Early outcome and complications of endo-vascular aortic repair for abdominal aortic aneurysm: a prospective single-centre experience

Resultados tempranos y complicaciones de la reparación aórtica endovascular del aneurisma aórtico abdominal: una experiencia prospectiva en un solo centro

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Abstract

Background: Medical literature has advanced knowledge and treatment of abdominal aortic aneurysms (AAAs) for millennia. AAA treatment has progressed from ancient Egyptian papyrus to endovascular methods. Endovascular aneurysm repair (EVAR) is a huge advancement, giving a less invasive alternative to open surgery. Aims of the study: This study aims to review the complications associated with EVAR and assess procedural outcomes in patients with infrarenal AAAs. Patients and **Methods**: Ghazi AL-haryri Hospital / Medical City conducted a prospective study of 30 elective EVAR patients for infrarenal AAAs from October 2021 to September 2023. Vascular surgeons conducted operations in the catheterization lab under spinal anaesthesia after analysing clinical and radiological data. The procedure involved bilateral femoral artery access, angiography, stent-graft placement, and CT angiography. **Results**: The patient sample was 90% male, averaged 69 years old, and had hypertension (70%) and diabetes (40%). Technical success was 100% with a 2.8-day hospital stay and 10% transfusion rates. Acute lower limb ischemia (6.6%), myocardial infarction (3.3%), and wound complications (6.6-10%) were consequences. Graft problems included Type I endoleak (3.3%), emphasising postoperative surveillance. Conclusion: AAA treatment has improved with EVAR, which has reduced procedural morbidity and mortality. Long-term patient outcomes depend on vigilantly monitoring and treating problems.

Keywords: Early, outcome, Complications, Endo- Vascular Aortic, Repair, Abdominal Aortic Aneurysm.

Resumen

Antecedentes: La literatura médica ha avanzado en el conocimiento y el tratamiento de los aneurismas de la aorta abdominal (AAA) durante milenios. El tratamiento del AAA ha progresado desde el papiro del antiguo Egipto hasta los métodos endovasculares. La reparación endovascular de aneurismas (EVAR) es un gran avance que ofrece una alternativa menos invasiva a la cirugía abierta. Objetivos del estudio: Este estudio tiene como objetivo revisar las complicaciones asociadas con EVAR y evaluar los resultados del procedimiento en pacientes con AAA infrarrenal. **Pacientes y métodos:** El Hospital Ghazi AL-haryri/Ciudad Médica realizó un estudio prospectivo de 30 pacientes con EVAR electivo para AAA infrarrenales desde octubre de 2021 hasta septiembre de 2023. Los cirujanos vasculares realizaron operaciones en el laboratorio de cateterismo bajo anestesia espinal después de analizar datos clínicos y radiológicos. El procedimiento implicó acceso bilateral a la arteria femoral, angiografía, colocación de stent y angiografía por tomografía computarizada. **Resultados**: La muestra de pacientes fue 90% masculina, con edad promedio de 69 años, hipertensión (70%) y diabetes (40%). El éxito técnico fue del 100% con una estancia hospitalaria de 2,8 días y tasas de transfusión del 10%. Las consecuencias fueron isquemia aguda de miembros inferiores (6,6%), infarto de miocardio (3,3%) y complicaciones de las heridas (6,6-10%). Los problemas del injerto incluyeron endofuga tipo I (3,3%), destacando la vigilancia postoperatoria. **Conclusión**: El tratamiento del AAA ha mejorado con EVAR, lo que ha reducido la morbilidad y mortalidad del procedimiento. Los resultados de los pacientes a largo plazo dependen de un seguimiento y tratamiento atentos de los problemas.

Palabras clave: Temprano, resultado, Complicaciones, Aórtica Endovascular, Reparación, Aneurisma de Aorta Abdominal.

