

Efforts for detection of aortic aneurysms and human resources training for the optimization of their treatment

Esfuerzos en la detección de aneurismas aórticos y la formación de recursos humanos para la optimización de su tratamiento

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Abstract

Objective: To review admissions, interventions and in-hospital mortality associated to Abdominal Aortic Aneurysms (AAA), and to analyze the impact of the introduction of a training program and imaging screening at our institution. **Methods:** Retrospective study where hospitalizations, procedures and mortality secondary to AAA were recorded. The national databases (ND) from the Secretariat of Health were utilized from 2010 to 2020. In-hospital lethality was calculated and compared with the experience at the Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán (INCMNSZ). The statistical analysis was completed with the STATA version 17. **Results:** According to the ND, 899 (91%) hospital admissions secondary to AAA occurred, while in the INCMNSZ 85 (9%). Most of them belonged to the male gender (68%); 811 (82%) patients underwent open surgical repair, and 173 (18%) to an endovascular exclusion (EVAR), the latter approach was significantly more frequently performed at our institution ($p = 0.007$). The 30-day hospital mortality was 22.5%; in the ND was 23.9 vs. a 16.4% in the INCMNSZ without significant difference ($p = 0.1$). **Conclusions:** AAA remain unrecognized in our country. The introduction of University programs and imaging screening might impact in the early detection, and to reduce the morbidity and mortality associated to emergency procedures.

Keywords: Abdominal Aortic aneurysms. Ultrasonographic screening. Training of human resources.

Resumen

Objetivo: Revisar los ingresos, procedimientos y defunciones intrahospitalarias asociadas a aneurismas aórticos abdominales (AAA) y analizar el impacto de la introducción de programas de formación de recursos humanos y tamizaje ultrasonográfico. **Métodos:** Estudio retrospectivo, se analizaron las bases de datos nacionales obtenidas del portal datos abiertos de la Dirección General de Información en Salud (DGIS) del año 2010 al 2020. Se calculó la letalidad intrahospitalaria anual y comparamos la experiencia del Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán (INCMNSZ). El análisis estadístico se realizó en el programa STATA versión 17. **Resultados:** De acuerdo con la base nacional (BN), se registraron 899 (91%) ingresos, mientras que en el INCMNSZ 85 (9%). La mayoría pertenecía al sexo masculino (68%), un total de 811 (82%) pacientes fueron sometidos a cirugía abierta, mientras que 173 (18%) a terapia endovascular (EVAR), siendo este abordaje más frecuente en nuestra institución ($p = 0.007$). La mortalidad intrahospitalaria fue del 22.5%, en la BN fue del 23.9%, mientras que en el INCMNSZ fue del 16.4%, sin que encontráramos diferencia significativa ($p = 0.1$).

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Conclusiones: Los AAA continúan siendo poco reconocidos en nuestro país. La introducción de programas universitarios de especialidad y el tamizaje podría impactar en la reducción de la morbilidad y mortalidad.

Palabras clave: Aneurismas aórticos abdominales. Tamizaje ultrasonográfico. Formación de recursos humanos.

Introduction

Abdominal aortic aneurysms (AAA) are one of the clinical entities that most frequently develop within the spectrum of conditions and disease affecting the human aorta. They are typically diagnosed when imaging modalities reveal the presence of a focal or localized dilatation with diameters > 50% of the normal diameter of this artery. The most common anatomical location of AAA is the infrarenal part of the abdominal aorta¹⁻³.

