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ORIGINAL ARTICLE

Comparative study of vascular access techniques for endovascular repair of aortic aneurysm

Daniel Santos Costa[a], Sidnei José Galego[b,c], João Antônio Correa[b,c]

Open acess

[a]Programa de Pós-graduação em Ciências da Saúde. Centro Universitário FMABC, Santo André, SP, Brasil;

[b]Departamento de Cirurgia. Centro Universitário FMABC, Santo André, SP, Brasil;

[c]Laboratório de Delineamento de Estudos e Escrita Cientifica. Centro Universitário FMABC, Santo André, SP, Brasil.

Corresponding author
mdcostad@gmail.com

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ORCID dos autores:
Daniel Santos Costa - ORCID: 0000-0002-7688-0417
Sidnei José Galego - ORCID: 0009-0007-0524-9787
João Antônio Correa - ORCID: 0000-0002-3192-3436

Abstract

Introduction: the global prevalence of abdominal aortic aneurysms was 0.92% in 2019, with regional variations related to risk factors and access to treatment. Endovascular repair has become the preferred approach due to its lower mortality rate than open surgery, with a significant increase in use between 2004 and 2015. Within this context, percutaneous endovascular repair has emerged as a minimally invasive alternative, associated with a reduction in complications and surgical time, although its effectiveness may be limited in cases of complex vascular anatomy. Percutaneous access to the femoral artery has been widely used, providing lower morbidity, emphasizing the importance of careful vascular planning.

Objective: evaluating the experience of a vascular surgery service in using the percutaneous endovascular aneurysm repair technique and comparing the outcomes related to percutaneous access and conventional access by femoral dissection.

Methods: this is an observational, descriptive, and retrospective study with a quantitative approach, conducted with 42 patients who consecutively underwent endovascular repair via percutaneous access or femoral dissection at a private tertiary hospital located in Santo André, São Paulo. Data was extracted from electronic medical records and organized into spreadsheets for analysis of clinical and epidemiological variables.

Results: of the 67 patients initially assessed, 42 met the inclusion criteria, 71.43% were male and 28.57% female. Elective procedures accounted for 52.38% of cases, while 47.62% were emergency surgeries. The overall rate of local complications was 16.67%, and the perioperative mortality rate was 14.28%. There was a higher perioperative mortality rate in patients who underwent femoral dissection (20%) compared to puncture access (5.9%), although this was not statistically significant. The Perclose ProGlide device had a success rate of 98.48%. The most frequent pathology was abdominal aortic aneurysm (42.86%).

Conclusion: the percutaneous approach had lower rates of local complications and perioperative mortality compared to femoral dissection, proving to be a safer and more effective alternative for the endovascular treatment of aortic pathologies. On the other hand, dissection, because it is a more invasive procedure, was associated with a higher incidence of local complications, reinforcing the preference for the percutaneous approach whenever technically feasible.

Keywords: aneurysm. ascending aortic dissection. thoracoabdominal aortic aneurysm. abdominal aortic aneurysm.

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Authors summary

Why was this study done?
This study aimed to describe the experience of a vascular surgery department in using percutaneous and femoral dissection access techniques for endovascular repair of aortic pathologies. The clinical profile of the patients was analyzed, including age and gender, as well as the success rates of the procedure, perioperative mortality, and types and incidence of local complications associated with each access technique.

What did the researchers do and find?
Data analysis showed that percutaneous access had lower complication and mortality rates when compared to conventional surgical access via femoral dissection. These findings suggest that percutaneous access is a safer and more effective approach for the endovascular treatment of aortic diseases in carefully selected patients.

What do these findings mean?
The results of this study indicate that the choice of percutaneous access contributes to the reduction of local complications associated with the procedure, positively impacting the reduction of perioperative mortality. These findings reinforce the importance of proper anatomical and clinical assessment of patients to select the safest access route.

Highlights
Aortic diseases represent a complex therapeutic challenge, requiring detailed surgical planning.
The choice of the type of vascular access is a determining factor in the clinical outcomes of patients undergoing endovascular repair.
Percutaneous access showed lower rates of local complications and mortality, making it the preferred technique when carefully indicated.

