

Peer Review File

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Reviewer A

The authors compared the classic Bentall procedure and the modified Bentall procedure after propensity matting and reported the usefulness of the modified Bentall procedure. The cross-clamp time in the modified Bentall is about 20 minutes longer than the classic Bentall, but the CPB time in the modified Bentall is about 30 minutes shorter than the other. However, the modified Bentall is superior in terms of contrast extravasation or pseudoaneurysm and persistent shunt. There is no difference in intraoperative transfusion volume. In both methods, the cross-clamp time and the CPB time are short, and the results are good. So comparing the two groups is reasonable.

Comment 1: Since it is necessary to distinguish between the modified Bentall described in the reference or in general and the modified Bentall described by the author, it would be better to use a different name for the modified Bentall described by the author.

Reply: We greatly appreciate your friendly advice, and based on your suggestions, we have decided to use the term “Modified Cuff Wrapping Bentall Procedure”.

As you mentioned that both the CPB time and cross-clamp time were longer in our Modified cuff wrapping Bentall group. However, it is important to note that the extended surgical durations were still within acceptable limits and met our satisfaction, as you pointed out, “In both methods, the cross-clamp time and the CPB time are short, and the results are good”. Classic Bentall procedure with right atrial shunt/ the Cabrol shunt (which perform after release the cross-clamp) of course could reduce the time used for hemostasis, and the surgical duration, however, as we all both know, it leaves us and patients a lot problems unsolved, especially has an adverse impact on the long-term outcomes, as you indicated “the modified Bentall is superior in terms of contrast extravasation or pseudoaneurysm and persistent shunt”.

The topic of our article specially focused on “cuff wrapping technique in modified Bentall procedure”, and “modified Bentall procedure” was routinely refer to Bentall procedure using Carrel patch technique which was introduced by Kouchoukos in 1981 (Kouchoukos NT, Wareing TH, Murphy SF, Perrillo JB. Sixteen-year experience with aortic root replacement. Results of 172 operations. *Ann Surg.* 1991;214(3):308-320.), however, we agree and greatly appreciate your friendly advice. In order to avoid any misunderstanding among readers, we believe that using the term "Modified Cuff Wrapping Bentall Procedure" as per your suggestion sounds more accurate and beneficial. Thank you for your valuable advice.

Changes in the text: we have modified our text as advised (see in the Abstract and introduction part and Page 6, line 4 and Page 7, line 11 and Page 15, line 19-20).

Comment 2: Regarding the classic Bentall, the method in the author's institution should be explained a little more, as there may be slight differences.

Reply: Thank you for bringing that to our attention. Based on your suggestion, we

have provided a detailed description of the protocol for the classic Bentall surgery combined with the "Cabrol shunt" technique performed at our institution. This information has been incorporated into the "Methods" section, and we greatly appreciate your valuable feedback in enhancing the overall quality of our article. Changes in the text: we have modified our text as advised (see in the method part, Page 8, line 16 to Page 9, line 11).

Comment 3: With the improvement of artificial blood vessels, we are now in an era where we do not have to worry about bleeding from needle holes. So I would like you to mention what kind of artificial blood vessels were used.

Reply: I apologize for the lack of clarity in our article. In our institution, if a mechanical valve is implanted in the patient, the valved conduit used is the Medtronic Open Pivot Valved Conduit (Medtronic, Minneapolis, MN). Conversely, if a biological valve is selected, we combine the Medtronic Hancock II valve (Medtronic, Minneapolis, MN) with a collagen-impregnated Hemashield Platinum straight graft (manufactured by MAQUET Cardiovascular LLC, Wayne, NJ) through manual suturing.

