

*Research Article***Open surgical repair of infra renal abdominal aortic aneurysm with challenging neck****Mahmoud S. Eldesouky^{*}, Magdy A. Haggag^{**} and Mostafa M. Abdelghany^{***}**^{*} Department of Vascular Surgery, Monofyia University^{**} Department of Vascular Surgery, Cairo University^{***} Department of Vascular Surgery, Minia University**Abstract**

Background: Hostile aortic neck is defined as the presence of one or all of the following characteristics: neck length < 15 mm, diameter > 28 mm and neck angulation > 60°. Other adverse morphological parameters include proximal neck circumferential thrombus or calcification (> 50%) or a tapered/conical neck. **Patients & Methods:** Twenty patients proved with AAA challenging aortic neck from Cairo, Minia and Monofyia University hospitals. CT angiography was done in all patients; supraceliac clamping was done in some cases while in the majority of cases infra renal clamping was possible. Trans peritoneal approach was used in most of our cases. **Results:** In our study 75% of the patients underwent open surgical repair through trans-peritoneal approach and 25% of the patients underwent retro-peritoneal approach. The aneurysm size was highly variable, 10 (50%) of the patients had the aneurysm diameter between (5.5- 6.5) cm, 4 (20%) of the patients had the aneurysm diameter between (6.5- 8) cm and 6 (30%) of the patients had the aneurysm diameter > 8cm. The proximal neck length was from 10.3mm to 15 mm, neck angulation was from 60 to 80 degree, neck diameter was from 28 to 30mm and circumferential neck thrombus in our patients varied from 50%-75%.

It was found that 2 patients (10%) had intra-operative bleeding, one patient (5%) had graft thrombosis 3 patients (15%) had wound infection, 2 patients (10%) had incisional hernia, and 2 patients (10%) died in ICU. **Conclusion:** Elective surgical repair remains the best standard treatment for AAAs larger than 5 cm in diameter especially in those with contraindications to EVAR. Abdominal aortic aneurysms less than 5cm are monitored yearly by computerized tomography, magnetic resonance imaging or ultrasound.

Keywords: Infra renal, abdominal aortic aneurysms, challenging neck.

Introduction

Aneurysms of the infra-renal aorta are by far the most common arterial aneurysms encountered in clinical practice today; they are 3-7 times more common than thoracic aneurysms⁽²⁾.

Lederle et al., 1988 reported that abdominal aortic aneurysms occur in about 1.4% of men aged over 50 years and the incidence appears to be increasing, partly as a result of the increasing age of the population and also because of greater diagnostic awareness⁽³⁾.

In the United States, a screening study of male veterans found new abdominal aortic aneurysms in 2.6% of patients 4 years after an initial normal aortic ultrasound study, for an incidence of 6.5 per 1000 person per year.⁽⁴⁾

Most abdominal aortic aneurysms are asymptomatic unless rupture occurs, which presents with the classical triad of abdominal and back pain, hypovolemic shock and a pulsatile abdominal mass⁽⁵⁾.

The reported incidence of ruptured AAA varies from 1 to 21 per 100,000 person per year, as for patients older than 50 years; the incidence of AAA rupture is much higher because AAA increases dramatically with age⁽⁶⁾.

The aneurysm neck was classified as “challenging” in the presence of one or more of the following criteria: hourglass neck, angulated neck: $\geq 60^\circ$ (angle between the juxta-renal aorta and long axis of the aneurysm sac), short neck: neck length <15 mm, significant thrombus: >50% of the proximal neck circumference

covered, reverse conical neck: neck dilated ≥ 2 mm within 10 mm of the most caudal renal artery or barrel neck ⁽⁷⁾.

The risk of rupture is related to size, as AAAs greater than 5.5 cm in diameter have a significant risk of rupture and elective repair with insertion of a prosthetic graft is therefore indicated ⁽⁸⁾.

