

Pannus-Related Mechanical Valve Dysfunction Leading to Hemodynamic Shock

Manabu Shiraishi¹, Chieri Kimura¹, Taro Takeuchi¹, Miki Kanoh², Kenichi Muramatsu², Atsushi Yamaguchi³, Hideo Adachi³

¹Division of Cardiovascular Surgery, Saitama Red-cross Hospital, Saitama, JAPAN.

²Division of Cardiovascular Internal Medicine, Saitama Red-cross Hospital, Saitama, JAPAN.

³Division of Cardiovascular Surgery, Saitama Medical Center, Jichi Medical University, Saitama, JAPAN.

Received: February 09, 2012

Accepted: February 18, 2012

Arch Clin Exp Surg 2012;1: 50-53

DOI: 10.5455/aces.20120218124633

Corresponding author:

Manabu Shiraishi

Division of Cardiovascular Surgery,
Saitama Red-cross Hospital
8-3-33 Kamiochiai, Chyuo-ku,
Saitama-city, Saitama 338-8553,
JAPAN

manabu@omiya.jichi.ac.jp

Abstract

Mechanical prosthetic valve dysfunction caused by pannus formation is rare. Pannus restricts movement of prosthetic valve leaflets, resulting in severe aortic regurgitation. We describe the case of a 77-year-old woman who presented to the emergency room with increasing dyspnea, ischemia, and shock secondary to mechanical aortic valve dysfunction. Transesophageal echocardiography showed a blockade of the leaflets of the mechanical aortic valve, with severe aortic regurgitation. She underwent emergent cardiac surgery for aortic valve replacement. Pannus formation should be considered as a potential cause of acute severe aortic regurgitation in a patient with a small-sized mechanical aortic prosthesis in the supra-annular position. On a pathological exam, extensive pannus was found on the ventricular side of the prosthetic valve, extending from the ring into the central orifice.

Keywords: pannus, mechanical valve dysfunction, aortic valve replacement

Introduction

Mechanical prosthetic valve dysfunction caused by pannus or thrombosis is an unusual but serious complication of heart valve replacement [1-5]. Thrombotic complications are most common early postoperatively, whereas pannus occurs later, especially in bileaflet valves in the aortic position [3]. A blockade of the valve caused by such tissue ingrowth in the late postoperative period can lead to hemodynamic compromise. Although the precise mechanisms of pannus formation are

not clearly understood, it is currently considered to be the result of an immunohistochemical reaction, which may be associated with the process of periannular tissue healing [6, 7]. In addition, many factors, such as mechanical prosthetic valve design, mechanical valve size, infection, chronic inflammation and surgical techniques, also contribute to pannus formation [1-5, 8]. In this report, we describe an unusual case of dysfunction of a mechanical aortic valve due to early pannus formation in a patient presenting with massive aortic regurgitation, severe ischemia and shock.

Case report

A 77-year-old woman had already received mechanical bileaflet aortic and mitral valve prostheses 3 years earlier for aortic and mitral valve stenosis caused by rheumatic fever. The cardiovascular risk profile showed no further factors other than diabetes mellitus. Because of the small build of the patient, it was possible to implant only a 19-mm St Jude Medical bileaflet mechanical valve (St Jude Medical, Inc., St Paul, Minn.) for aortic valve stenosis and a 25-mm St Jude Medical bileaflet mechanical valve for mitral valve stenosis. We used a non-everting interrupted suture technique for implanting the aortic valve. The early postoperative course was uneventful and echocardiographic evaluation showed that both the aortic and mitral valve prostheses were working well. The patient was discharged to her home in a good condition.

Twenty days prior to presentation to our hospital for the second time, the patient was seen in the cardiology clinic for a routine follow-up. At that time, she was asymptomatic, with no evidence of prosthetic valve dysfunction, as shown by the physical exam and laboratory data. The postoperative anticoagulation level was examined by her cardiology clinic every month and the prothrombin time-international normalized ratio (PT-INR) was maintained at between 1.7 and 2.0.