Multiple international studies have demonstrated that the presence of AAA increases proportionally with age, with a higher prevalence being reported in men at, or older than 65 years, and in women older than 70 years. Risk factors associated with this condition include smoking (current or prior), male gender, family history, systemic arterial hypertension, coronary and peripheral artery disease, and chronic obstructive pulmonary disease²⁻⁴. The prevalence of these lesions has been reported in 1.4% of the patients aged 55 to 84 years in the United States, while frequencies of up to 2% (and even as high as 8%) have been reported in men older than 65 in former studies^{1,4}. Nonetheless, controversy surrounds the relatively low prevalence reported among the Latin American population of the United States, particularly Mexican-Americans, while the experience treating this condition in Mexico remains modest⁵⁻⁷. Since we launched the ultrasonographic screening program in 2015 at Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán (INCMNSZ), Mexico City, Mexico we have detected a prevalence of 3.29% in the at-risk population studied⁷. Subsequently, efforts have continued, and as part of an initiative by the current administration of the Mexican Society of Angiology, Vascular Surgery, and Endovascular Surgery (SMACVE), the first multicenter trial ever conducted on this subject in 9 centers has found a prevalence of AAA of 3.08%⁸. This confirmed that in the 4 metropolitan areas included in this trial, the frequency of this disease does not seem significantly different from that in at-risk populations from other international registries. This has led us to further investigate possible genetic factors in Mexican mestizo individuals at risk of developing AAA^{9,10}.

Rupture is undoubtedly the most feared complication of AAA and is fatal in most cases, with nearly 200 000 deaths reported worldwide attributed to this cause, and mortality rates between 70% and 80%^{1,4}. This underscores the importance of timely detection to allow for adequate elective planning and repair. International experience has suggested that early referral can directly impact the reduction of mortality associated with emergently performed procedures¹¹. Additionally, one of the most important goals of SMACVE and the Mexican Council of Angiology, Vascular Surgery, and Endovascular Surgery in Mexico has been to promote the expansion of university residency programs with the highest international standards¹².

The objective of this study is to review admissions, procedures, surgical and endovascular techniques, and in-hospital deaths associated with AAA in Mexico and analyze the impact of the introduction of human resource training programs at INCMNSZ and ultrasonographic screening.

Materials and methods

This was an observational, retrospective trial where we first analyzed AAA related mortality nationwide, and investigated the number of hospital admissions, procedures, and AAA related in-hospital mortality among the study population. We used national databases obtained from the 'open data' portal of the General Directorate of Health Information (DGIS). We analyzed all available years in the portal for overall population deaths (from 1998 through 2020) and hospital discharges reported (from 2010 through 2020)¹³. Subsequently, data were filtered according to the ICD-10 code for AAA (I713, I714). Code I713 corresponds to AAA rupture, while I714 corresponds to AAA without mention of rupture. The variable 'medical care,' in the context of national databases, is considered positive when the patient receives any type of health care intervention by a health care professional, without necessarily implying hospital admission.

We used descriptive statistics, represented in percentages, frequencies, and rates. To obtain mortality rates per million inhabitants, we used mid-year population projections as published by the National Population Council (CONAPO)¹⁴. We calculated the annual in-hospital

