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Endovascular procedures versus Open Repair in the management of Abdominal Aortic Aneurysm

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ABSTRACT

Background: Endovascular repair or open surgery are two options for treating abdominal aortic aneurysm. To avoid potentially fatal aortic ruptures, prosthesis is inserted in both instances. different research arrived at different findings when trying to determine the best course of treatment.

Aim and objectives: Examining the anesthesia, operating time, hospital stay, main patency, and complications of Endo Vascular Aortic Repair (EVAR) vs. open surgical repair (OSR) for infra renal abdominal aortic aneurysms (AAA).

Patients and methods: From July 2021 to October 2023, fifty patients at Beni-Sueif University hospital and Military hospitals in Cairo were randomly assigned to either endovascular or open repair of big abdominal aortic aneurysms (≥5.5cm in diameter) in a retrospective observational comparative analysis. Each group consisted of twenty-five patients.

Results: The result of study comparing EVAR to open repair is EVAR less in duration of procedure 130-minutes versus 190-minutes for open, less in intraoperative complication 28%for EVAR 52% for open, less in ICU stay 1-day for EVAR versus 3-days for open, less in hospital stay 2-days for EVAR versus 4-days for open. One-week post-operative complications 8% for EVAR 36% for open one-month complications 6% for EVAR 12% for open.one year complications 16% for EVAR and 8% for open.

Conclusion: There are a number of advantages to EVAR over traditional surgery, including shorter hospital stays, less blood loss, fewer rates of complications, and rates of inpatient mortality.

Keywords: *EVAR;Open repair;Abdominal aortic aneurysm;End leak*

1. INTRODUCTION

The aortic diameter is 3.0 cm or more in abdominal aortic aneurysms (AAAs), suggesting a dilatancy. The aorta wall weakens and eventually bursts as a result of the pressures exerted by the luminal blood pressure; this disastrous event is linked to a death rate of 50-80% if not addressed [1].

Patients with infra-renal aneurysms bigger than 5.5 cm often undergo endovascular aortic repair (EVAR) instead of open surgery, which lowers the chance of death within 30 days from 4.7% to 1.7% [2].

Due to the significant risk of complications and deaths associated with open AAA repair in elderly patients, endovascular AAA repair (EVAR) has replaced it as the treatment of choice for these fragile patients [3].

For more than four decades, the principal method of treatment involved open surgical repair (OSR) by a retroperitoneal or laparotomy technique, and the substitution of a synthetic graft for the aneurysmal aortic section. Patients with a moderate life expectancy have generally been provided open repair because to its long-term durability. One important drawback of open repair is the high 30-day death rate—as high as 8.2% in certain series—that has been linked to it [4].

EVAR was developed as a gentler alternative to open repair for patients who were deemed unfit for the procedure [5].

Compared to traditional surgery, EVAR offers a number of benefits. To begin with, it is a minimally invasive treatment, which is crucial for patients with several medical conditions who would not fare well with traditional surgical procedures. When compared to open procedures, EVAR causes far less operational trauma, blood loss, and major hemodynamic and ventilator-related disruptions. There has been a considerable decrease in both the length of time patients spend in the hospital and the time they need to recover after EVAR was introduced. The former reduction was around 10–3 days, while the latter was closer to 6 months to 11 days [6].

In order to better understand the pros and cons of EVAR vs OSR for infra renal AAA therapy, this study compared the two procedures in terms of anesthesia, operating time, length of hospital stay, main patency, and complications.

2. PATIENTS AND METHODS

Fifty patients undergoing endovascular or open repair for large abdominal aortic aneurysms (≥5.5 cm in diameter) were part of a retrospective observational comparative study that ran from July 2021 to October 2023 in Beni Sueif University hospital and Military hospitals in Cairo. Each group consisted of twenty-five patients. The following variables were tracked: patient demographics, clinical presentation, anesthetic type, duration of surgery, blood loss, length of hospital stay, risk of complications, death, and illness.

Inclusion criteria:

Individuals necessitating infra-renal AAA, AAA measuring 5.5 cm or more, being physically able to undergo open surgery, and meeting the anatomical criteria for EVAR.

