Long-term fate of the ascending aortic wall after wrapping with polytetrafluoroethylene felt: A case series

Yuki Tadokoro (✉ ss598yaeshio@gmail.com)

Kitasato University School of Medicine

Tadashi Kitamura

Kitasato University School of Medicine

Yoshimi Tamura

Kitasato University School of Medicine

Kagami Miyaji

Kitasato University School of Medicine

Case report

Keywords: aortic wrapping, ascending aorta replacement, aortic aneurysm, polytetrafluoroethylene

Posted Date: March 26th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-327545/v1>

License: This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background: Aortic wrapping aims to prevent aortic enlargement or dissection; it is less invasive than ascending aorta replacement. Several studies have reported low mortality and morbidity rates in patients treated using aortic wrapping. Wrapping is often accompanied by aortic valve replacement, which may require a redo surgery after some years. However, only few reports have focused on the redo surgery after aortic wrapping. We report three such cases of redo surgery in patients who previously underwent aortic wrapping using polytetrafluoroethylene felt.

Case presentation: Among the three cases, two were referred with complaints associated with the deterioration of the prosthetic valve, 10 years or longer after the initial surgery. In all the cases, the aortic wall exhibited severe erosion, necessitating replacement of the ascending aorta.

Conclusion: The portion of the ascending aortic wall wrapped with polytetrafluoroethylene felt exhibited severe erosion late after surgery. Therefore, ascending aorta graft replacement is highly likely to be necessary in redo surgery performed long after initial ascending aorta wrapping.

Background

Wrapping, instead of replacement, of the ascending aorta is often performed alongside aortic valve replacement (AVR) in patients with aortic stenosis (AS) and dilated ascending aorta [1]. In a meta-analysis by Ploneck, wrapping was reported to have good long-term aorta-related outcomes, such as low mortality and morbidity [2]. Of note, most of the patients included in this analysis also underwent concomitant aortic valve surgery. Therefore, aortic wrapping procedure has chances of reoperation in the distant postoperative period due to structural valvular deterioration. However, only a few reports have focused on the redo surgery after aortic wrapping. Here, we present three cases of redo surgery after previous AVR with aortic wrapping.

Case Presentation

Case 1

A 73-year-old woman with AS and dilation of the ascending aorta underwent AVR using a mechanical prosthesis (Regent, Abbott, St. Paul, MN, USA), and the dilated ascending aorta was wrapped using polytetrafluoroethylene (PTFE) felt. Ten years later, she was referred for prosthetic valve deterioration with a peak gradient of 91 mmHg, tricuspid valve regurgitation, and atrial fibrillation (AF). Redo AVR was performed with a bio-prosthesis (Inspiris Resilia, Edwards Lifesciences, Irvine, CA, USA), along with septal myectomy, tricuspid valve plasty, and the Maze procedure. During the surgery, meticulous peeling of the PTFE felt resulted in a minor rupture of the extremely thin aortic wall. Subsequently, the femoral artery was cannulated, and the ascending aorta was replaced (Triplex, Terumo Corp, Tokyo, Japan) under hypothermic circulatory arrest. The PTFE felt was visible from the luminal side of the aorta (Fig. 1A). Histopathological examination of the aortic fragments revealed disappearance of intimomedial cells in

the wrapped portion of the ascending aortic wall; moreover, the aortic wall structure was almost disrupted, and only the extravascular membrane remained (Fig. 1B).

Case 2

A 60-year-old woman with AS with a bicuspid valve and dilation of the ascending aorta underwent AVR with a mechanical prosthesis (Regent, Abbott, St. Paul, MN, USA), replacement of a short segment of the ascending aorta (Gelweave, Terumo Corp, Tokyo, Japan), and wrapping of the remaining ascending aorta using PTFE felt. Fifteen years later, she exhibited paravalvular leak (PVL) of the aortic valve, mitral valve regurgitation, and AF. Redo AVR (Avalus, Medtronic Japan Co., Ltd.), mitral valve plasty, and the Maze procedure were performed. As the felt was peeled away from the aorta, blood flow was visible through the thinned aortic wall. Because aortic clamping posed a risk of rupture, the femoral artery was cannulated, and the ascending aorta was replaced (Triplex, Terumo Corp, Tokyo, Japan) under hypothermic circulatory arrest. The PTFE felt was visible from the luminal side of the aorta (Fig. 1C). Histopathological examination revealed dissection of the elastic lamellae of the tunica media and associated defects of the intima and media due to disappearance of intimomedial cells in the wrapped portion of the ascending aortic wall (Fig. 1D).

Case 3

A 65-year-old woman with infective endocarditis and dilation of the ascending aorta underwent aortic and mitral valve replacements using mechanical prostheses (Regent, Abbott, St. Paul, MN, USA) and aortic wrapping using PTFE felt (Fig. 2A). Fourteen years later, she exhibited re-dilation of a non-wrapped part of the ascending aorta (Fig. 2B) and underwent ascending aorta replacement (Triplex, Terumo Corp, Tokyo, Japan) (Fig. 2C). During surgery, thinning of the wrapped aortic wall was observed compared with the non-wrapped area (Fig. 1E). The histopathological findings were similar to those of patients 1 and 2 (Fig. 1F).