Although advancements in artificial vascular materials have significantly reduced the occurrence of leaks through needle holes in prosthetic grafts, other challenges include pinholes in the suture knots on the sewing cuff and oozing from the sewing cuff of the composite valve graft / oozing in the groove between the anastomosis of the composite valve graft and the aortic annulus still could lead to unfavorable outcomes. These issues continue to be encountered periodically in modified Bentall procedure. as mentioned in our paper, bleeding and oozing from the proximal anastomotic line of the aortic root remain major complications in the modified Bentall procedure that many surgeons encounter. Various improved techniques have been developed to address this issue, as we referenced in our study [references 7-15].

Changes in the text: we have modified our text as advised (see in the method part, Page 7 line 20 to Page 8, line 4).

Comment 4: Explain or correct the platelet transfusion (0(1)) in the modified Bentall in table 2.

Reply: Sorry for the misunderstanding we made, we used the median and IQR for continuing variables without normal distribution, the median value was zero, and the IQR was 1. We carefully reviewed and revised the statistical description section to ensure clarity in our presentation. Thank you once again for your suggestions, as your feedback has been immensely helpful to us.

Changes in the text: Details can be seen in the method- Statistical analysis part, Page 10, line 11-16).

Comment 5: During transplantation, maintaining the running suture, was the other method, e.g. pledged interrupted suture considered?

Reply: Your question is very insightful. In general, we typically employ a continuous suture technique. It is important to note that our study population does not include patients with acute type A aortic dissection. The vascular tissue in these

dissection patients differs significantly from patients with aneurysms. In cases of aortic dissection where Bentall surgery is performed, we utilize an adventitial inversion technique, and in certain situations, we reinforce the anastomosis with pledged interrupted sutures after the running suture.

Comment 6: The classic Bentall has hardly been used in recent years. On the other hand, the modified Bentall, according to the author, is not new, as some facilities or operators perform it popularly.

Reply: We appreciate your comments, as it provides valuable insights for us. However, there is no perfect technique, only the most suitable one. Indeed, in recent years, there has been a growing popularity of modified Bentall procedures. However, this does not imply that the classic Bentall is no longer applicable. It still offers advantages such as ease of hemostasis and a relatively easier learning curve. In specific situations, such as in acute aortic dissection involving the root, when faced with challenging hemostasis, the inclusion of the wrapping shunt technique remains a reliable means to manage difficult bleeding scenarios. Furthermore, there have been ongoing technological advancements and refinements in recent years to improve the classic Bentall procedure further. (1. Galla JD. Commentary: To wrap or not to wrap- Have we now come full circle?. *J Thorac Cardiovasc Surg.* 2019;158(5):1315-1316. 2. Kao CL, Chang JP. Perigraft-to-right atrial shunt for aortic root hemostasis. *Tex Heart Inst J.* 2003;30(3):205-207. 3. Lin TW, Tsai MT, Wu HY. "Mantle-style" modification of Cabrol shunt for hemostasis after extended aortic reconstruction in acute type A aortic dissection. *Gen Thorac Cardiovasc Surg.* 2019;67(11):1001-1005. 4. Zhang H, Wu X, Fang G, Qiu Z, Chen LW. Is it justified to apply a modified Cabrol fistula in surgical repair of acute type A aortic dissection?. *J Thorac Cardiovasc Surg.* 2019;158(5):1307-1314.e2.).

This situation is similar to what has been happening in recent years, with the resurgence of the Ross procedure among young adult patients with aortic valve disease. Yacob reported at the 103rd ATS Annual Meeting that the Ross procedure has shown excellent long-term survival rates and minimal rates of re-intervention. (Survival and Reinterventions After the Ross Procedure in Adults: A 28 Year Follow-Up Study. 103rd AATS Meeting)