INTRODUCTION

The global prevalence of abdominal aortic aneurysm (AAA) in people aged between 30 and 79 was 0.92% in 2019, which equates to approximately 35.12 million cases. The prevalence of AAA varies by region, with the Western Pacific region having the highest prevalence, at 1.31%, while the African region had the lowest, at 0.33%. This regional variation may reflect differences in prevalent risk factors and health systems, as well as access to diagnosis and treatment[1].

Several factors are associated with the development of AAA, including smoking, male gender, fam-ily history of AAA, advanced age, hypertension, hypercholesterolemia, obesity, cardiovascular disease, cerebrovascular disease, and claudication. These risk factors are related to conditions that affect vascular health and increase the likelihood of aneurysm development[2].

Endovascular abdominal aortic aneurysm repair (EVAR) increased significantly for ruptured aneu-rysms, from 10% in 2004 to 55% in 2015 ($P < 0.001$), with an operative mortality of 35%. For intact aneu-rysms, the use of EVAR also increased from 45% in 2004 to 83% in 2015 ($P < 0.001$), with a lower opera-tive mortality of 2.0%[3].

This data reflects the growing adoption of the endovascular technique as a preferred approach for the treatment of AAA, due to its lower mortality compared to traditional surgical interventions.

Percutaneous endovascular aneurysm repair (PEVAR) has emerged as a minimally invasive treat-ment option for patients with AAA. PEVAR offers advantages such as a lower incidence of complications at the vascular access site and a reduced procedure time[4].

However, although PEVAR has benefits in terms of recovery and fewer complications, its applica-bility may be limited in cases of complex anatomies or difficult access, reinforcing the importance of careful preoperative planning. That said, a detailed assessment of the vessels at the access site is para-mount for proper device selection[4].

This study is justified because endovascular treatment has been an acceptable option for correcting many diseases of the thoracic and abdominal aorta in recent years[5]. Access to the common femoral arteries is usually done by surgical exposure, so that the delivery system can be introduced[6]. With the proven safe-ty of the percutaneous technique for larger sheaths, the PEVAR approach to the femoral arteries has been applied as an alternative to surgical cutting[7].

Percutaneous access to the femoral artery is increasingly being used in endovascular aortic repair (EVAR). According to the literature, the technique can be challenging in patients with previously exposed or surgically repaired femoral arteries, due to excess scar tissue. However, a successful percutaneous ap-proach can cause less morbidity than a 'redone' open femoral approach[8].

Thus, the aim is to demonstrate the experience of a vascular surgery service using percutaneous and dissection access techniques for endovascular repair of aortic diseases, in addition to evaluating the clini-cal profile of patients, such as age and gender; success rates, deaths during hospitalization, types and rates of local complications related to access to the femoral arteries.

METHODS

Study design and location

This is an observational, descriptive, retrospective study with a quantitative approach, using data from patients who consecutively underwent endovascular repair of aortic pathologies, using percutaneous access or femoral dissection, between April 2013 and July 2018. The study was conducted at a large pri-vate tertiary hospital located in the city of Santo André, in the state of São Paulo (Hospital e Maternidade Brasil), which specializes in overly complex procedures, including vascular surgery.

Selection process, inclusion, and exclusion criteria

The study included all patients over the age of 18, of both sexes, with adequate vascular anatomy and

complete data recorded in electronic medical records, referring to endovascular surgical procedures performed in the hemodynamics room at Hospital e Maternidade Brasil between 2013 and 2018. Eligible patients were those with at least one femoral artery with a minimum diameter of 1.2 cm, no calcification of the anterior wall or less than 50% calcification of the posterior wall, and with a life expectancy of more than 1 year. Patients whose medical records contained incomplete, duplicate, or inaccurate data were ex-cluded.

Study variables

The independent variables analyzed were gender (male/female), age (years), type of pathology (AAA, AATA, ATD, APR, aortic dissections and endoleaks), type of procedure (elective or emergency), type of surgical access (percutaneous or femoral dissection) and number of devices used. The dependent variables were the occurrence of local complications (yes/no), type of local complication (ischemia, infec-tion, hematoma, pseudoaneurysm, hemorrhage), patient outcome (discharge/death) during hospitalization, and length of hospital stay (days).

Surgical procedures

The procedures were conducted by a team specializing in vascular surgery. Percutaneous access was used whenever possible, after prior assessment of the anatomical conditions of the common femoral artery (CFA) under ultrasound guidance. The technique used included puncturing the CFA above the bifur-cation, the Seldinger technique with a 0.035-inch Teflon guide wire, and the introduction of Perclose ProGlide® devices (Abbott Vascular, Redwood City, California) for percutaneous closure. In cases of femoral dissection, conventional surgical exposure of the artery was performed.