Exclusion criteria:

Diameter less than 5.5cm, patients with AAA and occlusive aortic disease, patients with AAA and aortic dissection or rupture, patients with AAA and aortitis, patients outside instruction for use of EVAR devise, patients with thoracic aortic aneurysm, and patients not fit for surgery.

Methods:

After patients gave their written agreement, they underwent standard medical procedures, including taking a full medical history, doing a physical examination, and running basic laboratory tests.

Imaging:

Arterial duplex, CT angiography for accurate diagnosis of level of aneurysm. neck length, diameter and angulation. Landing zone length and diameter.

Peri- procedural evaluation;

Measured in terms of procedure time, blood loss and transfusions, intensive care unit stay, hospital stay, mortality, and morbidity

Short term evaluation:

Was represented in re-intervention, and conversion from endovascular to open surgery.

Follow up:

Was done at 1m, 6m and 12m 18m 24m by: CT scan, and post intervention medications.

Technique of operation:

Endovascular:

Preoperative Imaging Studies:

The main way to find out if EVAR is right for you is to look at your vascular morphology. CT scans show anatomical structures in an axial plane, so you can measure the aorta and iliac arteries accurately. However, if you measure them along the cranio-caudal axis, you might be underestimating how far the endograft needs to go. Surgical cut-down capabilities are available in an endovascular suite. EVAR carried out in an endovascular suite while the patient is under general anesthesia.

Procedure:

From this vantage point, you can make out the common femoral arteries. Prior to the operation, an aortogram is taken at the intersection of the renal arteries, the aortic bifurcation, and the iliac bifurcation. The device is deployed by introducing a calibrated pigtail from the opposite side. Once the device is positioned correctly beneath the image intensifier, the deployment sheath is slid right over it and the catheter and prosthesis it carries are inserted over a superstiff guide wire into the artery. The catheter is advanced under radiographic supervision until the prosthetic tip is positioned immediately below the renal arteries. The exact position of the renal arteries can be determined by cautiously removing the angiographic catheter and then administering contrast material through it. The ipsilateral limb and trunk of the bifurcated prosthesis are deployed under radiographic control.

Following the ipsilateral limb deployment, the following step is to find the contralateral femoral artery and thread a guide wire through the prosthetic stump. With the use of an angled guiding catheter, this can be accomplished from below. Under radiographic guidance, insert the graft from the other limb into and over the stump after cannulation of the contralateral stump. At this point, the balloon is inflated to ensure that the stents are appropriately stretched and touching the arterial wall. Following the procedure, a digital subtraction aortogram is conducted to check for endoleak, confirm graft placement, and guarantee that enough of the iliac artery has been covered to provide stable distal fixation. Once the graft insertion has been verified, all catheters, sheaths, and guide wires can be removed. The groin incisions can be closed after the arteriotomy incisions have healed.

Surgical repair:

Procedure

A thorough examination of the abdomen is conducted under general anesthesia through a transperitoneal incision in order to measure the aneurysm's size and to eliminate alternative potential causes. Dividing the Treitz ligament and drawing the transverse colon superiorly allow for a rightward retractio of the small bowel. Retraction is made much easier with a permanent, self-retaining device. To reach the aneurysm, a cross-sectional incision is made in the peritoneum, somewhat to the left of the base of the small bowel mesentery. By locating the left renal vein and pulling it superiorly, the aneurysm neck can be clearly seen. Once the normal aorta and iliac arteries have been sufficiently dissected, a vascular clamp is placed either close to or distant from the aneurysm. The aneurysm is opened longitudinally along its front surface, away from the inferior mesenteric artery, after making a horizontal incision in the proximal aorta at the level selected for the proximal anastomosis. Draining the aneurysm of atherosclerotic debris and intraluminal thrombotic material prepares it for the proximal anastomosis. Surgeons can check the suture line for bleeding and make any required adjustments after briefly releasing the proximal aortic clamp, which is used to clamp the graft after proximal anastomosis. The aorta (tube graft) is the distal anastomosis in 10 cases. The iliac artery aneurysms are cut anteriorly in fifteen individuals, and the normal iliac artery is sutured to the limbs of a bifurcated graft beyond the aneurysms. This process is comparable to the one used immediately preceding the bifurcation. After closing the aortic prosthesis and upper anastomosis in three patients, the duodenum was placed above it using a pedicle of larger omentum to separate the two. Before the abdomen was closed, the small intestine was carefully checked and then put back where it had been.