Discussion And Conclusions

Aortic wrapping aims to reduce the risk of aortic enlargement and dissection by decreasing wall tension, while having a shorter cardiopulmonary bypass and operative times than replacement. In his meta-analysis, Plonek reported that the aortic wall is subjected to similar stress following a wrapping procedure as that in the normal aorta [2]. Therefore, long-term outcomes were good, with a re-dilatation and reoperation rate of 1.7% and 1.8%, respectively [3]. In our unit, from 2003 to 2020, 30 patients underwent aortic wrapping with concomitant AVR. There was no early or late aortic-related mortality. However, among these, three patients (10%) underwent reoperation one for re-dilatation (3%) and two for structural valvular deterioration (6%).

Bauer et al. reported a case in which dislocated wrap after a previous reduction aortoplasty caused the erosion of ascending aorta [4]. In our series, there was no instance of dislocation of the wrap, but the wrapped portion of the aortic wall exhibited severe erosion in all of the cases.

Doyle et al. reported a successful redo AVR without the need for replacement of the aorta when the ascending aorta was previously wrapped of with a Dacron sheet [5]. In this report, in cases 1 and 2, aortic cannulation and clamping could not be performed without removing the wrapping material, which in turn would have resulted in catastrophic bleeding or rupture due to severe erosion of the wrapped aortic wall. Hence, replacement of the ascending aorta had to be performed. It is unclear whether aortic wall thinning was caused by ischemia due to the wrapping force or inflammation due to the wrapping material. However, it seemed that erosion of the aortic wall below the previous wrapping occurred without the dislocation of the wrapping or re-dilatation of the aorta.

In summary, we had three patients who underwent redo surgery 10 to 15 years after previous ascending aortic wrapping with PTFE felt for dilatation. Histopathological examination revealed disappearance of intimomedial cells only in the wrapped portion of the ascending aortic wall in all three cases.

Thus, patients who require redo surgery after prior wrapping of the ascending aorta are likely to need concomitant replacement of the ascending aorta.

List Of Abbreviations

AF: atrial fibrillation

AS: aortic stenosis

AVR: aortic valve replacement

PTFE: polytetrafluoroethylene

PVL: paravalvular leak

Declarations

Ethics approval and consent to participate: Since the study did not consist of any new or experimental procedures, the need for ethical approval and consent to participate was waived by the institutional ethics committee.

Consent for publication: Written informed consent was obtained from the patients for the publication of the case series and accompanying images.

Availability of data and materials: Not applicable.

Competing interests: The authors declare that they have no competing interests.

Funding: Not applicable.

Authors' contributions: Yuki Tadokoro: Writing – original draft, investigation and data curation; Tadashi Kitamura: Writing – review & editing and data analysis; Yoshimi Tamura: Investigation and the acquisition of data; Kagami Miyaji: Supervision and project administration. All authors read and approved the final manuscript.

Acknowledgements: The authors would like to thank Dr. Itaru Sanoyama for providing support with the interpretation of the pathological findings.

References

1. Zhu P, Zhou P, Ling X, Ohene BE, Bian XM, Jiang X. Surgical treatment of mild to moderately dilated ascending aorta in bicuspid aortic valve aortopathy: the art of safety and simplicity. *J Cardiothorac Surg.* 2020;15:24.
2. Plonek T. A metaanalysis and systematic review of wrapping of the ascending aorta. *J Card Surg.* 2014;29:809–15.
3. Plonek T, Rylski B, Dumanski A, Siedlaczek P, Kustrzycki W. Biomechanical analysis of wrapping of the moderately dilated ascending aorta. *J Cardiothorac Surg.* 2015;10:106.
4. Bauer M, Grauham O, Hetzer R. Dislocated wrap after previous reduction aortoplasty causes erosion of the ascending aorta. *Ann Thorac Surg.* 2003;75:583–4.
5. Doyle M, Peeceeyan S, Bonar F, Horton M. Rarefaction of the aorta under Dacron wrap: a rare complication. *Interact Cardiovasc Thorac Surg.* 2014;19:341–3.

Figures

Figure 1

Surgical photographs and histological images showing erosion of the wrapped aorta. (A), (C), (E): Erosion of the wrapped aorta (blue arrows: wrapped area of the aortic wall; red arrow: non-wrapped area of the aortic wall). (B) Aortic wall structure is almost disrupted, and only the extravascular membrane remains, as indicated by the black arrow. (D) Fewer elastic fibers than in the normal aortic wall are seen, and partial dissection of the elastic lamellae of the tunica media can be seen, as indicated by the green arrow.

(F) Defects are seen in the intima and media, and only the extravascular membrane and partial elastic fibers remain.

Figure 2

Computed tomography images of a patient (case 3) who underwent wrapping of the dilated ascending aorta. (A) Three months after the first operation. (B) Before the second operation. (C) After the second operation.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [CAREchecklistEnglish2013.pdf](#)