Introduction

The history of aortic aneurysms stretches back to ancient times, with the first descriptions appearing in Egyptian scrolls around 1550 BC. This condition's understanding has evolved significantly over centuries, influencing advances in medical treatments and surgical techniques. In ancient times, knowledge of aortic aneurysms was primitive, but by the era of Galen, detailed anatomic illustrations were produced, marking a significant advancement in medical understanding. Despite early efforts by Antyllus using vessel ligation yielding poor outcomes, the foundational work set the stage for later developments[1]. During the 14th century, advancements continued with notable figures like Vesalius, who utilized cadaveric dissections to enhance anatomical knowledge. In the same period, Pare and Morgagni identified the link between syphilis and aneurysms in certain populations, adding to the understanding of etiological factors influencing this condition[2]. The 20th century ushered in a wave of innovations in surgical management for aortic aneurysms. Techniques such as proximal ligation, extra-arterial wrapping, and direct reconstruction using both autologous and synthetic materials were developed and refined during this time by pioneers like Cooper, Matas, Poppe, Carrel, Dubost, and Voorhees[3]. The collaborative work of DeBakey and Cooley further advanced open repair techniques, setting the groundwork for future surgical interventions[4]. A significant breakthrough occurred in 1986 when Volodos described the first endovascular repair of abdominal aortic aneurysms (AAA), a technique further popularized by Juan Parodi's work on retrograde stent deployment using a Dacron-prosthetic graft through the femoral arteries[5,6]. This endovascular approach (EVAR) aimed to depressurize the aneurysm sac, significantly reducing rupture risks. The design of aortic endografts began with simple configurations, such as tubular or "aorto-aortic" designs and evolved into more sophisticated bifurcated stents. By 1993, unibody bifurcated aorto-bi-iliac stents were developed, improving the anatomical fit and effectiveness of the grafts[7]. Regulatory approval in Europe and the United States soon followed, endorsing the safety and efficacy of these innovations. However, the journey was not without setbacks. Various complications associated with different grafts, such as the Guidant Ancure device's delivery system failures and the high migration rate of the AneuRx graft, highlighted ongoing challenges in EVAR[8-10]. Other issues included fabric tears in the Vanguard endograft and type IV endoleaks associated with the initial Excluder graft due to fabric porosity[11,12]. Modifications and innovations, such as chemical etching and the introduction of more robust support structures in graft designs, gradually reduced failure rates and improved outcomes[13-15]. By the 21st century, stent-graft designs have largely shifted to bifurcated grafts using modular systems, enhancing flexibility and adaptability to individual patient anatomy. The most recent designs include features like suprarenal stents and active fixation mechanisms to minimize migration and endoleak risks[16-18]. EVAR, while revolutionary, introduced its own spectrum of complications, categorized into various types of endoleaks, migration issues, graft limb occlusions, and other potential post-operative challenges. These complications necessitate ongoing monitoring and innovation in both surgical technique and graft design to optimize patient outcomes and extend the durability of repairs in treating abdominal aortic aneurysms. Aims of the study: This study aims to review the complications associated with EVAR and assess procedural outcomes in patients with infrarenal AAAs.

Materials and methods

We conducted a prospective study at Ghazi Al-Hariry Hospital in Medical City, focusing on patients with infrarenal abdominal aortic aneurysms (AAA) who underwent elective endovascular aneurysm repair (EVAR) from October 2021 to September 2023. The study aimed to assess both device-related and systemic complications associated with EVAR. Procedures were performed in the catheterization lab by a team of vascular surgeons and vascular specialists, utilizing spinal anesthesia for pain management. Access to the common femoral artery (CFA) was achieved through a bilateral femoral artery cut-down approach, followed by the insertion of 6F introducer sheaths. The procedure involved advancing a flush catheter over a guidewire to the suprarenal aorta, followed by an angiogram of the aorta and bilateral iliac arteries to assess the proximal neck, angulations, and access arteries. All pre-operative measurements from CT-Angiography (CTA) were reviewed and discussed again. Patients were administered intravenous heparin based on their weight, and super-stiff wires were used for exchanges. The ipsilateral main body of the graft was introduced just below the lowest renal artery. An additional angiogram was performed before the deployment of the proximal end if deemed necessary. Cannulation of the contralateral limb was attempted; if unsuccessful, alternate approaches like the brachial artery approach or crossover technique were employed. The contralateral iliac tube graft was then advanced over another super-stiff wire. A completion angiogram confirmed the complete exclusion of the aneurysm and ensured continued perfusion to the lower extremities. In cases where the contralateral limb cannulation failed,

necessary occlusion of the internal iliac artery (IIA) was performed prior to endograft deployment. Patients presenting with stenosis or occlusion in the access arteries were treated concurrently or in a subsequent procedure. Post-procedure follow-up involved CTA angiography at 1 month, 6 months, and annually thereafter to monitor for complications and the integrity of the graft.

In this study 30 patients underwent EVAR during the period of study. Data shows patient cohort had a mean age of (69 ± 3) years, with predominance of males 27 (90%). The patient cohort exhibited a prevalence of elective procedures targeting infra-renal location. The common comorbidities included hypertension 21 (70%), diabetes mellitus 12 (40%), chronic obstructive pulmonary disease (COPD) 9 (30%) and coronary artery disease (CAD) 15 (50%) accompanied by a notable history of smoking 24 (80%). The average aortic aneurysms diameter was from 5.2 - 9.8 cm. as in table 1.

Table 1: Patient demographic and characteristic

VARIABLES	ALL PATIENT (30)
AGE, YEARS, MEAN ± SD	69±± 3
GENDER	
MALE	27 (90%)
FEMALE	3 (10%)
EVAR	
ELECTIVE	30 (100)
EMERGENCY	0
LOCATION	
INFRA-RENAL	30 (100%)
SUPRA-RENAL	0
ASSOCIATED DISEASES	
HTN	21 (70%)
DM	12 (40%)
COPD	9 (30%)
CAD	15 (50%)
SMOKING	24 (80%)

Hospital stays averaged 2.8 days, exclusively utilizing iodinated contrast. procedural outcomes indicated a 30 (100%) technical success rate, with no instances of conversion to the operating room. Only 3 (10%) patients received blood transfusions with average of 1.2 units. The follow-up period extended to a mean 16 ± 2.3 months. As in table 2.