Statistical Analysis:

The data was entered, processed, and analyzed statistically using MedCalc ver. 18.2.1 (MedCalc, Ostend, Belgium). Mann-Whitney U, chi-square, logistic regression, and Spearman's correlation were among the many statistical tests utilized. We displayed the data for each variable and performed appropriate analyses depending on the type of data we received, whether it was parametric or non-parametric. With a p-value less than 0.05 (5%), statistical significance was established. A p-value is deemed significant (S) if it is less than 0.05, non-significant (NS) if it is more than 0.05, and highly significant (HS) if it is less than 0.01.

3. RESULTS

Table (1): Basic clinical data among 50-AAA patients.

Variables		Frequency (%)
Age (years)		63.10±4.78*
Gender	Female	5(10%)
	Male	45(90%)
Co-morbidities	Smoking	45(90%)
	DM	10(20%)
	HTN	41(82%)
	IHD	39(78%)
	Hyper lipidemia	31(62%)

* Mean±SD. IHD stands for ischemic heart disease, DM for diabetes mellitus, and HTN for hypertension.

All patients were 63.10±4.78) years old on average. In terms of patient gender, 90% of patients were men, and 10% were women.

In terms of comorbidities, 90% smoked, 20% had diabetes, 82% had hypertension, 78% had IHD, and 62% had hyperlipidemia.

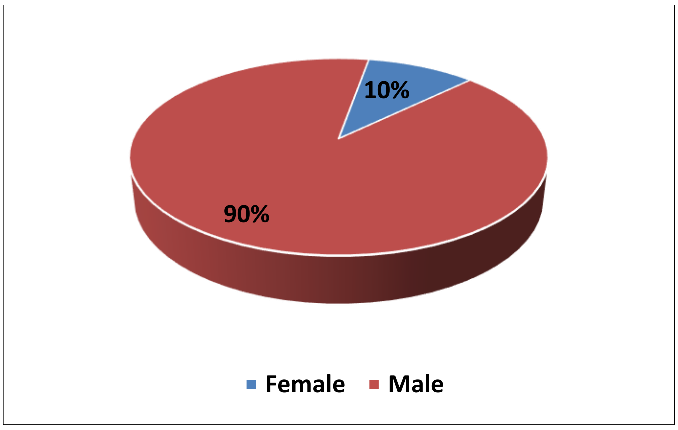

Figure (1): Gender among 50-AAA patients.

Table (2): Preoperative and intraoperative information for 50 AAA patients.

Variables		Frequency(%)
AAA Size(cm)		7.65±1.05
Operative time(min)		167.46±41.66
Transfusion of blood (intraoperative)		8(16%)
Problems (intraoperative)	Rate of complications	20(40%)
	Arrhythmia	2(4%)
	Distal Emboli	4(8%)
	Hemorrhage	8(16%)
	Endoleak	6(12%)

The mean operating time was 167.46±41.66 minutes, and the mean AAA size was 7.65±1.05 cm.

The overall rate of intraoperative complications was 40%, with 4% experiencing arrhythmias, 6% endoleak, 4% distal emboli, and 16% hemorrhaging and requiring blood transfusions.

Table (3): Post-operative information for 50 individuals with AAA.

Variables		Frequency (%)
ICU stay(days)		2.28±1.39
Ward stay(days)		3.02±1.17
Blood transfusion (post-operative)		2(4%)
Complications (1-week post-operative)	Complications rate	11(22%)
	Chest infection	3(6%)
	Wound infection	4(8%)
	Endoleak	2(4%)
	seroma	2(4%)
Complications (1-month post-operative)	Complications rate	9(18%)
	Renal impairment	5(10%)

	Surgical hernia	1(2%)
	Wound dehesins	1(2%)
	Endoleak	2(4%)
Complications (1-year post-operative)	Complications rate	6(12%)
	CKD	4(8%)
	Intervention	1(2%)
	Surgical hernia	1(2%)

CKD: chronic kidney disease.