On the other hand, as you mentioned, the commonly referred to modified Bentall procedure is indeed not a new technique, as relevant literature was published by Kouchoukos and his colleagues as early as 1980. (Kouchoukos NT, Karp RB, Blackstone EH, Kirklin JW, Pacifico AD, Zorn GL. Replacement of the ascending aorta and aortic valve with a composite graft. Results in 86 patients. *Ann Surg.* 1980;192(3):403-413.). This "modified Bentall procedure" described by Kouchoukos and colleagues alleviated the majority complication associated with the inclusion technique (like reduced tension on button coronary anastomoses, prevention of development of false aneurysms, avoidance of kinking of coronary arteries), allowed complete replacement of the root and ascending aorta, and made treating these patients more routine with acceptable outcomes. Nonetheless, complications of the

repairs remain confounding. Among the most humbling of these complications is bleeding, which has been reported in as many as 28% of selected patient subsets. Besides, this button technique is more time-consuming and difficult than a classic Bentall repair, to prevent the surgical bleeding from proximal anastomosis is always a big issue every surgeon must to face, and many modifications have been made for preventing proximal suture line bleeding.

In other words, opting for a traditional approach can result in pseudoaneurysm and internal shunting, while choosing the modified Bentall procedure presents difficulties in achieving effective hemostasis.

Our protocol is different from modified Bentall procedure. This approach is a further improvement on the modified Bentall procedure, focusing primarily on achieving hemostasis at the proximal suture line. In this article, First, we explain why Modified Bentall procedure is popularity recently years, then we explained the problem of proximal hemostasis in Modified Bentall procedure we all encountered, finally we introduced our modified cuff warpping Bentall procedure, which was prove to be worth to perform. As we have shown in Table 3, the contrast extravasation or pseudoaneurysm and persistent shunt is less in Modified Bentall group, which is good for long-term outcomes. And the reason is indicated in discussion part.

Changes in the text: we have carefully edited and revised the full article according to your suggestion. The suggestions are very valuable for us to improve the writing quality.

Reviewer B

First of all, congratulation on this excellent result of tricky Bentall operations.

My questions;

Comment 1:How often were occurred this bleeding problem (how many percentage) before introducing this wrapping technique?

- I experienced a couple of cases in this kind of bleeding problem from the proximal suture line.

Reply: Dear reviewer, it was very honored to answer your questions. Since the very beginning I was severed as a surgeon and was able to perform Bentall procedure, initially, I performed the Classic Bentall procedure, but later on, I shifted to the modified Bentall procedure for several reasons. One reason is that creating a shunt can certainly reduce the challenges of achieving hemostasis and short the total surgical and CPB time. However, it also introduces several issues:

1. Hinder the improvement of surgical skills: The presence of Cabrol shunt in the classic Bentall procedure lowers the requirements for suturing, which can inadvertently hinder the improvement of surgical skills. Surgeons may prioritize speed over meticulous suturing, leading to a compromise in the quality of the suture line. This can

potentially create a situation where surgeons develop suboptimal habits, hindering further skill development.

2. Increased risk of long-term complications: The use of a Cabrol shunt in the classic Bentall procedure can potentially lead to long-term complications such as pseudoaneurysm formation at the coronary artery and aortic root. This increases patient risks and affects surgical outcomes and long-term prognosis. As mentioned in our article, bleeding at the proximal suture line is a common issue encountered by many surgeons. Uneven suturing, pinholes in the suture knots on the sewing cuff and oozing from the sewing cuff of the composite valve graft / oozing in the groove between the anastomosis of the composite valve graft and the aortic annulus, and needle hole oozing caused by graft material are contributing factors.

In my personal experience, the classic Bentall procedure with Cabrol shunt is an effective solution to achieve hemostasis, but it is not without its flaws. The reason I no longer perform the classic Bentall procedure is because we cannot directly observe bleeding at the suture site; we can only assess the severity of bleeding through palpation of the inclusion. We typically gauge the adequacy of hemostasis based on the firmness of the inclusion. If it feels soft like lips, the bleeding risk is low. If it feels like the tip of the nose, it indicates noticeable bleeding but is still acceptable. If it feels as hard as the forehead, it indicates significant bleeding and substantial risks, potentially requiring reconstruction of the root. Theoretically, there is certainly a risk of long-term coronary artery and root pseudoaneurysm in patients. However, comparatively, in our center, we rarely encounter cases with significant intraoperative bleeding and high inclusion tension (which usually compresses the coronary artery ostium), if that is what you are referring to. By employing internal Cabrol shunting techniques, bleeding issues in classic Bentall procedures can usually be resolved, allowing smooth completion of the surgery and reducing the need for re-exploration.