The preoperative evaluation and anatomical features of the aneurysm play a very important role in patient selection for open repair of aortic aneurysm ⁽⁹⁾. Ultrasonography is used for screening because it is non-invasive, cheap, can be performed in a community setting and has a high sensitivity and specificity for the detection of AAA ⁽¹⁰⁾.

Computed Tomography is the imaging modality of choice in cases diagnosed by ultrasound to confirm the diagnosis and adequately evaluate the aneurysms for further management plan ⁽¹¹⁾. It provides more accurate measurement of diameter, with 91% of studies showing less than 5mm inter-observer variability ⁽¹¹⁾.

The decision to proceed with open surgical repair is based on balancing the risk of aneurysm rupture with the peri-operative risk of repair, a calculation that has to be tailored to the individual patient based on preoperative risk factors and the risks of the proposed intervention ⁽¹²⁾.

Careful patient selection and preparation is critical to obtain excellent outcomes, this is due to the physiologic derangements that occur as a result of the hemodynamic stress of an aortic cross-clamp, a detailed understanding of the patient's cardiac, pulmonary and renal function is necessary to determine who is a candidate for open repair ⁽¹³⁾.

The aim of this study is to assess outcome of open surgical repair of infra renal abdominal aortic aneurysm with challenging neck

Patients and Methods

This study is a prospective multicenter study that was done in the period between December 2013 and August 2018 included 20 patients, from Cairo, Monofyia and El-Minia University hospitals.

Inclusion criteria:

Aneurysms measure ≥ 5.5 cm in diameter ,aneurysm with challenging neck that include:
a-Hourglass neck. b. Angulated neck $>60^\circ$. c. Short neck < 15 mm d-Significant thrombus or calcification e- Reverse conical neck

Exclusion criteria:

Infra renal aneurysm with friendly neck, thoraco-abdominal aortic aneurysm. Complicated AAA that indicated emergency intervention, small asymptomatic aneurysms less than 5 cm in the maximum diameter, patients unfit for surgery.

For all the patients the whole procedure planned to him was explained and the possible complications and an informed consent was obtained following the ethical committee requirement of the university.

Clinical history taking and examination was meticulously done for all patients concluding the following criteria: age, gender, possible risk factors and co-morbidities that are supposed to associated with AAA or may affect the general condition of the patient such as smoking, hypertension, dyslipidemia, cardiac condition, chest condition, renal function and diabetes.

Some of the patients were asymptomatic and were discovered accidentally. Majority of the patients presented with symptoms such as back pain and sense of abdominal pain\fullness and pulsations.

General examination was done for all patients to assess the general status of these patients and presence of associated peripheral vascular diseases.

Local examination was also done especially in patients whom have pulsatile abdominal mass to assess the site and the character of this mass.

Preoperative preparations were done in the form of the routine measurements especially kidney function, Echo cardiology, abdominal ultrasound, duplex arterial study of lower limb and CT Angiography which is the key investigation tool for full evaluation of the condition and it provides all the needed criteria as aneurysm size, length and morphology of the neck, infra-renal angle, the length, diameter and angulation of the iliac vessels, renal arteries and accessory renal arteries.

Preoperative intravenous antibiotics (usually a cephalosporin) were administered to reduce the risk of prosthetic graft infection. Intra-arterial pressure recording and monitoring of urine output are routine.

For patients with significant cardiac disease, pulmonary artery catheters were used frequently to guide volume replacement, vasodilator or inotrope therapy intra-operatively and in the early postoperative period .

Trans-esophageal echocardiography was done in selected patients to monitor ventricular volume and cardiac wall motion abnormalities and to guide fluid administration and the use of vasoactive drugs

From 20 patients included in this study, 15(75%) cases underwent trans-peritoneal approach while 5(25%) cases underwent retro-peritoneal approach.

Trans-peritoneal approach:

Anesthesia:

Ten patients underwent trans-peritoneal repair by general anesthesia while five patients underwent the operation by combined spinal and epidural anesthesia.