The mean ward stay was 3.02±1.17 days, and the ICU stay was 2.28±1.39. Four percent of patients had post-operative blood transfusions. A total of 22% of patients experienced problems within 1 week after surgery, including 4% endo leak, 8% wound infection, 4% seroma, and 6% chest infection. After one month, the overall rate of complications was 18 percent, with 10 percent experiencing renal impairment, 4 percent having an endo leak, 2 percent having a surgical hernia, and 2 percent having wound dehesins.

In terms of complications that occurred one year after surgery, the overall rate was 12%; 8% of patients had chronic kidney disease (CKD), 2% had reintervention, and 2% had a postoperative hernia. 18 months and 24 months are equivalent to a year.

Table (4): Comparing the two groups based on fundamental clinical data using the Chi square and Mann-Whitney's U tests.

Variable		EVAR-group (25)	OSR-group (25)	Mann-Whitney's U-test
		Median(IQR)	Median(IQR)	P-value
Age(years)		63(7.5)	63(6)	=0.95
Variable		EVAR group (25)	OSR group (25)	Chi square test P-value
Gender	Female	3(12%)	2(8%)	=0.64
	Male	22(88%)	23(92%)	
Co-morbidities	Smoking	23(92%)	22(88%)	=0.64
	DM	5(20%)	5(20%)	=1
	HTN	23(92%)	18(72%)	=0.066
	IHD	23(92%)	16(64%)	=0.017*

IQR: inter-quartile range. *Percentage of Column Total.

A comparison of the two groups showed that the EVAR-group had a considerable rise in terms of IHD when compared to the OSR group, with a significant statistical difference (p<0.05). When the two groups were compared, there was no discernible difference in age, gender, smoking, diabetes, or hypertension (p>0.05).

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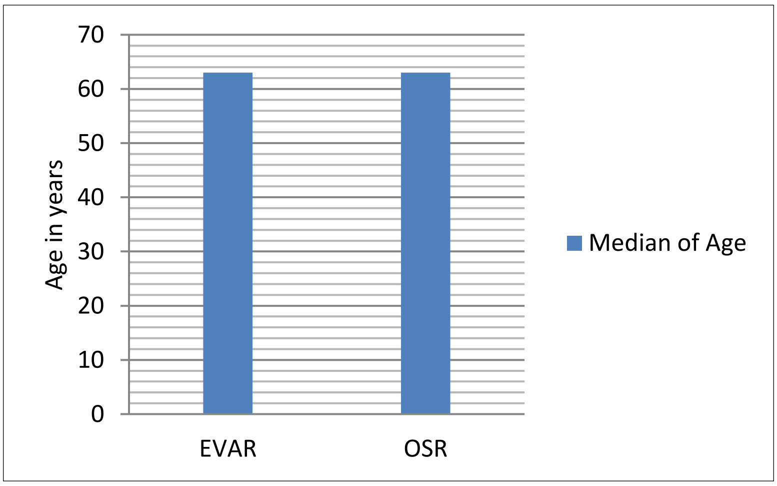

Figure (2): Age comparison between the two groups.

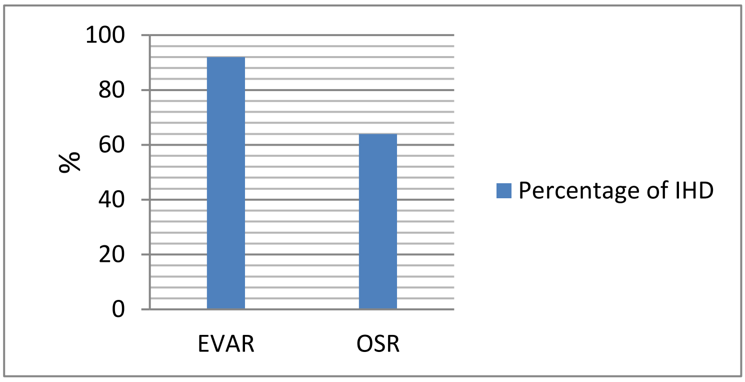

Figure (3): Comparison of the two groups with respect to IHD.

