ORIGINAL ARTICLE

SPINAL CORD ISCHEMIA DURING ENDOVASCULAR REPAIR OF THE THORACIC AORTA

ABSTRACT

Background and objectives: This work aims to analyze the incidence of medullary ischemia (MI) and identify the factors contributing to its development during endovascular repair of the descending thoracic aorta in patients requiring complete coverage.

Material and methods: A retrospective study. Between April 1999 and December 2014, 176 thoracic aortic endovascular repairs were performed. Sixty-two patients (48 male and 14 female) were treated with thoracic stents from the aortic arch to the celiac trunk due to thoracoabdominal aneurysms (n = 13), aortic dissections (n = 42), intramural hematomas (n = 4), post-traumatic pseudoaneurysms (n = 2) and aortic ulcers (n = 1). All procedures were performed under general anesthesia with strict invasive blood pressure control. Cerebrospinal fluid drainage was performed in 5 patients.

Results: The success rate of stent placement was 96.7%, and mortality was 4.84%. The incidence of spinal cord ischemia was 4.84% (3 patients, one in the immediate postoperative period and two during follow-up). Permanent paraplegia was observed in 1.6%. Overall survival (Kaplan-Meier) at 1, 3, and 6 years was 76%, 69.1%, and 64.32%, respectively.

Conclusions: thoracic aortic coverage is an effective procedure with a high probability of success. Our study identified a previous procedure on the abdominal aorta and a thromboembolic aortic event as risk factors for developing medullary ischemia in patients requiring complete coverage of the thoracic aorta. In this study, full coverage of the thoracic aorta and left subclavian artery alone are not predictors of paraplegia.

Keywords: *thoracoabdominal aneurysms; spinal cord ischemia*

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INTRODUCTION

Stenting of the thoracic aorta is a procedure that is being performed with increasing frequency. Recent literature shows that extensive coverage of the thoracic aorta is associated with the incidence of neurological complications[1].

Although reports in the international literature generally reflect a lower incidence of MI during stenting than during conventional surgery, MI persists as one of the most devastating and feared complications[2,3].

Several factors have been identified as favoring the occurrence of MI; among them a history of abdominal aortic treatment, arterial hypotension during implantation, coverage of the left subclavian artery, and extension of the covered aorta[4].

This presentation aimed to analyze the incidence and identify the risk factors associated with MI in patients in whom the thoracic aorta was covered entirely.

MATERIALS AND METHODS

A retrospective study was performed between April 1999 and December 2014. A total of 176 patients were treated with thoracic stents. Sixty-two patients (48 male and 14 female), with a mean age of 59.95 years, received thoracic aortic stents from the aortic arch to the celiac trunk due to thoracoabdominal aneurysms (n = 13), aortic dissection (n = 42), intramural hematoma (n = 4), posttraumatic pseudoaneurysms (n = 2), and aortic ulcer (n = 1).

Table 1 shows the clinical and demographic characteristics of the patients.

Variable	n	Percentage (%)
Blood pressure (mmHg)	61	98,44
Active smoking	21	35,94
Diabetes	13	20,31
Obesity	27	43,55
Coronary heart disease	15	23,44
Chronic obstructive pulmonary disease	26	43,75
Chronic renal failure	10	16,13
Age (years)	59,95 (22-87)	

TABLE 1. Clinical and demographic characteristics of the patients.

RESULTS

All patients underwent angiotomography before surgery.

The left subclavian artery was intentionally occluded without revascularization in 22 cases (35.48%) because the proximal aortic neck was less than 15 mm long. The celiac trunk was deliberately covered in three patients due to a short distal aortic neck.

Spinal protection by cerebrospinal fluid (CSF) drainage was performed in five patients. All these patients had a history of abdominal surgery.

All procedures were performed under general anesthesia and invasive blood pressure monitoring, with mean arterial pressure above 90 mmHg.

Technical success of implantation was defined as a correct release of the stents, no conversion to conventional surgery, and no evidence of immediate endoleaks of types I and III.

Continuous variables are presented as the median and interquartile range (25-75), while categories are expressed as percentages with their absolute value.

The difference in survival at one, three, and six years was evaluated by the Kaplan-Meier method.

Statistical analysis was performed with the Stata program 13™.

The technical success rate of implantation was 96.7%; there were two cases of type I endoleaks (3.23%) at the end of the procedure and perioperative mortality in three patients (4.84%). No conversion to conventional surgery was recorded; the causes of death were aortic rupture in one patient and multiorgan failure in two.

The mean length of aortic coverage was 288 mm (200 to 360 mm).

No patient in whom the left subclavian artery (35.48%) and celiac trunk (4.84%) were intentionally covered developed left upper limb or mesenteric ischemia, respectively.

MR was observed in three patients (4.83%), in one immediately and in the other two, far apart in time, regarding the form of presentation of MI; one patient presented with paraparesis 24 hours after treatment while hospitalized in the coronary unit. The second patient developed retrograde ejaculation and paresthesias of both lower limbs three years after the procedure, and the third developed permanent paraplegia four years after the procedure.

Survival at 1, 3, and 6 years was 76%, 69.91%, and 64.32%, respectively (*Figure 1*).