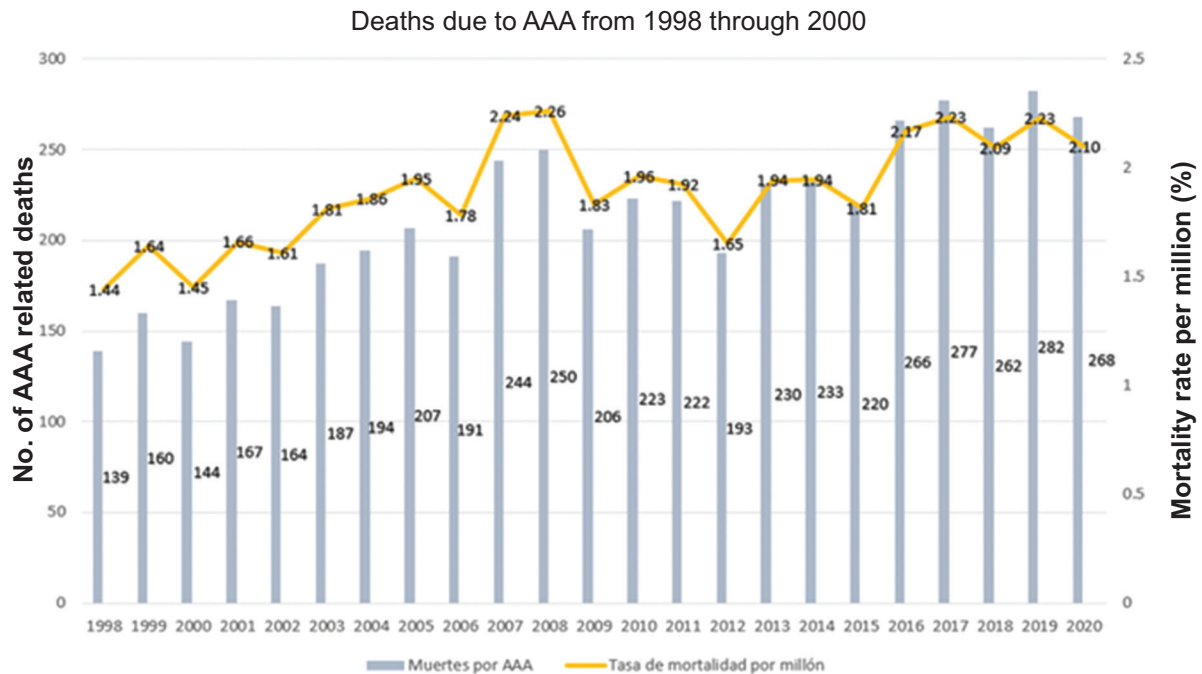


Figure 1. Graph of mortality due to abdominal aortic aneurysms (AAA) from 1998 through 2020 with an analysis of the mortality rate per million inhabitants.

lethality, and compared it with the admissions and institutional experience of the Angiology and Vascular Surgery Service of INCMNSZ. Statistical analysis was performed using STATA version 17. The Student's t-test was used for the comparisons of means and the chi-square test was used for the comparison of proportions. The protocol was approved by INCMNSZ research and ethics committee.

Results

According to the national database (NDB), which includes records from 1998 through 2020, a total of 4924 deaths were reported due to complications associated with AAA in Mexico. The mean age of these patients was 74 years, and most of these deaths, totaling 3517 (71%), were reported in men. The number of deaths, mortality, and annual incidence rate are detailed in figure 1. According to the NDB, in 4500 (95%) of these deaths, the patient was contacted or treated from a health care professional (medical care), while in 2963 (60%) of these patients, the cause of death was a ruptured aortic aneurysm, which confirmed the need for specialists for timely diagnosis and management¹³.

Regarding hospital admissions with records in the NDB from 2010 through 2020, 899 (91%) out of 984

admissions due to AAA, belonged to the NDB on AAA¹³, while 85 (9%) patients were admitted to INCMNSZ. Most individuals studied were men (68%), with a mean age of 69 years and a standard error of 0.4. A total of 811 (82%) of these patients underwent open surgery, while 173 (18%) underwent endovascular aneurysm repair (EVAR), being the latter the most common approach in our center ($p = 0.007$). Figure 2 presents a graph from the NDB on the annual mortality rate. Figure 3 through 5 present and illustrate cases from the INCMNSZ successfully treated with both open and endovascular approaches. The in-hospital mortality rate, mainly associated with emergency procedures, was 22.5% across the 11 years evaluated; in the NDB, this rate was 23.9%, while at INCMNSZ, it was 16.4% ($p = 0.1$). We did not see any differences in mortality with respect to gender (men, 23%; and women, 21%; $p = 0.6$). Table 1 compares demographic variables, types of procedures, and mortality between the NDB and INCMNSZ. Figure 6 graphically represents the overall mortality of the studied populations with respect to gender.

Discussion

In most cases, AAAs remain asymptomatic, and their diagnosis often occurs incidentally in our setting.