Technical success was defined by completing the procedure without persistent bleeding or arterial ischemia.

Data collection and organization

The data were obtained from the patients' electronic medical records, made available by the hospi-tal through the TASY® system. The information was organized in Microsoft Excel® spreadsheets for later statistical analysis.

Statistical analysis

Statistical analysis was conducted using SPSS V26 (2019), Minitab 21.2 (2022), Excel Office 2010, and Python. Categorical variables (gender, type of procedure, occurrence of complications, and outcome) were expressed as absolute and relative frequencies. Numerical variables (age, number of devices used, and length of stay) were described by means and standard deviations. Student's t-test was used to compare means, while Pearson's correlation investigated associations between numerical variables. A significant level of 5% ($p<0.05$) was adopted for all analyses.

Ethical aspects

The study was approved by the Research Ethics Committees of the Centro Universitário da Fac-uldade de Medicina do ABC (CAEE 91334218.8.0000.0082) and Hospital e Maternidade São Luiz (CAEE 91334218.8.3001.0087), by the guidelines and standards for research involving human beings.

RESULTS

Of the 67 patients who initially underwent surgical procedures, 42 (62.7%) had complete medical records and were included in the study. The remaining 25 patients (37.3%) were excluded due to a lack of adequate data.

Among the 42 patients analyzed, 30 (71.43%) were male and 12 (28.57%) female. As for the type of surgery, 22 (52.38%) procedures were elective, while 20 (47.62%) were urgent.

Regarding the occurrence of local surgical complications, 7 patients (16.67%) had local complica-tions at the access site, while 35 patients (83.33%) did not. The complications observed included: ischemia (2 cases), surgical wound infection (1 case), large hematoma (2 cases), pseudoaneurysm (1 case), and oc-cult hemorrhage (1 case). Mortality among patients with complications was 42.9% (3 deaths), significantly higher than among patients without complications (8.6%; 3 deaths), with $p=0.018$. It should also be noted that local complications in patients who died directly or indirectly influenced this outcome.

Analysis of mortality by the type of surgery showed that 1 death (4.54%) occurred in an elective procedure and 5 deaths (25%) in emergency surgeries ($p=0.05$).

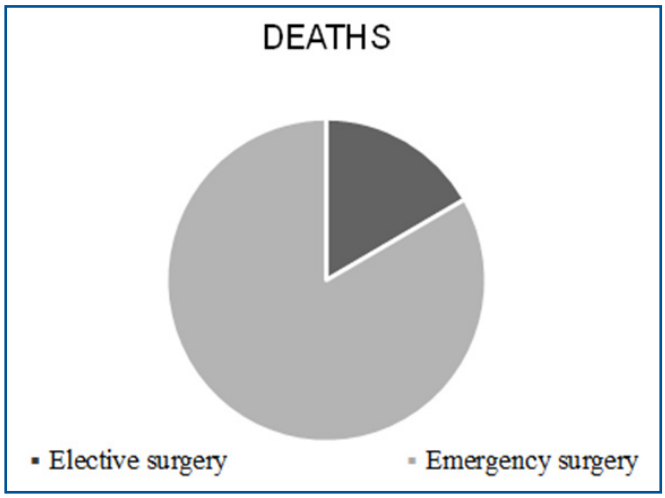

Figure 1: Ratio of deaths by type of surgery

Table 1: Relation of "Local Complication" to Qualitative Factors

		With local complications		Without local complications		P-Value
	N	%	N	%		
Outcome	Hospital discharge	4	57.1%	32	91.4%	0.018
	Death	3	42.9%	3	8.6%	
Sex	Female	3	42.9%	9	25.7%	0.359
	Male	4	57.1%	26	74.3%	
Hospitalization Class	From 0 to 3	1	14.3%	11	31.4%	0.219
	From 4 to 10	1	14.3%	5	14.3%	
	From 11 to 20	1	14.3%	12	34.3%	
	Over 21	4	57.1%	7	20.0%	
Age group	Up to 50	1	14.3%	3	8.6%	0.294
	From 50 to 60	0	0.0%	7	20.0%	
	From 60 to 70	2	28.6%	8	22.9%	
	From 70 to 80	1	14.3%	12	34.3%	
	Above 80	3	42.9%	5	14.3%	

As for the type of access used, 25 patients (59.52%) underwent femoral dissection, and 17 patients (40.48%) underwent percutaneous access. Complications occurred in 6 patients (24%) in the dissection group and 1 patient (5.88%) in the percutaneous group (p=0.12). The mortality rate was 20% in the dissec-tion group and 5.9% in the percutaneous group (p=0.19).