Table (5): Comparison of the two groups' pre- and intraoperative data using the Chi square and Mann-Whitney's U tests.

Variable		EVAR-group (25)	OSR-group (25)	Mann-Whitney's U-test
		Median (IQR)	Median(IQR)	P-value
AAA Size(cm)		7(6.5-7.8)	7(7.6-8.9)	=0.014*
Operative time (min)		130(20)	190(47.5)	<0.0001**
Variable		EVAR-group (25)	OSR-group (25)	Chi square test P-value
Blood transfusion (intra-operative)	+ve	0(0%)	8(32%)	=0.002**
Complications rate (intra-operative)		7(28%)	13(52%)	
Arrhytmia		1(4%)	1(4%)	
Distal emboli	+ve	0(0%)	2(8%)	=0.042*
Renal artery injury		0(0%)	1(4%)	
Hemorrhage		0(0%)	8(32%)	
Endoleak		6(24%)	0(0%)	
mortality		0(0%)	1(4%)	

*Percentage of Column Total.

Comparison between the 2 groups revealed; statistically significant(p<0.05) decrease in AAA size and complication rate intraoperative and highly statistically significant(p<0.01) decrease in operative time and blood transfusion in EVAR group; compared to OSR group. Comparison between the 2 groups revealed non-significant difference as regards intra-operative complications(p>0.05).

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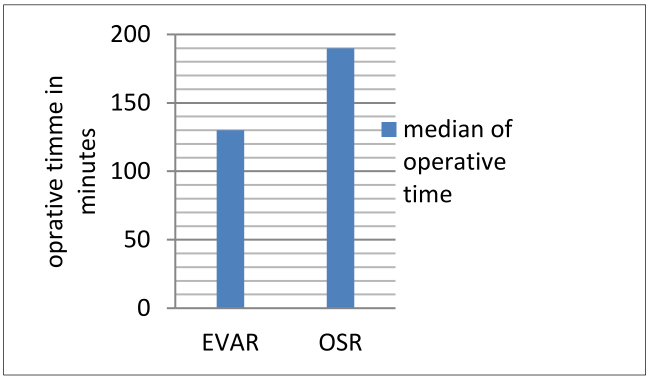

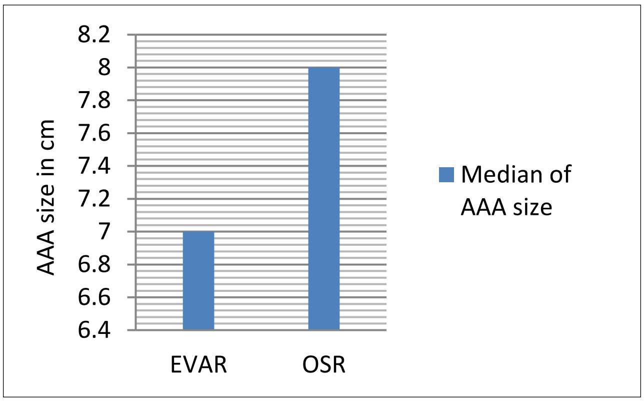

Figure (4): Comparison between the 2 groups as regards AAA size **Figure (5): Comparison between the 2 groups as regards operative time.**

Table (6): Comparison between the 2 groups as regards Post-operative data using Mann-Whitney's U and Chi square tests.

Variable		EVAR-group (25)	OSR-group (25)	Mann-Whitney's U-test
		Median (IQR)	Median (IQR)	P-value
ICU stay(days)		1(0)	3(1)	<0.0001**
Ward stay(days)		2(0)	4(2)	<0.0001**
Variable		EVAR-group (25)	OSR-group (25)	Chi square test P-value
Blood transfusion (post-operative)	+ve	0(0%)	2(8%)	=0.157
Complications rate (1-week post-operative)	+ve	2(8%)	9(36%)	<0.01*
Chest infection		0(0%)	4(12%)	
Wound infection		0(0%)	3(12%)	
seroma		0(0%)	2(8%)	
endoleak		2 (8%)	0 (0%)	
Complications rate	+ve		3(12%)	=0.87
(1-month post-operative)		6(24%)		
Renal impairment			1(4%)	
Surgical hernia		4(16%)	1(4%)	
Wound dehesins		0(0%)	1(4%)	
endoleak		0(0%)	0(0%)	
		2(8%)		
Complications rate (1-year post-operative)	+ve	4(16%)	2(8%)	=0.38
Chronic kidney disease		3(12%)	1(4%)	
Surgical hernia		0(0%)	1(4%)	
reintervention		1(4%)	0(0%)	

*Percentage of Column Total.

