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Short and medium term outcomes of ascending aorta surgery in Marfan Syndrome

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Acronyms
SD: standard deviation
HT: hypertension
CICU: Cardiovascular Intensive Care Unit

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ABSTRACT

Introduction and Objective: Marfan syndrome is a genetic disorder that causes destruction of elastic fibers in tissues that contain them. The cardiovascular system is one of the most commonly affected, where a progressive dilatation of the aorta (often asymptomatic) occurs, and if undiagnosed it can lead to the patient's death at an early age in life. The objective was to describe the results of the progress of patients with Marfan syndrome and ascending aortic surgery.

Método: A descriptive study was conducted between January 2007 and December 2010, where six consecutive patients with Marfan syndrome underwent surgery in the Service of Cardiovascular Surgery of Hermanos Ameijeiras Hospital. The variables related to the diagnosis and surgical procedures and postoperative progress at one year were analyzed.

Resultados: Aortic disorders in Marfan syndrome occurred at a relatively young age (40.33 ± 8.33). Aortic dissection was the most common disease (66.6%), and was related to the presence of pain and hypertension. Radical techniques predominated (66.6%) over the conservative ones. Surgical mortality was 16.6%, with one death; the remaining patients had a survival at one year of 100%.

Conclusiones: Male patients with aortic dissection and normal ejection fraction were predominant. The most used surgical technique was that of Bental De Bono. Only one patient died in the hospital, the rest had an excellent evolution at one year.

Palabras clave: Aortic surgery, Marfan syndrome, Follow-up studies

Resultados a corto y mediano plazos de la cirugía de la aorta ascendente en el Síndrome de Marfan

RESUMEN

Introducción y objetivo: El síndrome de Marfan es un trastorno genético que provoca destrucción de las fibras elásticas de los tejidos que la contienen. El sistema cardiovascular es uno de los que más se afecta, donde ocurre una dilatación progresiva de la

aorta, muchas veces asintomática, que si no se diagnostica puede llevar a la muerte del paciente en edades tempranas de la vida. El objetivo fue describir los resultados de la evolución de los pacientes con síndrome de Marfan y cirugía de la aorta ascendente.

Método: Se realizó un estudio descriptivo entre enero de 2007 y diciembre de 2010, donde se intervinieron quirúrgicamente de manera consecutiva 6 pacientes con diagnóstico de Síndrome de Marfan en el Servicio de Cirugía Cardiovascular del Hospital "Hermanos Ameijeiras". Se analizaron las variables relacionadas con el diagnóstico y los procedimientos quirúrgicos, así como la evolución posquirúrgica hasta el año.

Resultados: Las afecciones aórticas en el síndrome de Marfan se presentaron en edades relativamente jóvenes (40,33 ± 8,33). La disección aórtica fue la enfermedad de mayor incidencia (66,6 %), relacionada con la presencia de dolor e hipertensión arterial. Predominaron las técnicas radicales (66,6 %) sobre las conservadoras de la válvula aórtica. La mortalidad quirúrgica fue del 16,6 %, con un caso fallecido, el resto de los pacientes tuvieron una sobrevida al año, del 100 %.

Conclusiones: Predominaron los pacientes masculinos, con disección aórtica y fracción de eyección normal. La técnica quirúrgica más empleada fue la de Bental De Bono. Solo un paciente falleció en el hospital; el resto tuvo una excelente evolución al año de seguimiento.

Palabras clave: Cirugía de aorta, Síndrome de Marfan, Estudios de Seguimiento

INTRODUCTION

Marfan syndrome is a genetic disorder of the connective tissue of autosomal dominant transmission, determined by a mutation on chromosome 15q21, which encodes a glycoprotein called fibrillin-1, the main component of the extracellular microfibers that are found in large quantities in the connective tissue. This inherited disorder causes the formation of abnormal elastic fibers with the resulting dysfunction of tissues containing them, such as: cardiovascular, skeletal and ocular systems, as well as the skin, dura and lung[1-3].

Elastic fibers are part of the extracellular matrix of tissues that are composed of elastins and a network of microfibrils serving as a frame for the deposit of elastin. The main changes in the cardiovascular system are ascending aorta dilatation with or without its valve insufficiency, dissection and rupture, and also mitral valve prolapse.