The evaluation by gender showed that among female patients, the complication rate was 25% (3 cases) and mortality was 8.33% (1 death). Among male patients, the complication rate was 13.33% (4 cas-es) and mortality was 13.33% (4 deaths), with no statistically significant difference between the groups. The use of the Perclose ProGlide device for percutaneous access had a success rate of 98.48%, with only one failure out of 67 devices used (p 0.029).

Regarding the pathologies treated, abdominal aortic aneurysm (AAA) was the most common (42.86%), followed by descending aortic dissection (26.19%), thoracoabdominal aortic aneurysm (9.52%), and other less prevalent conditions. (Figure 2 and Figure 3).

Local complication rates occurred in 14.3% of patients under the age of 50, with no complications in patients aged between 50 and 60, 28.6% among patients aged between 60 and 70, 14.3% in those aged between 70 and 80, and the highest rate occurring in patients over 80 (42.9%).

The overall mean age was 68.67 years, 77.58 years for women, and 65.23 years for men. Patients with local complications had a significantly higher mean age (t-statistic=2.191; p=0.041).

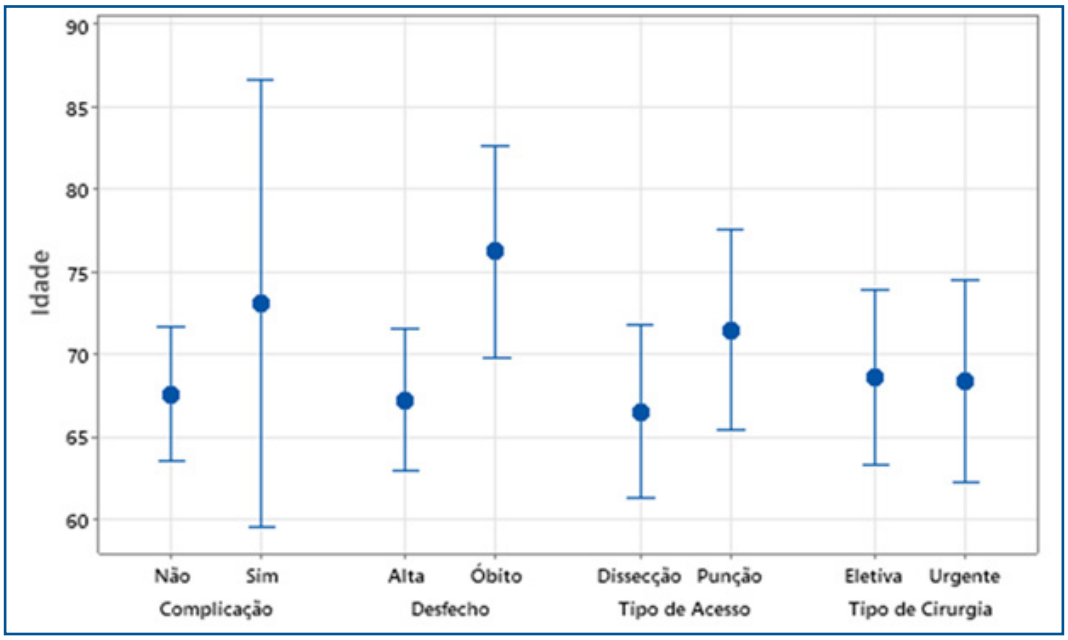

Figure 2: Comparison of average age

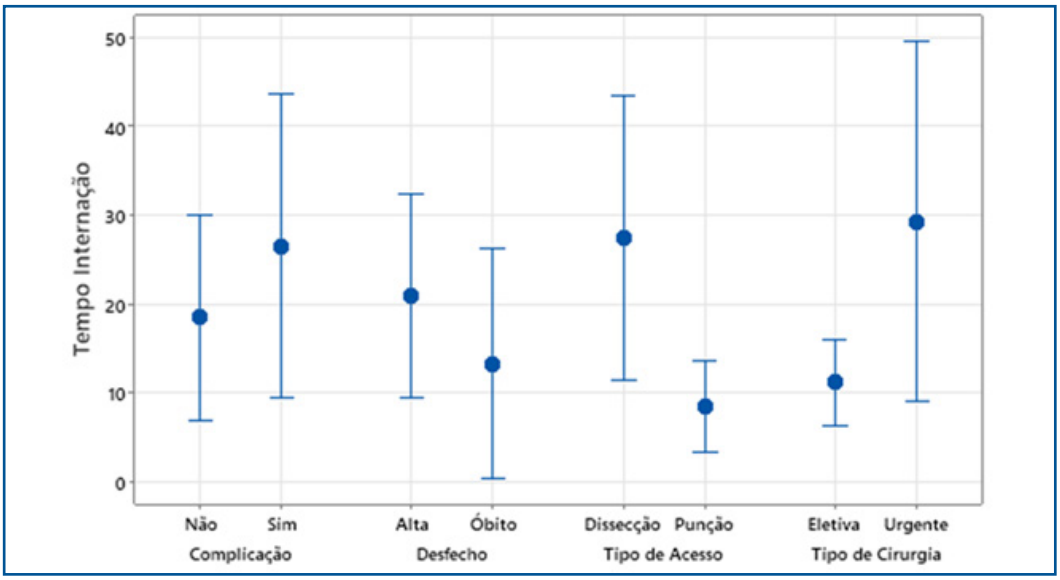

Figure 3: Comparison of the average length of stay

About hospitalization time, although there was no statistical significance, there was a trend towards shorter hospitalization time for patients undergoing the puncture technique than for the conventional tech-nique.

It is also possible to observe a trend towards longer hospital stays for patients undergoing emergen-cy procedures compared to elective procedures, as well as for patients who had local complications, than for those who did not.

DISCUSSION

The endovascular technique has been consolidated as the preferred approach for the treatment of aortic pathologies, especially about conventional open surgery, due to the lower rates of complications and short-term mortality, as demonstrated in several studies, including the EVAR Trial 1 and the meta-analyses by Lovegrove (2008)[9], Stather *et al.* (2013)10, Dangas *et al.* (2012)[11] and Schermerhorn *et al.* (2015)[12].

