomes such as surgery duration, hospitalization, and amount of blood loss, type of anesthesia in AAA patients undergoing open surgery versus EVAR.

Lederle et al. reported that patients in EVAR group received zero units of blood and patients in open surgery group received 1.0 unit of blood, and the results of the present study also showed that amount of blood loss, length of stay in ICU, and the total length of postoperative hospitalization were significantly higher for patients undergoing open surgery than for those undergoing EVAR [24].

Jun Ho Yang et al. stated in their study that procedure duration (209.6 min vs. 350.9 min, P <0.001) and length of hospitalization (7.79 days vs. 17.46 days, P <0.001) were significantly higher for patients in OSR group compared with those in EVAR group. Finally, EVAR was optimal in terms of intervention time and length of hospital stay [25]. Length of hospital stay, amount of blood loss, and surgery duration of the EVAR group were significantly smaller in the investigation carried out by García Madrida et al. [26].

Length of stay in ICU of patients undergoing open surgery was higher in comparison with those undergoing EVAR. Length of stay in ICU (0 and 2 days) and length of hospital stay (2 days vs. 7 days) were significantly reduced in the EVAR group in the research performed by Wesley S. Moore et al. [27].

Type of anesthesia is a factor determining the length of hospitalization and length of stay in ICU. Since 100% of patients in the OSR group received general anesthesia and only 12.8% of patients in the EVAR group received general anesthesia and the rest of patients in the EVAR group received spinal anesthesia, type of anesthesia could play a role in different outcomes that patients in these two groups experience. Other studies have also confirmed this result. Shiels et al. showed in a study that most patients undergoing open surgical repair of AAA stay in ICU [28]. Bakker et al. also stated in their study that general anesthesia received before EVAR results in worse cardiac complications [29]. Ruppert et al. found that hospitalization morbidity, length of hospitalization, and length of stay in ICU were significantly lower in patients who received local anesthesia before EVAR compared with those who received general anesthesia before EVAR [30].

Patients with a history of CVA and smoking had the highest mortality rate in the present study. Numerous studies have shown that smoking increases the prevalence of AAA [31-32], and doubles the risk of AAA rupture [33], and reduces the chances of EVAR success [34] and increases the likelihood of stent-graft migration [35] and a healthy lifestyle reduces the chances of developing AAA [32].

Conclusion

Mortality probability of patients with AAA who had a history of CVA and smoking was the highest. Surgery duration, length of stay in ICU, length of hospital stay, and rate of blood transfusion of patients undergoing EVAR was reduced in comparison with those undergoing open surgery.

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