Incision:

The midline incision was done extending from xiphi-sternum to symphysis pubis.

Exposure:

The aorta was exposed starting at the neck of the aneurysm at the level of the ligament of Treitz just to the right of the inferior mesenteric vein exposing the left renal vein crossing over the neck of the aneurysm to gain proximal control.

This is followed by distal control via exposure of the iliac vessels. In most of the cases exposure of only the first 2cm of the common iliac arteries is enough but the exposure may need to extend down to the external iliac artery.

Clamping:

In 16 patients the clamping was infra-renal and 4 patients was suprarenal. Before cross-clamping, systemic heparinization (5000 I.U.) was given. Once proximal and distal control is achieved, the aneurysm is entered. The thrombus is evacuated and any bleeding lumbar arteries and inferior mesenteric artery were suture ligated from within the aneurysmal sac.

Reconstruction:

An end to end anastomosis between the prosthetic graft and aorta is performed proximally with running polypropylene sutures. Distally the anastomosis is performed with the common iliac arteries in 14 cases while in 6 cases distal anastomosis were done in distal aorta by short straight graft.

Closure:

After ascertaining hemostasis, the aneurysmal sac is closed over the graft with running absorbable suture. Closure of the posterior peritoneum with absorbable suture is performed to avoid contact of the bowel with the graft, then closure of the abdominal wall with drains.

Retro-peritoneal repair:

Exposure:

The patient was placed in right lateral decubitus position with the break in the table centered at the iliac crest. The table was maximally flexed and then leveled. A surgical beanbag positioner was used to help secure the patient in this position.

The chest, abdomen and the left groin were prepped and draped in the standard fashion. Access to the right groin can be obtained, if needed, by flexing the hips posteriorly.

The incision started in the 10th intercostal space at the posterior axillary line; this could be varied depending on the proximal extent of the aneurysm. It was carried onto the abdomen, where it run lateral and parallel to the lateral boarder of the left rectus muscle and terminated below the umbilicus at a level determined by the distal extent of the intended arterial reconstruction.

The skin and subcutaneous tissues were divided to expose the anterior fascia of the external oblique.

The external oblique, internal oblique and transversus abdominis muscles were sequentially opened over a short distance using a combination of blunt dissection and electrocautery.

Care must be taken not to violate the peritoneum as it was blindly freed from the abdominal wall and diaphragm by using careful blunt digital dissection.

Exposure can be increased by entering the chest through the 10th intercostal space contiguous with the abdominal portion of the incision by diving 2 to 3cm of the diaphragm.

The left psoas muscle is identified; the peritoneal and retroperitoneal contents were swept antero-medially throughout the length of the wound as well as off the inferior surface of the diaphragm.

This exposed the entire intra- abdominal aorta. At this stage, the left ureter was identified and protected, because it run anterior to the aorta and left common iliac artery.

By staying on a plane directly anterior to the iliac arteries, the right ureter can also be identified and protected. Aneurysm repair was done as previously described steps in trans-peritoneal approach.

All patients were transferred to ICU post-operatively for proper monitoring and

controlled hydration. Postoperative hemoglobin level was measured at day-1 and serum creatinine level was measured at day-2 postoperatively.

Each patient was transferred to the ward after being stabilized. Then each patient was planned to be followed up after hospital discharge twice, the first after 2-weeks and the second after one month. Then regularly every 6 months. The patients were instructed to seek the follow up if any problem happens during the period in-between.

Each patient was followed-up for the vascular status based on the CT angiography and also follow up for the general health and existing or possible comorbidities and the wound.

The statistical analysis: the data were presented as numbers and percentage using Statistical SPSS for Windows, issue 15.8.