Similarly to what was found in these studies, the results of this study showed that the percutaneous approach had a lower complication rate (5.88%) and mortality rate (5.9%) compared to the femoral dissec-tion approach, whose rates were 24% and 20%, respectively. These findings reinforce the safety and effec-tiveness of minimally invasive endovascular repair, also described by Behrendt *et al*. (2017)[13], who showed lower hospital mortality and shorter length of stay after EVAR compared to open surgery.

Additionally, although Patel *et al.* (2016)[14] and Lederle *et al.* (2019)[15] have pointed out that the sur-vival benefits of EVAR may be reduced in the long term, the immediate and perioperative outcomes still show clear advantages of minimally invasive access, which corroborates the data observed in this study.

Another relevant aspect was the profile of the patients who underwent percutaneous access. In this study, it was observed that this approach was used more in older patients, with a mean age higher than that of patients undergoing femoral dissection (71.41 vs. 66.88 years). This characteristic was also described by Behrendt *et al.* (2017)[13], who showed greater benefit from EVAR in octogenarian patients.

About the use of the Perclose ProGlide device, the data from this study showed a success rate of 98.48%, in line with what was reported by Moonen *et al.* (2019)[16], who found a technical success rate of 98.6% in their sample. This high rate of effectiveness reinforces the technical feasibility of the percutane-ous approach, even in real-life scenarios and in high-volume services.

The low complication rates observed in the percutaneous group, especially at the access site, are compatible with the findings of Ong, Tay and Chong (2023)[17], who reported the safety of the PEVAR pro-cedure, even in Asian patients with a smaller femoral diameter, with rare and easily manageable complica-tions.

Another important finding in this study was the correlation between age and complications, which showed that patients over 60 had a higher frequency of local complications, a statistically significant result (p=0.041). This behavior is expected and described in the literature, since advanced age is a recognized risk factor for vascular and surgical complications[13,14].

Finally, the distribution of pathologies observed, with a predominance of abdominal aortic aneu-rysms (42.86%), is in line with the global epidemiological data described by Song *et al.* (2023)[1], consoli-dating the applicability of the results found.