The patient presented to our emergency department with the chief complaint of increasing dyspnea, orthopnea and chest pain for 3 days. After the first operation, she had been in her usual state of health and she denied any other cardiac complaints for 3 years prior to this admission. In the emergency department, the patient was in marked respiratory distress. Initial vital signs showed a blood pressure of 109/47 mm Hg and a regular pulse of 81 beats/min. A to-and-fro murmur was noted in the 4th intercostal space along the left sternal border. Her extremities were cool, without edema. Her white blood cell count, and lactate dehydrogenate and B-type natriuretic peptide levels were elevated to 13270/ μ , 906 mU/ml and 1901 pg/ml, respectively. Electrocardiography revealed sinus rhythm and a complete right bundle branch block. Pulmonary edema was present on the chest X-ray.

Transthoracic echocardiography showed good left ventricular function (ejection fraction was 70%). There was a gradient of 57 mm Hg across the aortic valve and severe aortic regurgitation (Figure. 1). No thrombus or vegetation was detected on the prosthetic valve.

On the basis of the acute presentation, echocardiographic findings and laboratory data, the presumptive diagnosis was prosthetic valve infection. Because of the patient's rapidly worsening hemodynamic status, antibiotic therapy was not considered. While awaiting urgent surgery, the patient had a sudden onset of cardiac shock. She was stabilized with inotropic therapy and percutaneous cardiopulmonary support (PCPS), and was transferred to the operating room for emergency surgical treatment. Transesophageal echocardiography was performed after general anesthesia, and it showed a blockade of one of the leaflets of the mechanical aortic valve prosthesis, with severe aortic regurgitation. Intraoperatively, the reason for failure of the valve was found to be pannus formation, which led to a blockade of one of the leaflets (Figure. 2). The mechanical aortic prosthetic valve and pannus were excised and a 19-mm St Jude Medical bileaflet mechanical valve was implanted at the intra-annular position by the everting mattress suture technique. The patient needed temporary PCPS and continuous hemodiafiltration (CHDF) in the early postoperative period; however, she did not develop other serious complications.

On a pathological exam, extensive pannus was found on the ventricular side of the prosthetic valve, extending from the ring into the central orifice (Figure. 3). Ingrowth of the pannus resulted in restriction of leaflet motion, causing aortic regurgitation. Histological findings confirmed macroscopic suspicion of pannus formation with fibromyxoid change of the endocardium and a fibrin clot. There was no endocarditis.

Discussion

Pannus formation after aortic valve replacement is uncommon, but obstruction due to chronic pannus is one of the most serious complications of valve replacement. The incidence of pannus formation causing the failure of St Jude Medical mechanical aortic prosthetic valves is low, occurring in 0.73% of patients [8]. A previous study found that, on reoperation, pannus was found to be the etiology of valve failure in approximately 50% to 80% of patients [1]. Time from implantation to pannus formation is variable and has been reported to be 6 months to 23 years after valve implantation [1, 3].

The clinical course of pannus formation is variable. The majority of symptomatic patients experience gradual worsening of congestive heart failure [1]. However, in our case, there were uncommon circumstances, such as the acute onset of symptoms and immediate progression to circulatory insuff-

iciency that required PCPS. In general, pannus is suspected when there is a gradual progressive increase in the transprosthetic gradient, and identification of a hyperechogenic mass with systolic restriction of leaflet motion supports the diagnosis [2].

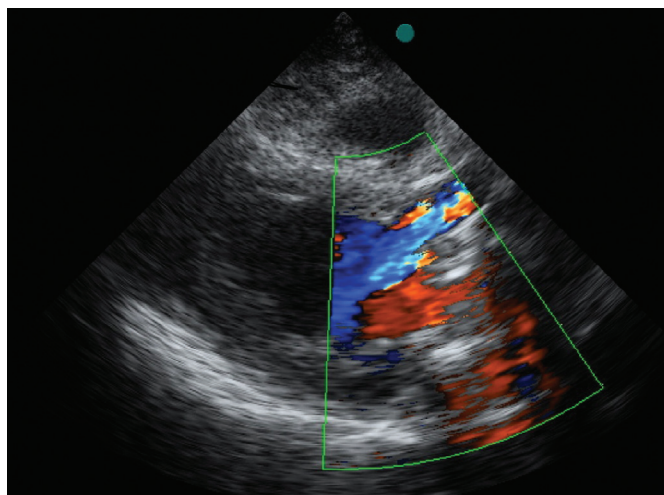


Figure 1. Long axis view of transthoracic echocardiography shows severe aortic regurgitation.