A comparison of the two groups showed that the EVAR group had a highly significant statistical distinction from the OSR group in terms of a decrease in ICU and ward stay as well as a 1-week post-operative complication rate (p<0.01). A comparison of the two groups' blood transfusion and one-month and one-year problems showed no significant differences (p>0.05).

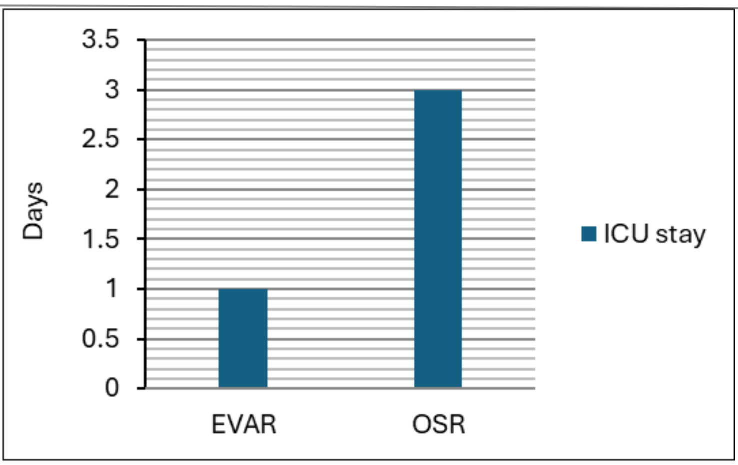

Figure (6): Comparison of the two groups with respect to ICU stay.

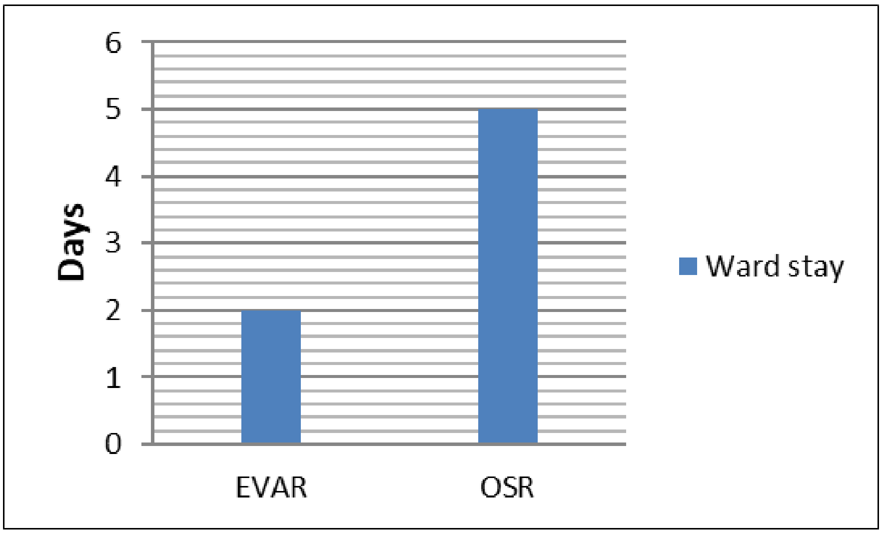

Figure (7): A comparison of the two groups' ward stays.

Table (7): Basic clinical/pre and intraoperative factors related to intensive care unit and ward stay are analyzed using Spearman's correlation:

Associated Factor	ICU stay		Ward stay	
	Rho	P	rho	P
Age(years)	-0.14	=0.92	-0.98	=0.50
AAA Size(cm)	0.444	=0.013*	0.321	=0.0835
Operative time(min)	0.8	<0.0001**	0.89	<0.0001**

rho: Spearman's rho (correlation coefficient).