Most frequently histological findings are observed in the middle layer, with disruption, dislocation and destruction of elastic fibers, disorganization, fibrosis and necrosis. Cardiovascular lesions and aortic dilatation in up to 80% in children and almost in all adults cause the highest mortality (70-95% of patients). This dilatation causes progressive valvular insufficiency, aneurysm, dissection or rupture if not treated early. These lesions are often diagnosed by routine imaging studies[4,5].

The initial surgery consisted of palliative procedures such as reduction aortoplasties and wrapping[6,7]. In 1956, DeBakey, Cooley and Creech expanded the surgical area by performing a resection of an aneurysm of the ascending aorta with a homograft insertion and in 1964 they published some statistics of 164 operated patients[8]. At the end of this decade the composite replacement of ascending aorta and aortic valve with a valved graft and reimplantation of the coronary arteries was introduced (Bentall De Bono technique)[9]. Later, in the 80s, conservative procedures of the aortic valve were incorporated, when Yacoub and colleagues devised the aortic remodeling[10-13]. Later, Tirone David projected the aortic reimplantation technique when the aortic annulus and sinotubular junction exceeded 30 and 50 inches, respectively[14, 15]. From then and until the present new procedures have been incorporated in order to preserve the native unaffected tissues and prevent anticoagulation[16,1716,17].

METHOD

Between January 2007 and December 2010, in the Department of Cardiovascular Surgery of Hermanos Ameijeiras Hospital, there were a total of 30 ascending aorta surgeries in 28 patients; 6 of them were diagnosed with Marfan syndrome. Despite having a small

sample, variables related to the diagnosis, surgical procedure and further progress, were analyzed.

The nonparametric descriptive analysis was used. For continuous variables, the mean ± standard deviation (SD) and range were calculated, and in the rest of the variables, the percentage.

The surgical techniques used were: ascending aorta and aortic valve replacement through a valved conduit, with reimplantation of coronary arteries, ascending aorta replacement with commissural resuspension of the aortic valve and aortic repair.

The short-term follow-up was from surgery to hospital discharge. Outpatient follow-up (medium term), was performed by outpatient visits up to a period of one year after surgery.

The information was obtained through review of medical records, surgery, anesthesia and perfusion reports of the patients in question.

Table 1. Preoperative variables.

Variables	Nº of patients (%), Mean ± SD
Age	40,33 ± 8,33 (intervalo, 28 - 53)
Gender	
Male	5 (83,3 %)
Female	1 (16,6 %)
Diagnosis at admission	
Aortic dissection	4 (66,6 %)
Aortic Aneurysm	2 (33,3 %)
LV ejection fraction	
≥ 50 %	4 (66,6 %)
≥ 30 % y < 50 %	2 (33,3 %)
Functional class (NYHA)	
I, II	4 (66,6 %)
III, IV	2 (33,3 %)

LV: Left ventricle
NYHA: New York Heart Association

RESULTS

Of the 28 cases operated on for conditions of the ascending aorta, 6 (21.4%) had a history of Marfan syndrome, with a mean age of 40.33 ± 8.33 (range, 28-53) years. The remaining presurgical variables are reflected in Table 1. Four patients were diagnosed with acute aortic dissection (66.6%) and aneurysms in the 2 remaining, one of them symptomatic. Chest pain prevailed in all patients operated on for acute aortic syndrome, and hypertension (HT) was found in 75% of them. Dyspnea was predominant in one of the patients with aortic aneurysm, whereas in the other case aortic disease was confirmed by monitoring echocardiography.

In all patients diagnosis was confirmed by contrast computed tomography. Also transthoracic and transesophageal echocardiography confirmed the presence of these diseases in most cases.

Moreover, the time between the diagnosis of the disease and surgical treatment in three of the patients with acute aortic syndrome was less than 24 hours. However, the other patient was transferred to our center with seven days of illness evolution, in a poor overall condition, with dilatation and malfunction of the left ventricle. For those affected by aortic aneurysms, this range was longer, allowing bringing these patients in better conditions to the operating room.

A total of seven surgeries were performed, as a patient required a second surgery for pseudoaneurysm at the distal suture line of the valved conduit of initial surgery. Emergency surgery was performed in five patients (including reintervention), and extreme urgency in one of them, while the remaining two were electively operated on.