Table 2: Patient- related variables

VARIABLES	EVAR (N=30)
LOS, DAYS	
ICU (DAYS)	0
HOSPITAL (DAYS)	2.8
CONTRAST USED	
IODINATED	30 (100/%)
CO2	0
TECHNICAL SUCCESS	30 (100%)
CONVERSION TO OR	0
BLOOD TRANSFUSION	
PATIENTS NEED TRANSFUSION	3 (10%)
AVERAGE UNITES	1.2
FOLLOW-UP	
FOLLOW-UP, MONTHS, MEAN ± SD	16±±2.3
NO DOCUMENTED FOLLOW UP	0

Table 3 highlighted complications, revealing a 30-day mortality rate of 0% and an oberall mortality rate of 2 (6.6%). Specific complications included myocardial infarction MI 1 (3.3), various wound complications {hematoma 2 (6.6%), access site active bleeding 1 (3.3%), access site infection 3 (10%) and false aneurysm 1 (3.3%) (6.6-10%) and acute lower limb ischemia 2 (6.6%). Graft-related complication develops type I endoleak 1 (3.3%) presented after 2 months with abdominal pain, anemia and abdominal swelling (rupture AAA).

Table 3: Complications and mortality

COMPLICATIONS	EVAR (N = 30)
NONE-GRAFT-RELATED COMPLICATIONS	
MI	1 (3.3%)
WOUND COMPLICATION	
HEMATOMA	2 (6.6%)
INFECTION	3 (10%)
PSEUDOANEURYSM	1 (3.3%)
ACUTE LOWER LIMB ISCHEMIA	2 (6.6%)
DEATH	
30-DAYS MORTALITY	0
OVERALL MORTALITY	2 (6.6%)
GRAFT-RELATED COMPLICATIONS	
ENDOLEAK	
TYPE I	1 (3.3%)
TYPE II	
TYPE III	
TYPE IV	
TYPE V	
TOTAL	
GRAFT LIMB OCCLUSION	1 (3.3%)

Discussion

In a single-center study at Ghazi Al-Hariry Hospital, 30 patients underwent endovascular abdominal aortic aneurysm repair (EVAR). This cohort, primarily composed of males (90%) with an average age of 69, demonstrates the procedure's efficacy and safety. This demographic is similar to the findings of Handa N et al. and Al-Zoubi NA et al., who reported 84% and 97.7% male participants with average ages of 77 and 68.8 years, respectively[19,20]. All interventions were elective, targeting infra-renal locations, contrasting with Al-Zoubi NA et al., who reported a mix of elective (83.7%) and emergency (16.3%) procedures[16]. Common comorbidities included hypertension (70%), diabetes mellitus (40%), chronic obstructive pulmonary disease (COPD) (30%), and coronary artery disease (CAD) (50%), which differed from Handa N et al. and Al-Zoubi NA et al. due to variations in sample size and societal factors[15,16]. A significant proportion (80%) of patients had a history of smoking, aligning closely with Al-Zoubi NA et al.'s findings[20,21]. The procedural outcomes were positive, achieving a 100% technical success rate, with patients staying an average of 2.8 days in the hospital and exclusively using iodinated contrast. Blood transfusions were necessary for 10% of patients, averaging 1.2 units—fewer than in[16,22]. Follow-up lasted 16 ± 2.3 months, ensuring thorough assessment of long-term EVAR outcomes. Regarding complications, there was a 30-day mortality rate of 0% and an overall mortality rate of 6.6%, closely paralleling Handa N et al.'s results but differing from[16,23-25]. Notable complications included myocardial infarction (3.3%), wound issues (6.6-10%), and acute lower limb ischemia (6.6%). Graft-related complications such as Type I endoleak occurred in 3.3% of cases, presenting with symptoms like abdominal pain, anemia, and swelling leading to a ruptured aneurysm, highlighting the critical need for diligent postoperative monitoring. While the findings underscore the success and relatively low mortality of EVAR, they also point to certain complications requiring careful attention. The incidence of graft-related issues, especially Type I endoleak, underscores the importance of ongoing surveillance and potentially refining patient selection criteria. The relatively brief follow-up period may not fully capture long-term outcomes and complications, suggesting that future research should involve larger patient cohorts and longer follow-up to provide more detailed insights into the long-term efficacy and safety of EVAR for aortic aneurysms in this population.

Conclusions

Endovascular aneurysm repair (EVAR) is a secure and minimally invasive surgery used to treat patients with abdominal aortic aneurysm (AAA). It has the advantage of reduced complications and shorter hospitalisation periods. Despite the aforementioned information, open surgical repair of the aorta remains a viable option for those who are not suitable candidates for endovascular aneurysm repair (EVAR) or when the physician deems it preferable.

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