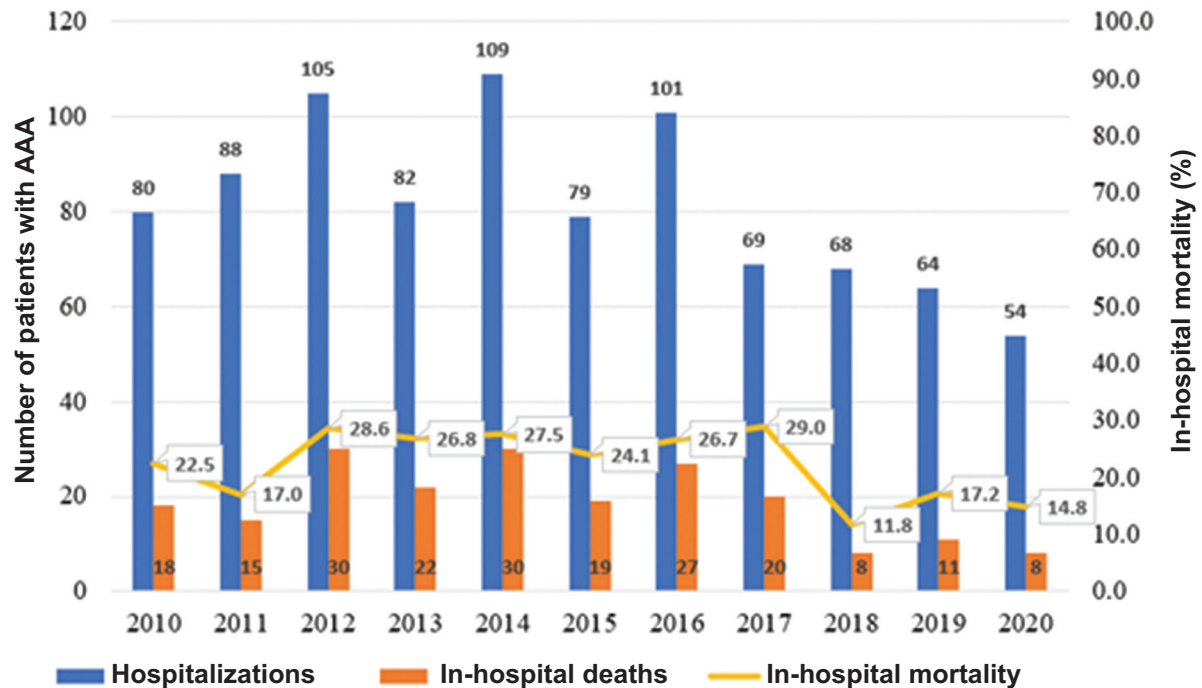


Figure 2. Graph showing the overall number of hospital admissions according to the National Database and annual mortality from 2010 through 2020. AAA: abdominal aortic aneurysm.