According to Spearman's correlation analysis, there was a statistically significant (p<0.05) positive association between AAA size and ICU stay, and a highly significant (p<0.01) positive correlation between surgical duration and ICU stay. Age and ICU stay had a non-significantly negative association, according to Spearman's correlation analysis (p>0.05).

In respect to ward stay, Spearman's correlation analysis reveals a highly significant positive association between operational time and ward stay, with a statistically significant difference (p<0.01). Age and AAA size did not significantly correlate with ward stay, according to Spearman's correlation analysis, however there was a substantial statistical difference (p>0.05).

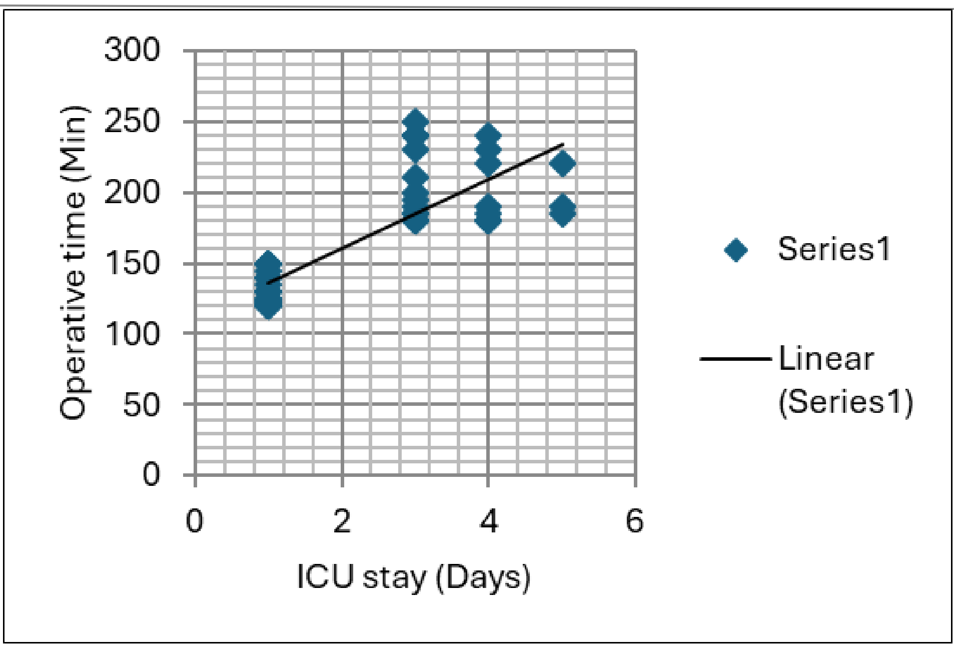

Figure (8): ICU stay and operating time correlation.

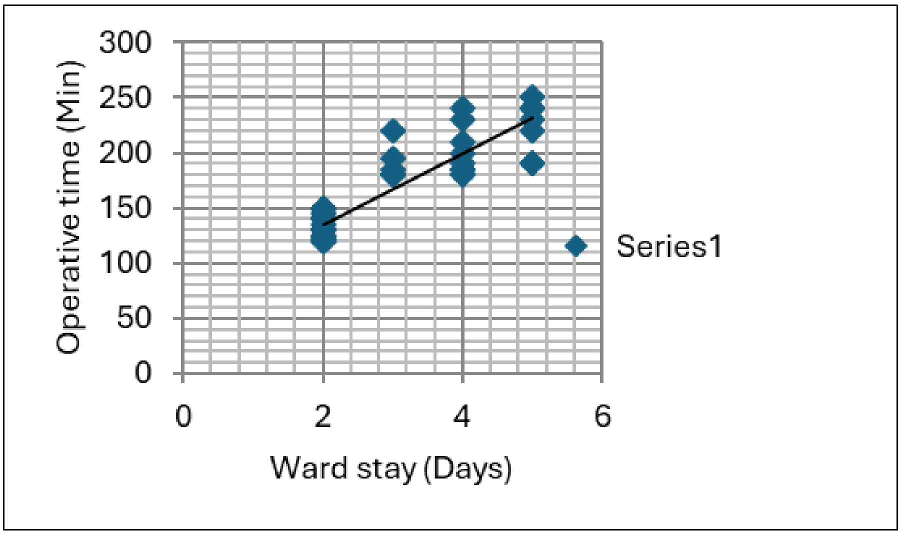

Figure (9): Ward stay and operating time correlation.