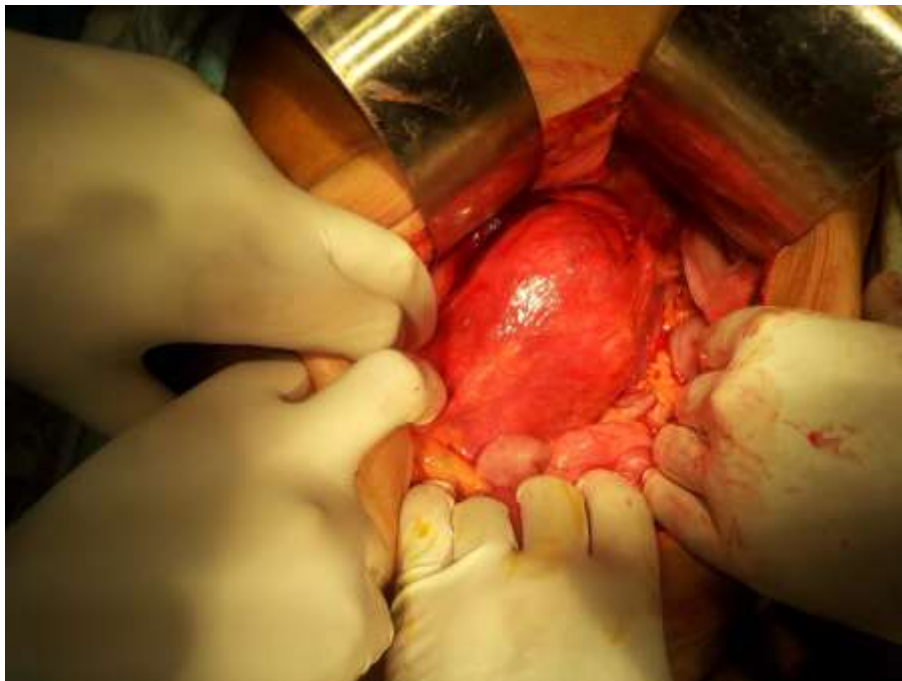


Fig. (1): Picture of the aneurysm before control



Fig. (2): Distal control of common iliac arteries

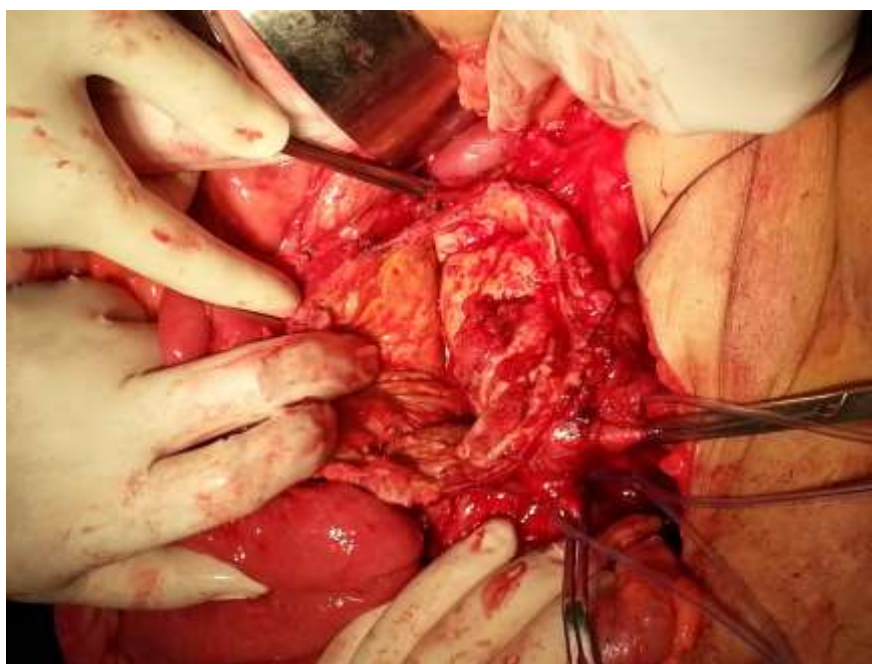