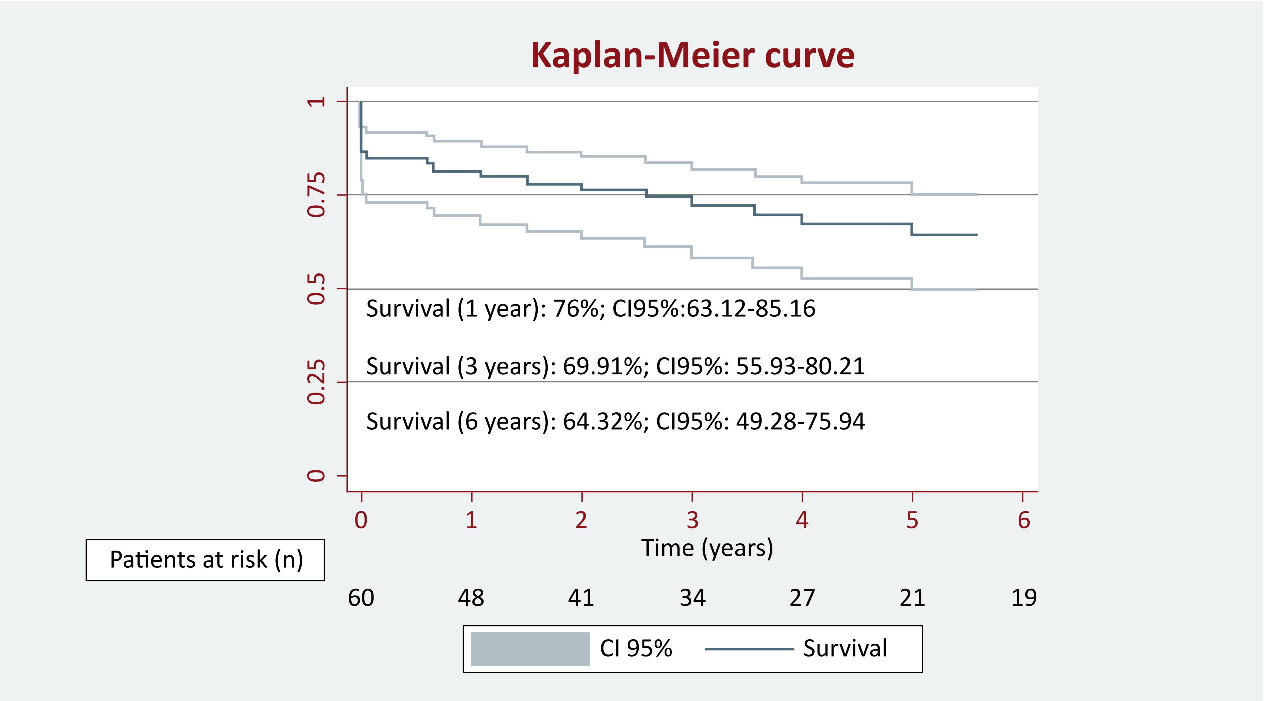

FIGURE 1. Survival at 1, 3, and 6 years.

DISCUSSION

According to the international literature, MI is a severe complication during stent placement in thoracic aortic pathology; the incidence is 0 to 12%[3-5]. In our study, the incidence of MI was 4.83% (3 patients). One patient presented paraparesis 24 hours after treatment while hospitalized in the coronary unit. He had been treated for a thoracic aneurysm and, years earlier, had undergone a bifemoral aortic bypass. CSF drainage was performed using a spinal catheter placed during the intervention until reaching 10 mmHg. The patient was discharged 72 hours later, asymptomatic.

The second patient was treated for a chronic dissection and had undergone endovascular intervention of the abdominal aorta; he developed a sudden picture of paresthesias of both lower limbs and retrograde ejaculation three years after the procedure, which was corrected with blood pressure stabilization. The last patient, also treated for chronic aortic dissection, developed paraplegia four years after the procedure, probably due to atheromatous embolism in an aorta with multiple calcified fibro-lipidic plaques, with the persistence of paraplegia during follow-up.

The occurrence of MI after thoracic aortic stenting is more frequent when the arteries that supply the spinal cord (Adamkiewicz artery and intercostal and lumbar arteries) are sacrificed, as well as after a period of severe hypotension or embolisms from atheromatous lesions of the aorta[5].

Our results show that, despite covering large extensions of the thoracic aorta and the entirety of the intercostal arteries, there is no linear correlation between this procedure and the appearance of spinal cord ischemia. This may be explained by the model proposed by Griepp of spinal cord vascularization[6], according to which spinal cord irrigation depends on multiple collateral arteries supplying the anterior spinal artery instead of a single dominant artery of Adamkiewz, previously considered essential to maintain spinal cord perfusion[6].

It should also be mentioned that MI is a phenomenon that can not only occur during or immediately after endovascular treatment but can also appear after years, as occurred in two of the patients presented[6].

The only measure we systematically apply to prevent spinal cord ischemia is keeping mean arterial pressure elevated (≥90 mmHg) and stable during the intervention.

In our series, we performed medullary protection in cases where the entire thoracic aorta was covered and the abdominal aorta had been operated on. Although there is a risk of compressive hematoma of the spinal cord due to a puncture of the spinal canal, this technique should be used as a prophylactic measure only in this case.

CONCLUSION

It can be concluded that endovascular treatment of the descending thoracic aorta using stent placement should not be considered a factor causing spinal cord ischemia. When establishing a predictive factor, we consider that the only one is the previous repair of the aorta in the abdominal sector. All patients should receive medullary protection in these cases, maintaining a stable mean arterial pressure ≥90 mmHg throughout the intervention and the first 48 hours after the procedure.

Conflicts of interest

The authors declare no conflict of interest.

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