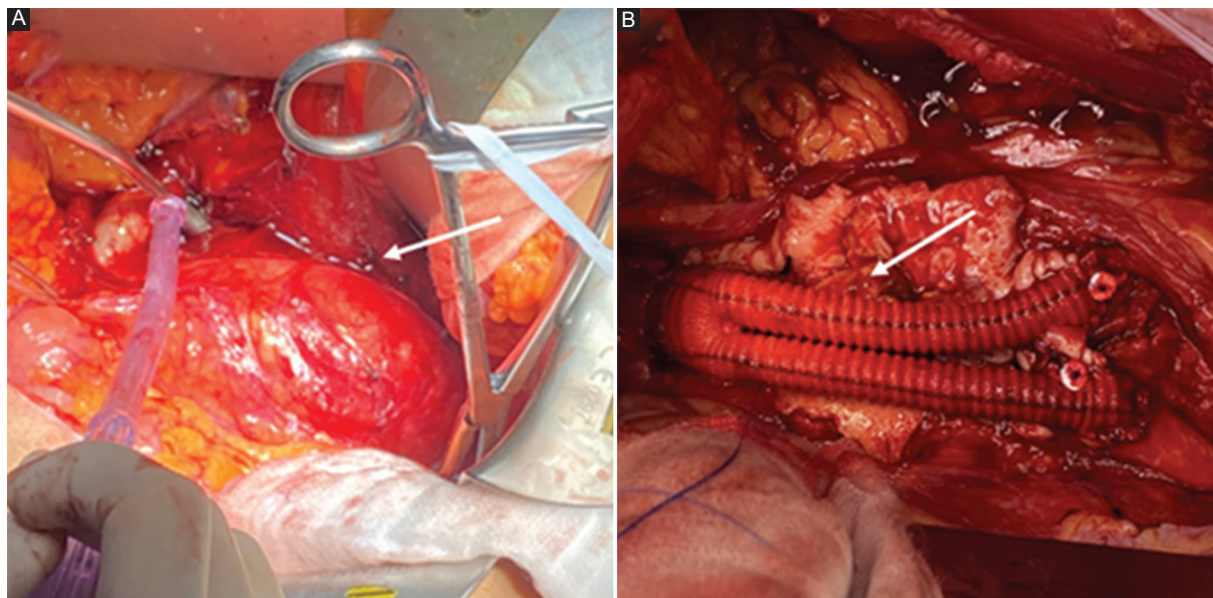


Figure 3. Intraoperative image of a 74-year-old woman undergoing open repair of an abdominal aortic aneurysm. **A:** image of the aneurysm sac. **B:** intraoperative image of the repair with a bifurcated aortic bi-iliac Dacron graft. EVAR, endovascular aneurysm repair.

When they manifest clinically, as previously mentioned, the most feared complication is rupture, with a mortality rate close to 80%¹⁵. Invasive treatment aimed at excluding the lesion from circulation is an

absolute indication to prevent this risk. AAAs must be evaluated and treated by highly trained and qualified professionals in open and endovascular surgical techniques. Currently, widely disseminated clinical practice