Fig. (3): Opening of the aneurysm sac after applying clamps

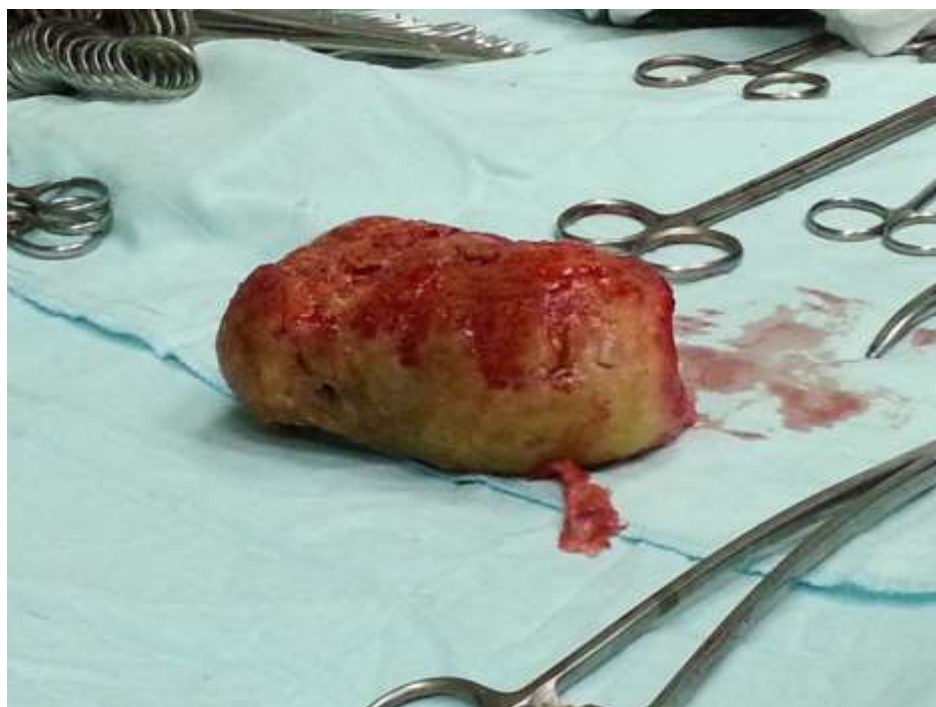


Fig. (4): Extracted mural thrombus



Fig. (5): Suture ligation of the ostia of aortic branches inside the sac (lumbar and IMA)