4. DISCUSSION

This comparison is challenging because, despite three randomized trials comparing EVAR and OPEN, none of them have been completed. This is due to a number of factors, including the following: the selection of patients for EVAR and OPEN in clinical practice differs significantly from the trials' aims; EVAR is less stressful than OPEN, so higher-risk patients are typically assigned to it; and the fact that the trials' designs differ from those of the devices themselves. However, because to anatomical limitations, EVAR is not always an option; patients with complicated anatomy are typically treated with OPEN repair [7].

Compared to traditional open surgery, EVAR has several well-documented advantages, such as less blood loss during the procedure and a shorter hospital and intensive care unit stay. Systemic morbidity, vascular or local complications, procedural failure, and perioperative mortality are factors that negatively impact early outcome.

Results from non-randomized studies comparing EVAR with open repair indicate that EVAR has a decreased incidence of most systemic problems. Compared to open surgery, which had a mean incidence of 22% systemic problems, EVAR had a 9% incidence, according to a meta-analysis.

Considering that EVAR patients had a substantially greater prevalence of preexisting cardiac and other risk factors, these reductions were expected [8].

Fifty patients diagnosed with an abdominal aortic aneurysm were included in our study to evaluate the short-term and initial outcomes of endovascular annuloplasty against open surgical repair. We compared the new EVAR technique to the classical open surgical technique in terms of anesthesia technique, procedure time, blood loss, intensive care unit stay, hospital stay, re-explanation, vascular complications mortality, and morbidity. This was because our study was the first experience with EVAR. In terms of the kind of anesthesia, a higher percentage of procedures in the EVAR group and the open repair were performed under general anesthesia compared to other studies. In Eurostar, for example, 40% of procedures were performed under regional anesthesia [9].

One of the key benefits that must be considered in vascular patients is the procedure duration, as it significantly affects the patient's outcome; EVAR took approximately 130 minutes, whereas open repair took about 190 minutes. Consistent with a study that found endovascular repair to need 95–120 minutes of operating time compared to 180–300 minutes for open repair [10].

No one in the EVAR group required a blood transfusion, but 32% of those in the open surgical repair group did. This demonstrates that the EVAR technique causes very little blood loss during device insertion and deployment, a well-documented advantage of EVAR over traditional open surgical repair [11].

In this study, the EVAR group had a shorter median ICU stay than the open surgical repair group, with a 1-day versus 3-day median ICU stay. This finding is consistent with previous studies that have shown a shorter ICU stay than open repair, such as the EVAR trial and Eurostar [9].

The median length of stay for the EVAR group was two days, compared to four days for the open surgical repair group; this finding is consistent with previous research showing that EVAR requires shorter hospital stays than open repair [12].

Concerning vascular complications, there was an uneven distribution. In the EVAR group, no occurrences were reported. However, in the open repair group, three cases were recorded; two of these cases had lower limb thrombosis, which was treated with fogarty thrombectomy on one side and direct repair on the other.

Cardiac complications were comparable in the two groups, as were systemic complications such as pulmonary complications with EVAR (0% versus 12%). While some research has shown an increase in systemic problems following open surgical repair, other studies have found a decrease in the incidence of pulmonary complications, hemorrhage, graft infection, colonic ischemia, and graft infection after endovascular repair (EVAR) (2.9% vs. 10.9%, 1.8% and 3.4%, respectively) [13].

We did not see any fatality following EVAR, and one case occurred following open surgical repair. Compared to the open surgical repair group, the EVAR group had much lower fatality rates, according to all previous investigations [9].

5. CONCLUSION

There are a number of advantages to EVAR over traditional surgery, including shorter hospital stays, less blood loss, fewer rates of complications, and rates of inpatient mortality.

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