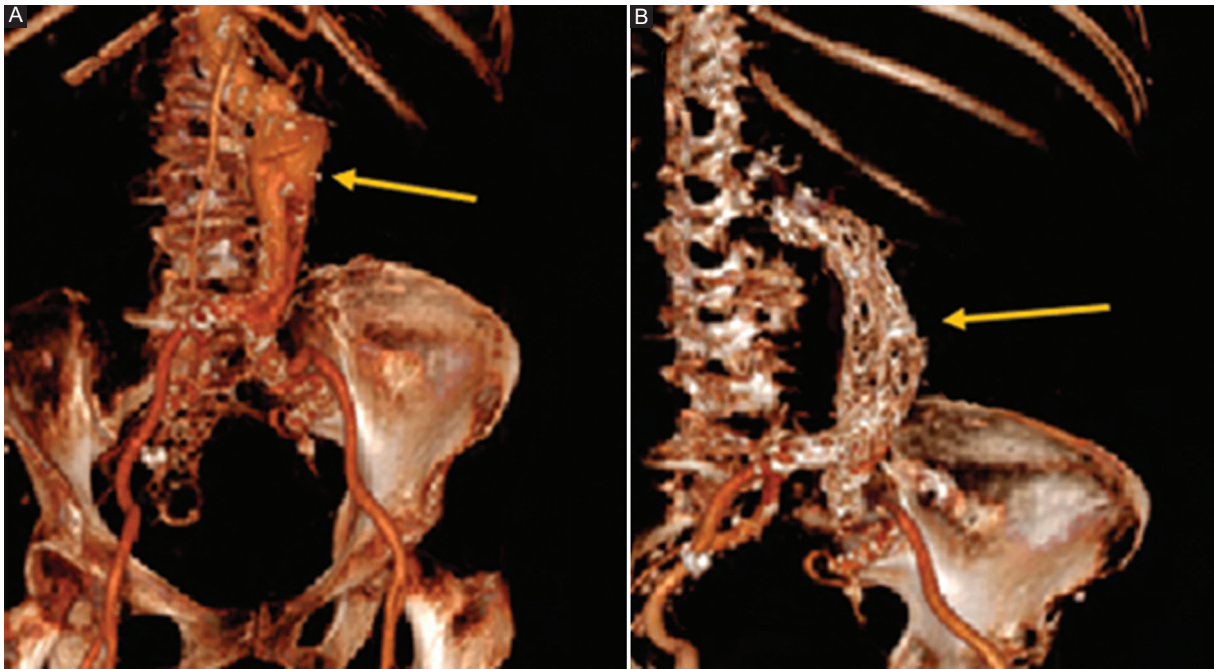


Figure 4. Coronary computed tomography angiography images with 3D reconstruction of a 28-year-old woman with a history of Marfan syndrome, 25 weeks pregnant. **A:** preoperative image where the yellow arrow points to a 6.2 cm abdominal aortic aneurysm (AAA), and the yellow arrow indicates a 25-week gestation product. **B:** postoperative image after open repair with aortic bi-iliac Dacron graft and EVAR explantation, with the yellow arrow showing the reconstructed abdominal aorta.

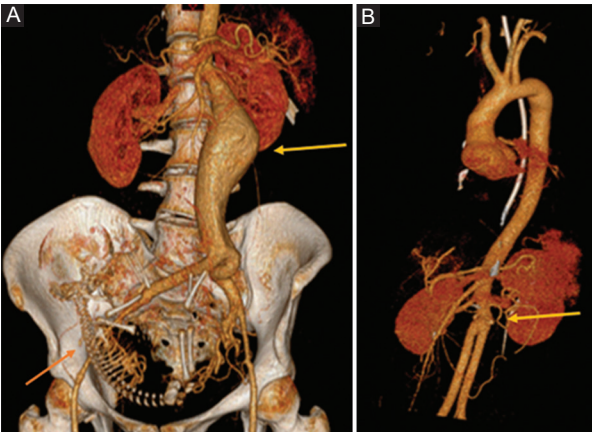


Figure 5. Coronary computed tomography angiography images with 3D reconstruction of an 80-year-old woman undergoing endovascular repair of an abdominal aortic aneurysm (AAA). **A:** preoperative image of a 6 cm in diameter AAA (yellow arrow). **B:** postoperative image of the stent-graft at infrarenal abdominal aorta level (yellow arrow).

Table 1. Comparison between the National Database and Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán (INCMNSZ) showing the number of admissions, demographic variables, procedures, and mortality

Variables	National database	INCMNSZ	p
Number of admissions	899	85	NS
Age (years)	69	69	NS
Men	606 (67%)	61 (72%)	NS
Women	293 (33%)	24 (28%)	NS
Open procedure	750 (83%)	61 (72%)	NS
Endovascular procedure	149 (17%)	24 (28%)	0.007
30-day mortality	208 (23%)	14 (16%)	NS

NS: not significant.

guidelines in the field recommend elective AAA repair in asymptomatic patients whose lesions have an anteroposterior diameter ≥ 55 mm in men and > 50 mm in women. Similarly, the type of repair (endovascular or open) should be selected by the vascular surgeon, individualizing this decision based on the patient's

clinical characteristics and favorable anatomical features of aneurysmal lesions for the implantation of approved endovascular devices^{4,16}. Thanks to the advances made in timely diagnosis, the refinement of techniques, and the expansion of highly advanced training programs, the perioperative mortality reported in patients undergoing elective AAA repair is $< 5\%$ in European and American series^{4,16}. In Mexico, we still