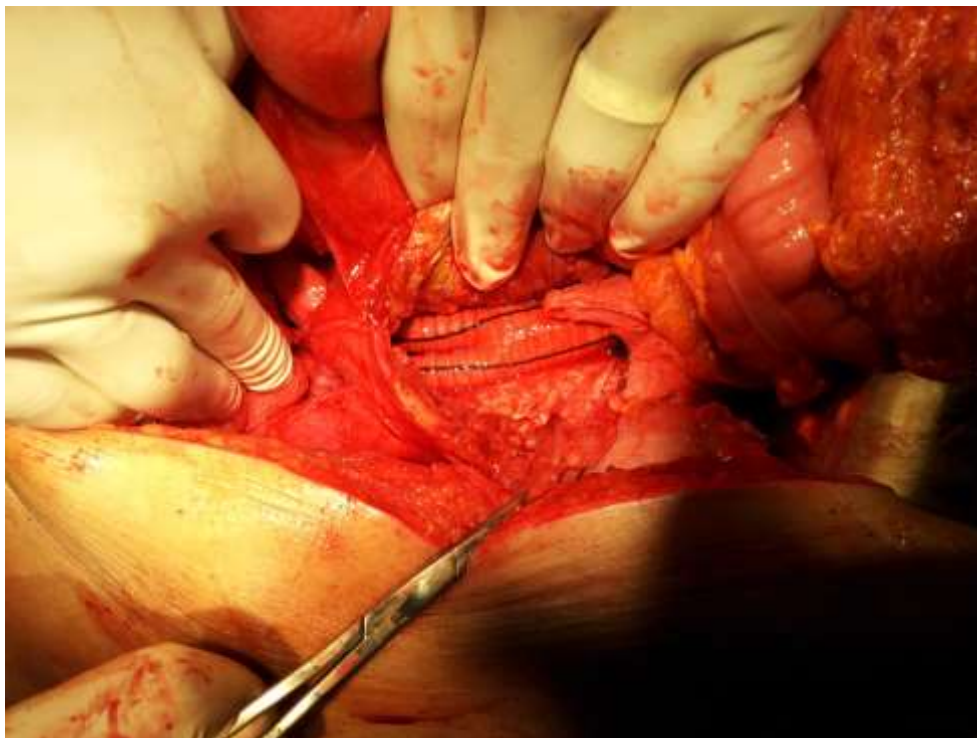


Fig. (6): After applying the bifurcated Dacron graft

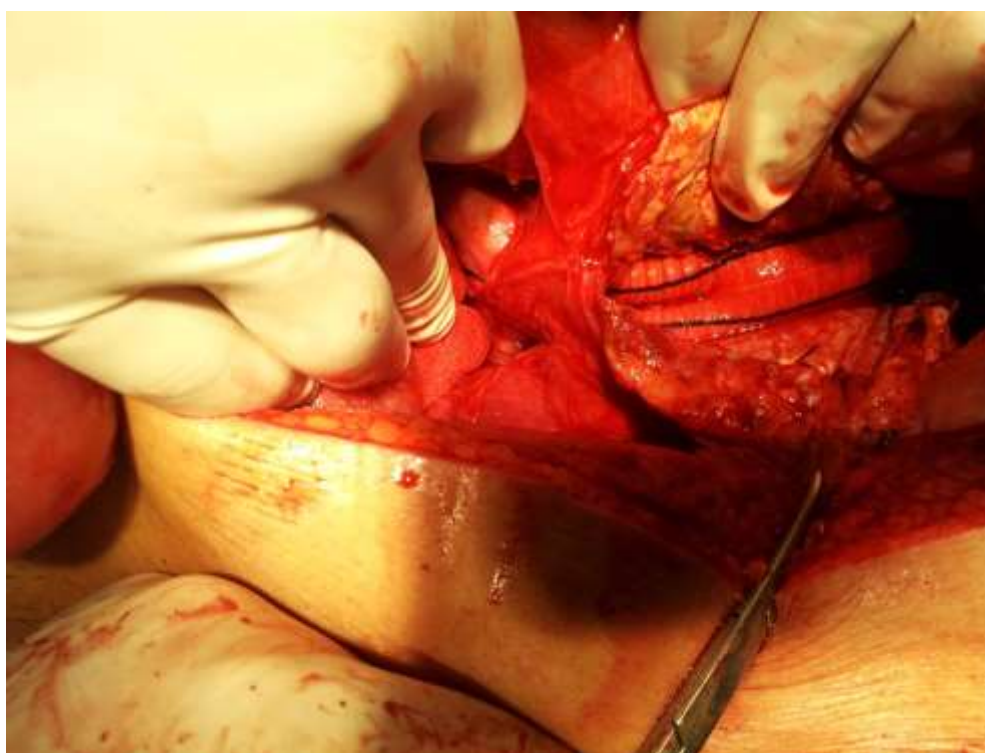


Fig. (7): The edges of the aneurysm sac is sutured over the graft before closure

Results

This study is a prospective multicenter study that was done in the period between December 2013 and August 2018 included 20 patients, from Cairo, Monofya and El-Minia University hospitals. All our patients have infra-renal abdominal aneurysm with challenging neck. As regard the age distribution of our patients, 10 (50%) patients were in the age group (36-55) years old, 8(40%) patients were in the age group (56-70) years old and only 2(10%) patients were in the age group (>70) years old. As regard the gender of the patients, (85%) of the patients were males and (15%) were females.