Thus, the results of this study reinforce the evidence in the literature regarding the advantages of the percutaneous approach over femoral dissection, demonstrating lower complication and mortality rates, even in elderly patients, as well as high technical effectiveness with the use of the Perclose ProGlide de-vice.

CONCLUSION

The results of this study showed that percutaneous access for endovascular repair of aortic patholo-gies had lower rates of complications and perioperative mortality compared to femoral dissection access. These findings reinforce the safety and efficacy of the minimally invasive

technique, especially in appro-priately selected patients.

On the other hand, surgical access by dissection was associated with a higher incidence of local complications, with a direct impact on the perioperative mortality of affected patients. These data high-light the importance of strategies that prioritize percutaneous access whenever possible to reduce compli-cations and improve clinical outcomes.

In addition, it was observed that the age of the patients had a noteworthy influence on the occur-rence of complications, pointing to the need for special attention when dealing with older patients.

Considering that this study was retrospective, carried out in a single center and with a limited sam-ple, it is recommended that future studies be conducted, especially prospective and randomized clinical trials, to validate and expand the evidence observed, as well as to explore the impact of different anatomi-cal profiles, clinical characteristics and long-term evolutions on the performance of percutaneous access in endovascular procedures.

Authors' contribution

DSC: development of the research project and writing of the manuscript; SJG: surgeon responsible for all the cases, development of the literature review; JAC: review of the manuscript and definition of the study objectives.

Financing

Does not apply.

Conflicts of interest

The authors declare that there are no conflicts of interest related to this study.

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Resumo

Introdução: o aneurisma de aorta abdominal apresentou uma prevalência global de 0,92% em 2019, com variações regionais relacionadas a fatores de risco e ao acesso ao tratamento. O reparo endovascular consolidou-se como a abordagem preferencial, devido à menor mortalidade em comparação à cirurgia aberta, com aumento expressivo de sua aplicação entre 2004 e 2015. Dentro deste contexto, o reparo endovascular percutâneo surge como uma alternativa minimamente invasiva, associada à redução de complicações e do tempo cirúrgico, embora sua eficácia possa ser limitada em casos de anatomia vascular complexa. O acesso percutâneo da artéria femoral tem sido amplamente utilizado, proporcionando menor morbidade, ressaltando a importância de um planejamento vascular criterioso.

Objetivo: avaliar a experiência de um serviço de cirurgia vascular na utilização da técnica de reparo endovascular percutâneo de aneurisma e comparar os desfechos relacionados ao acesso percutâneo e ao acesso convencional por dissecção femoral.

Método: estudo observacional, descritivo e retrospectivo, de abordagem quantitativa, realizado com 42 pacientes submetidos consecutivamente a reparo endovascular por acesso percutâneo ou dissecção femoral, em um hospital terciário privado localizado em Santo André, São Paulo. Os dados foram extraídos de prontuários eletrônicos e organizados em planilhas para análise das variáveis clínicas e epidemiológicas.

Resultados: dos 67 pacientes inicialmente avaliados, 42 atenderam aos critérios de inclusão, sendo 71,43% do sexo masculino e 28,57% do sexo feminino. Procedimentos eletivos corresponderam a 52,38% dos casos, enquanto 47,62% foram cirurgias de urgência. A taxa global de complicações locais foi de 16,67%, e a taxa de mortalidade per operatória foi de 14,28%. Observou-se maior mortalidade per operatória nos pacientes submetidos à dissecção femoral (20%) em comparação ao acesso por punção (5,9%), embora sem significância estatística. O dispositivo Perclose ProGlide apresentou taxa de sucesso de 98,48%. A patologia mais frequente foi o aneurisma de aorta abdominal (42,86%).

Conclusão: o acesso percutâneo apresentou menores taxas de complicações locais e mortalidade per operatória em relação à dissecção femoral, demonstrando ser uma alternativa mais segura e eficaz no tratamento endovascular de patologias da aorta. Por outro lado, a dissecção, por se tratar de um procedimento mais invasivo, esteve associada a maior incidência de complicações locais, reforçando a preferência pela abordagem percutânea sempre que tecnicamente viável.

Palavras-chave: aneurisma. dissecção da aorta ascendente. aneurisma da aorta toracoabdominal. aneurisma da aorta abdominal.

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