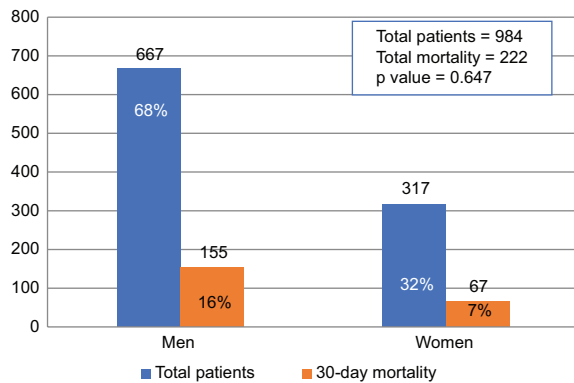


Figure 6. Graph of gender based 30-day mortality for all patients. Men's mortality rate was 23% compared to women (21%). No significant differences were observed in this variable ($p = 0.647$).

have much to do in terms of detection, planning, and execution of these procedures under the best safety conditions possible, as reflected in the still high mortality rate seen in this analysis¹⁵.

In the scientific medical literature currently available, reports from Mexican tertiary referral centers remain scarce, limiting the analysis of variables that have the greatest impact on the outcomes derived from the NDB. Factors determining postoperative evolution and survival of aortic reconstructions are known, including patient comorbidities and anatomical characteristics of the aneurysm. However, postoperative renal function has been one of the most statistically significant predictors of morbidity and mortality in our 10-year retrospective analysis published in *Cirugía y Cirujanos*¹⁷⁻¹⁹ of 80 patients undergoing both open and endovascular procedures for aortic diseases in different locations (thoracic, thoracoabdominal, and abdominal). An impaired postoperative renal function was the most statistically significant predictor of morbidity and mortality²⁰. Endovascular reconstructions have been associated with lower 30-day morbidity and mortality rates, and currently, these techniques that have gained global acceptance are the first-choice approach in industrialized countries like the United States, where it has been reported that > 70% of all abdominal aneurysms are repaired this way^{4,21,22}. Immediate availability of this technology is another aspect that limits the possibility of offering this treatment to patients in some Mexican health centers. Despite the reduced morbidity reported during endovascular reconstruction procedures, there are still patients in contemporary practice who must undergo open surgery, mainly due to anatomical factors and a younger age. Therefore, teaching and

refining open techniques remain relevant and necessary in training programs at the international level.

An interesting aspect regarding gender is the fact that the prevalence of AAA in women is lower compared to men. However, current international information indicates that perioperative morbidity and mortality rates are higher in women considering both approaches²³⁻²⁵. Although some authors explain that various variables could play a role in these results, such as anatomical characteristics, socioeconomic factors, and disparities in access to health care services²⁵, our current analysis confirms a higher prevalence of AAA in men but no gender related difference in mortality among patients who received medical and surgical care.

We emphasize that the prevention of deaths due to aneurysmal ruptures largely depends on timely diagnosis and the initiation of appropriate and timely treatment for these patients. The authors of this work believe that the formation of highly trained specialists in Mexico, along with education and dissemination of related topics directed at other specialties and primary care physicians, could impact the optimization of results in the medium term. SMACVE and university programs continue to work on implementing a national registry that accurately reports the prevalence of this disease and the clinical outcomes reported. We acknowledge that this study has limitations, such as the retrospective nature of the health records and, primarily, possible underdiagnoses of deaths at national level. In any case, as scholars, these data compel us to delve deeper into epidemiological and clinical studies in Mexico.

Conclusions

AAAs and their complications remain poorly recognized among medical-surgical specialties in Mexico. The introduction of university programs in the field of angiology and vascular surgery could impact early detection, referral, and the survival of patients with these conditions.

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Conflicts of interest

None declared.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained approval from the Ethics Committee for analysis and publication of routinely acquired clinical data and informed consent was not required for this retrospective observational study.

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