In our study 75% of the patients underwent open surgical repair through trans-peritoneal approach and 25% of the patients underwent retro-peritoneal approach. The time of the operation varied from 2 to 3 hours

Smoking, hypertension, dyslipidemia, ischemic heart diseases and peripheral vascular diseases were the main risk factors for development of the aneurysm in our study in 85%, 75%, 75%, 60% and 50% respectively as in table (1).

In this study the aneurysm size was highly variable, 10(50%) of the patients had the

aneurysm diameter between (5.5- 6.5)cm, 4 (20%) of the patients had the aneurysm diameter between (6.5- 8)cm and 6 (30%) of the patients had the aneurysm diameter > 8cm as in table (2).

As regard blood loss, 14 cases (70%) had blood loss between 500to 800 ml while only one patient had blood loss more than 1500 ml and received 3 units of blood as in table (3). As regard the level of clamping, in 80% of the patients infra-renal clamping was done while, in 20% of the patients supra-celiac clamping was used as in table (4).

In our study a bifurcated Dacron graft was used in 90% of the patients and P.T.F.E graft was used only in 10% of the patients as in table (5).

According to complications occurred in our study , it was found that 2 patients (10%) had intra-operative bleeding that required transfusion of 3 units of blood, 1 patient (5%) had graft thrombosis that require thrombectomy, 3 patients (15%) had wound infection treated by strong antibiotic, 2 patients (10%) had incisional hernia at midline incision, and 2 patients (10%) died in ICU due to severe respiratory infection as in table (6).

Table (1): Showing the preoperative co-morbidities and risk factors.

Co-morbidities and risk factors	No. of patients	Percentage
Hypertension	15	75%
Diabetes	4	20%
Dyslipidemia	15	75%
Ischemic heart disease	12	60%
Renal failure	1	5%
Peripheral vascular disease	10	50%
Chest disease	4	20%
Smoking	17	85%

Table (2): Showing the different aneurysmal sizes in open surgical repair patients

Aneurysm size	No. of patients	Percentage
5.5- 6.5 cm	10	50%
6.5- 8 cm	4	20%
8 cm	6	30%

Table (3): Showing the estimated blood loss intra-operatively.

Amount of blood loss	No. of patients	Percentage
350- 500 ml	2	10%
500- 650 ml	7	35%
650- 800 ml	7	35%
800- 1000 ml	3	15%
>1500 ml	2	10%

Table (4): Showing the level of clamping

Level of clamping	No. of patients	Percentage
Infra-renal	16	80%
Supra-celiac	4	20%

Table (5): Showing types of the grafts

Type of graft	No. of patients	percentage
Dacron	18	90%
P.T.F.E	2	10%

Table (6): Showing the complications occurred in open surgical repair patients

Complications	No. of patients	Percentage
Bleeding	2	10%
Wound infection	3	15%
Graft thrombosis	1	5%
Incisional hernia	2	10%
Death	2	10%

Discussion

In our study, 50% of the patients aged between 36 to 55 years old while only 5% aged less than 35 years and 85% of them were males.

In the Huntingdon, United Kingdom, screening program for men older than 50 years, the incidence of new AAAs was 3.5 per 1000 person-years. The most recent data from the U.K. National Aneurysm Screening Programme showed that of the 107,051 men ages 65 years offered screening in 2011, only 1.5% had aortic diameters more than 3 cm⁽¹⁴⁾.

Similarly, Scott et al., reported In his study that the prevalence of AAA was 7.6% in males and 1.3% in females The low incidence of AAA in females is due to the effect of estrogen with regard to inflammation in cardiovascular disease is thought to play a role in protection against aneurysm formation⁽¹⁵⁾.

Trans-peritoneal approach was more commonly used in this study in 75% of the patients and retroperitoneal approach was used in only 25% of the patients. The trans-peritoneal approach with inlay graft replacement described to be the most popular surgical approach to the abdominal aorta⁽¹⁶⁾. The retro-peritoneal approach reported to be less widely used but it was reported by many authors to be associated with reduced postoperative morbidity⁽¹⁷⁾.