Pannus formation usually occurs on structurally normal valves. It occurs more commonly on aortic valves, compared to mitral valves, and usually grows on the left ventricular aspect of the replaced valve and is not found on the aortic aspect [5,9].

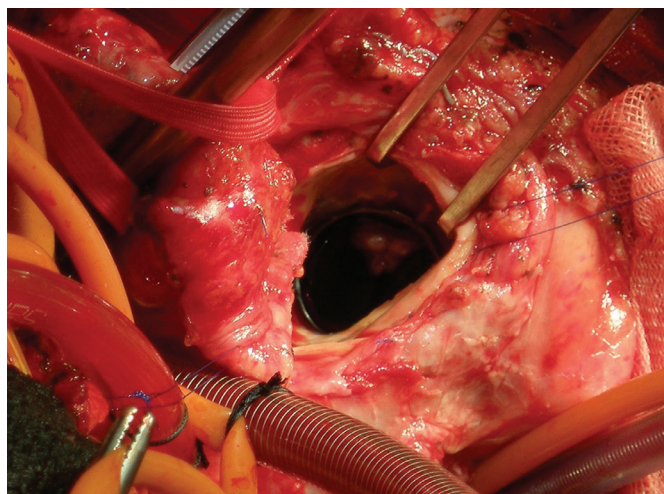


Figure 2. Pannus can be seen on the aortic valve extending into the central orifice.

Although the etiology is not known, there are some studies regarding the cause of pannus formation. The contributors to pannus growth are reported to be a response to chronic in-

flammation caused by a prosthetic valve, a small aortic prosthetic valve and endocarditis [1, 3, 5, 6-8]. It is controversial as to whether a causal relationship exists between pannus overgrowth and lower PT-INR levels [4]. Recently, there have been some reports regarding other contributors to pannus growth. They postulated that pannus formation after prosthetic valve replacement might be associated with the process of periannular tissue healing via the expression of transforming growth factor-beta [6, 7].

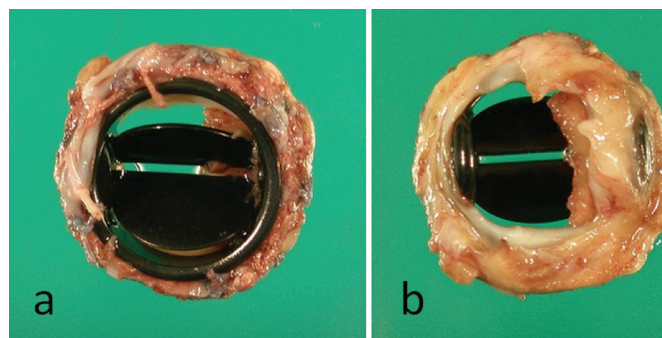


Figure 3. Pannus without thrombus is located adjacent to the annulus of the left ventricular septal side. It extends into the pivot guard, interfering with the movement of the straight edge of the leaflet. (a) Aortic aspect, (b) ventricular aspect.

Although the etiologic mechanism of pannus formation is considered to be multifactorial, we consider that suture technique and valve orientation are the most important factors to reduce the occurrence of pannus formation. In this case where an aortic prosthetic valve was implanted at the supra-annular position by the non-everting suture technique at the time of primary surgery, the resection stump of the aortic leaflets was in a position adjacent to the left ventricular side of the aortic prosthetic valve. The resection stump formed pannus in the process of periannular tissue healing and extending from the aortic valve ring into the aortic prosthetic valve orifice, and it restricted movement of the leaflets. On the other hand, at the time of second surgery where the aortic prosthetic valve was implanted at the intra-annular position by the everting suture technique, the resection stump of the aortic leaflets was everted at the aortic side of the aortic prosthetic valve. This is why pannus formation does not tend to occur at the left ventricular side of aortic prosthetic valves. Valve orientation may also be the most important factor of pannus formation. In this case, sub-prosthetic pannus overgrowth was mainly found around the pivot guard, adjacent to the intraventricular septum (IVS), and the pivot guard was buried in the overgrown pannus, as shown in Figure. 2 and 3. Based on these findings, we consid-

ered that contact of one of the pivot guards, which protruded from the inflow edge of the housing, with the IVS might be one very important factor to cause overgrowth of sub-prosthetic pannus.