In all patients, the femoral vessels were dissected, but only in four of them femoral vein and artery were cannulated, and in two cases the femoral artery was used with double-step cannula in the right atrium. In the patient that underwent reintervention for pseudoaneurysm at the distal suture line of the valved graft, the femoral vein was used with axillary artery as input path.

Custodiol was the cardioplegic solution used in all cases. Bentall De Bono technique, with the “button” procedure was the most used (Table 2, Figure 1), followed by the conservation of the aortic valve with commissural resuspension (Table 2, Figure 2) and in the case that underwent reintervention for pseudoaneurysm, a resection of the false aneurysm was performed at the distal suture line of the valved conduit of previous surgery by aortoplasty with Dacron patch.

Extracorporeal circulation times and aortic clamping are shown in Table 2, only one patient underwent circulatory arrest for 34 minutes. The extreme times corresponded to a case with ascending aortic dissection that extended to the arch and descending

aorta, who was transferred to our center with a seven-day illness evolution, in low cardiac output.

One case underwent reintervention for pseudo-aneurysm at the distal anastomosis level of the valved graft, as described above. In one patient a large pericardial effusion was diagnosed, which was drained by subxiphoid puncture under echocardiographic control.

Table 2. Variables related to surgery.

Variables	Nº de pacientes (%), Media ± DE
Cannulation Femoro - femoral Femoral artery - RA Axillary artery - RA	 4 (66,6 %) 2 (33,3 %) 1 (16,6 %) Reintervention
ECC time	270,83 ± 122,38 (range, 120-469)
Time of Anoxic arrest	189,33 ± 67,03 (intervalo, 80-261)
Time of circulatory arrest	1 caso (34 minutos)
Surgical technique: Bental De Bono Commissural resuspension Aortoplasty	 4 (66,6 %) 1 (16,6 %) 1 (16,6 %) Reintervención

RA: Right atrium, ECC: Extracorporeal circulation.

Four patients were extubated before 12 hours (Table 3), one intubated remained ventilated for 7 days and another could never be extubated from the ventilator.

The stay in the Cardiovascular Intensive Care Unit (CICU) was short in four of the operated patients (Table 3), which were transferred to an open ward within 48 hours. One patient died at 36 hours and the other remained nine days in the cardiovascular CICU.

With respect to postoperative complications, the cardiovascular and respiratory ones prevailed with two by system, and one patient suffered right cerebral stroke with full recovery before 21 days.

As for surgical mortality, there was one death, a patient with a diagnosis of dissection of the ascending aorta, aortic arch and descending aorta, which was referred to our center with seven days of illness evolution, in clear cardiogenic shock. The surgery was very laborious and the patient was moved to the cardiovascular CICU in critical condition, with high-dose inotropes, where he died 36 hours later.

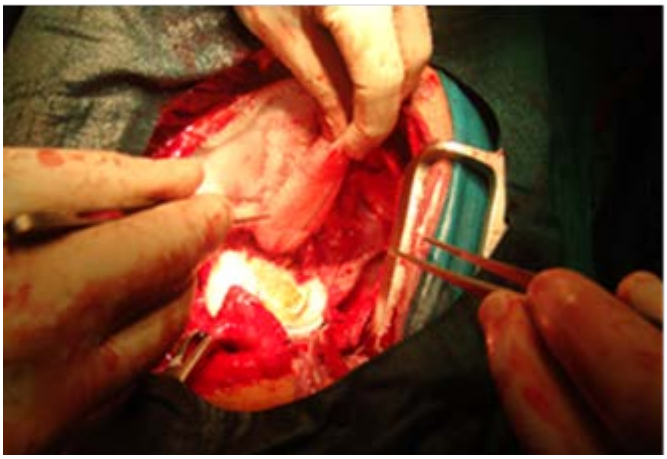

Figure 1. Bental De Bono technique.