However, in a study done by landry et al., trans-peritoneal approach was used in 38.8% of the patients and retro-peritoneal approach was used in 61.2%⁽¹⁸⁾.

Smoking, hypertension and dyslipidemia were the main risk factors in our patients with smoking present in 85% both hypertension and dyslipidemia were present in 75%.

In agreement with this study, Kent et al., assure that these are Well-defined clinical risk factors

are associated with the pathogenesis of AAA and reported in his literature that dyslipidemia and smoking are the main risk factor in pathogenesis of AAA.⁽¹⁹⁾

Concerning the size of the aneurysm in our study, there were 10 patients had an aneurysm diameter between (5.5- 6.5) and 6 patients had a diameter more than 8 cm. Once an aneurysm reaches 5cm in diameter, it is usually considered necessary to treat to prevent rupture. The diameter of an aneurysm is perhaps the single most important variable predicting rupture and, as such, is the primary consideration when recommending repair or observation to patients with aneurysms.⁽²⁰⁾

Several randomized clinical trials have identified an AAA size of 5.5cm as a reasonable threshold for recommending open surgical repair. Nevertheless, if a procedure with zero morbidity and uniform durability were available, all aneurysms would be treated, irrespective of size.⁽²⁰⁾

Two prospective clinical trials have compared surveillance with open repair of 4- to 5.5-cm AAAs: the Aneurysm Detection and Management (ADAM) trial¹³ and United Kingdom Small Aneurysm Trial (UKSAT). The conclusions of the trials were similar: no benefit of early open surgical repair was conferred in patients with a small AAA.⁽²¹⁾

In our study, the blood loss in open repair for infra-renal AAA was ranging from 350 to 1500 ml with the average range 650 ml.

Intra operative bleeding usually from bleeding of lumbar vessels, associated venous injuries during dissection or from splenic injury

In contrast to another study done by de la Motte et al., 2013 where the blood loss was ranging from 1050 to 2600 ml with the average range 1700 ml⁽²²⁾.

In our study, two types of grafts were used P.T.F. E and Dacron grafts. P.T.F. E graft was used in 10% of the patients and Dacron graft was used only in 90% of the patients.in contrast, in a study done by Biancari et al., 2006,, P.T.F. E graft was used in 99.5% of the patients and Dacron graft was used only in 0.5% of the patients⁽²³⁾.

The post-operative complications occurred in the patients of our study was wound infection in

15% of them, these patients were diabetic and treated by triple antibiotic with close follow up ,intra operative bleeding occurred in10% of the patients and blood transfusion of 3 units of blood was done, thus was due to bleeding from lumbar vessels usullay from dissection, and graft thrombosis occurred in only 5% of the patients graft thrombosis occurred in one case which discovered by Duplex and CT angiography. Death occurred in only two cases of our patients (10%) and thus due to severe respiratory problems as they had preoperative extensive copd and impairment of respiratory function.

Hertzer et al., presented data of the open aneurysm repair in the Cleveland Clinic between 1989 and 1998. The overall 30-day mortality rate was 1.2%. One hundred and fifty (13%) of the 1135 patients experienced peri-operative complications⁽²⁴⁾

The long-term mortality rate was influenced by age of more than 75 years, or previous history of congestive heart failure, chronic pulmonary disease, or renal insufficiency.⁽²⁴⁾

Conclusion

In this study we discussed the management of infra renal AAA with challenging neck and made spot lights in treatment by open repair incorporating on 20 patients. Elective surgical repair remains the best standard treatment for AAAs larger than 5 cm in diameter. Abdominal aortic aneurysms less than 5 cm are monitored yearly by computerized tomography, magnetic resonance imaging or ultrasound. Surgical risk is increased in patients over 90 years old, and in those with severe heart disease, chronic obstructive airway disease or renal impairment. The management of these patients is difficult and has to be dealt with on an individual basis.

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