Contact of the pivot guard with the IVS might induce mechanical injury or inflammation of the endocardium of the IVS with ventricular contraction, and repeated chronic mechanical injury might lead to pannus overgrowth. However, Aoyagi et al. reported that sub-prosthetic pannus overgrowth was also found in some St Jude Medical bileaflet mechanical valves, which were implanted with the everting mattress suture technique, and there was no significant difference in the incidence of re-operated cases due to sub-prosthetic pannus overgrowth between valve implantation with the everting suture technique and that with the non-everting suture technique. Valve orientation in the aortic position (perpendicular to the IVS or parallel to the IVS) also showed no significant difference in the incidence of re-operated cases due to sub-prosthetic pannus overgrowth [10].

Conclusion

Implantation of a large prosthetic valve in the intra-annular position by the everting mattress suture technique is recommended for preventing recurrent valve dysfunction.

Conflict of interest statement

No external funding was obtained for the work presented here

References

1. Hurwitz SE, Waxman D, Hecht S. Acute failure of a St. Jude's prosthetic aortic valve: large pannus formation masked by a small thrombus. *J Am Soc Echocardiogr* 2009;22:1086.e1-3.
2. Giroux SK, Labinaz MX, Grisoli D, Klug AP, Veinot JP, Burwash IG. Intermittent, noncyclic dysfunction of a mechanical aortic prosthesis by pannus formation. *J Am Soc Echocardiogr* 2010;23:107.e1-3.
3. Kondruweit M, Flachskampf FA, Weyand M, Schmidt J, Achenbach S, Strecker T. Early failure of a mechanical bileaflet aortic valve prosthesis due to pannus: a rare complication. *J Thorac Cardiovasc Surg* 2008;136:213-214.
4. Teshima H, Aoyagi S, Hayashida N, Shojima T, Takagi K, Arinaga K, et al. Dysfunction of an ATS valve in the aortic position: the first reported case caused by pannus formation. *J Artif Organs* 2005;8:270-273.
5. Kuniyoshi Y, Koja K, Miyagi K, Shimoji M, Uezu T, Arakaki K, et al. Pannus formation in aortic valve prostheses in the late postoperative period. *J Artif Organs* 2003;6:179-182.
6. Teshima H, Fukunaga S, Takaseya T, Tomoeda H, Akashi H, Aoyagi S. Obstruction of St. Jude medical valves in the aortic position: plasma transforming growth factor type beta 1 in patients with pannus overgrowth. *Artif Organs* 2010;34:210-215.
7. Teshima H, Hayashida N, Yano H, Nishimi M, Tayama E, Fukunaga S, Akashi H, Kawara T, Aoyagi S. Obstruction of St Jude Medical valves in the aortic position: histology and immunohistochemistry of pannus. *J Thorac Cardiovasc Surg* 2003;126:401-407.
8. Sakamoto Y, Hashimoto K, Okuyama H, Ishii S, Shingo T, Kagawa H. Prevalence of pannus formation after aortic valve replacement: clinical aspects and surgical management. *J Artif Organs* 2006;9:199-202.
9. Barbetseas J, Nagueh SF, Pitsavos C, Toutouzas PK, Quiñones MA, Zoghbi WA. Differentiating thrombus from pannus formation in obstructed mechanical prosthetic valves: an evaluation of clinical, transthoracic and transesophageal echocardiographic parameters. *J Am Coll Cardiol* 1998;32:1410-1417.
10. Aoyagi S, Nishimi M, Tayama E, Fukunaga S, Hayashida N, Akashi H, et al. Obstruction of St Jude medical valves in the aortic position: a consideration for pathogenic mechanism of prosthetic valve obstruction. *Cardiovasc Surg* 2002;10:339-344.