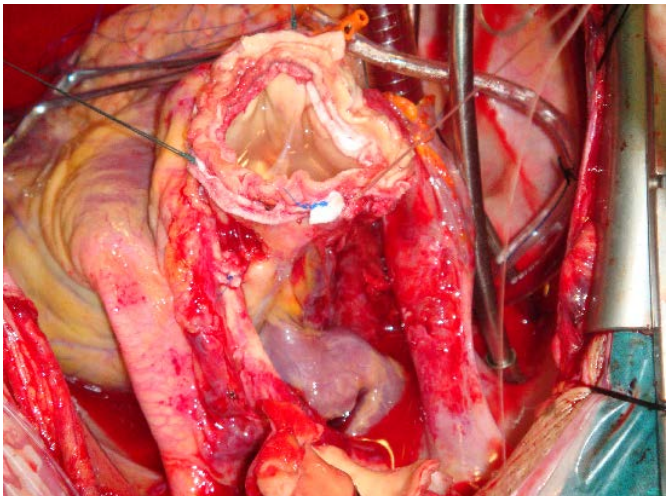

Figure 2. Commissural resuspension technique.

All five patients were discharged without disability, four joined their working lives. Survival of these five patients at one year was 100%. During this period one patient had upper gastrointestinal bleeding in the form of melena, which resolved with medical treatment.

Table 3. Postoperative variables.

Variables	Nº of patients (%)
Intubation time	
≤ 12 hours	4 (66,6 %)
> 12 hours	1 (16,6 %)
Never extubated	1 (16,6 %)
Stay in CICU	
≤ 48 hours	4 (66,6 %)
> 48 hours	1 (16,6 %)
Surgical Mortality	1 (16,6 %)
Survival at 1 year	5 (83,3 %)

DISCUSSION

In the early seventies of the last century, it was estimated that life expectancy of patients with Marfan syndrome was 37 years[18] as a result of complications of the ascending aorta. Currently, with the development of aortic surgery, the survival of these patients has increased almost twice.

Alterations in the middle layer cause dilatation of the aorta that according to the law of Laplace, creates a vicious cycle that ends with dissection or vessel rupture[19]. The risk of rupture of a 6 or more inches aneurysm is increased four times.

Today there is much controversy as to which surgical technique to perform on a patient with an aortic root complication in Marfan syndrome. At the beginning of this century several articles were published where radical procedures on the aortic valve (Bentall De Bono technique and its modifications) predominated[20-22]. The results in mortality were very encouraging, but the events associated with anticoagulation and mechanical prostheses were significant when compared with other series employing conservative procedures[23,24].

Many surgical groups, including most from our centers, after examining the aortic valve decide to replace it. But if you consider that the aortic insufficiency in Marfan syndrome is a consequence of the annulus-ectasia and not an intrinsic valve damage, the appearance of phenomena associated with mechanical prosthesis and anticoagulation would be avoided[25]. According to Montesinos and colleagues, Bentall De Bono technique and its modifications have advantages over conservative procedures, as the annulus-ectasia and aortic valve insufficiency are corrected, and the diseased aorta is replaced; while resuspension or preservation of the aortic valve in Marfan syndrome is associated with a residual aortic valvular insufficiency in the long term. It is also true that radical techniques on the aortic valve prevents these alterations described above, but if it is considered that conservative techniques as described by Tirone David[14,15], where the native valve is reimplanted within the prosthetic graft with several pledget stitches in the ventricular portion of the aortic annulus and the commissural resuspension technique associated with aortic annuloplasty with band of Teflon or another non-distensible prosthetic material, the possibility of residual aortic regurgitation would be negligible.

With the passage of time, conservative procedures on the aortic valve in surgical diseases of the ascending aorta, with or without a history of Marfan syndrome, have been increasing. In a cohort of The International Registry of Acute Aortic Dissection study[27], published in 2007, supracoronary aortic replacement was performed in 399 patients (58.5%), and Bentall De Bono technique or its modifications was used in just 16.2% of cases. Similar results reveal new works where other conservative techniques are added to the remodeling procedures and reimplantation created by Yacoub and David respectively, [28-31].

The results of aortic surgery in Marfan syndrome have been even more encouraging when these patients are prophylactically taken to the operating room. This surgical practice is been performed for many years in first world countries[32].

CONCLUSIONS

Male patients with aortic dissection and normal ejection fraction were predominant. The most used surgical technique was that of Bental De Bono. Only one patient died in hospital and the rest had an excellent outcome at one year.

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