Comment 2: At the table 2, there was no transfusion intraoperatively, even in C-group. And there was no difference in POD #1 in tube drainage btw groups. Then, why do you need a modified tech for Bentall operation?

Reply: I apologize for any misunderstanding caused by our unclear statement. We have blood transfusion during surgery, we used the median and IQR for continuing variables not conform to normal distribution, and the POD #1 tube drainage and intraoperative transfusion have no statistical significances.

The topic of our article specially focused on “cuff wrapping technique in modified Bentall procedure”. We used PSM to reduce the baseline bias, let the two groups comparable and let the outcomes more powerful to prove our opinion, that this technique is very useful and desirable. That don't increase the POD #1 tube drainage and intraoperative transfusion, but as we have shown in Table 3, the contrast extravasation or pseudoaneurysm and persistent shunt is less in our Modified cuff wrapping Bentall procedure group, which is good for long-term outcomes. And the reason is indicated in discussion part. First, we explain why Modified Bentall procedure is popularity recently years, then we explained the problem of proximal in Modified Bentall procedure we all may encountered, finally we introduced our modified warp

Bentall procedure, which was prove to be worth to perform.

We have made diligent revisions to the method part-statistical section to ensure clearer presentation. Once again, we greatly appreciate your comments.

Changes in the text: we have modified our text as advised (see in the Page 10, line 11-16).

Reviewer C

Comment 1: What is the definition of 'severe coagulation abnormalities' in the study?

Reply: We apologize for the lack of clarity in our previous statement. Currently, there is no effective method to predict which patients will experience significant bleeding after the Bentall procedure. However, it is crucial to identify patients who are at high risk for bleeding. Previous literature and guidelines have demonstrated that preoperative antithrombotic therapy can increase the likelihood of bleeding and transfusion requirements.

(1. Society of Thoracic Surgeons Blood Conservation Guideline Task Force, Ferraris VA, Ferraris SP, et al. Perioperative blood transfusion and blood conservation in cardiac surgery: the Society of Thoracic Surgeons and The Society of Cardiovascular Anesthesiologists clinical practice guideline. *Ann Thorac Surg.* 2007;83(5 Suppl):S27-S86.

2. Tarzia V, Bortolussi G, Buratto E, et al. Single vs double antiplatelet therapy in acute coronary syndrome: Predictors of bleeding after coronary artery bypass grafting. *World J Cardiol.* 2015;7(9):571-578.)

Some researchers even argue that for new oral anticoagulants, the cessation of therapy should be extended to 10 days (Hassan K, Bayer N, Schlingloff F, et al. Bleeding Complications After Use of Novel Oral Anticoagulants in Patients Undergoing Cardiac Surgery. *Ann Thorac Surg.* 2018;105(3):702-708.)

Thank you for pointing out the drawback of our article. We have revised the exclusion criteria to specify that “contraindications to ceasing preoperative antithrombotic therapy”.

Changes in the text: we have modified our text as advised (see in the Page 7, line 7).

Comment 2: An explanation is needed for the 16 and 7 patients excluded from each group respectively, who did not undergo imaging tests. If these excluded patients did not undergo the test due to death or clinically bad conditions, they should be included in the statistical analysis. If not, there may be an error in analyzing only patients with good outcomes.

Reply: We appreciate your helpful suggestions, which have contributed to improving the quality of our article. In the Results section, we have included the overall clinical results of all patients. In all 159 patients, only one patient died during hospitalization, and this patient was not excluded from our study. Furthermore, there were no patients discharged with clinically poor conditions. Without PSM, the difference is even more significantly. But there were bias in baseline data (Aortic sinus diameter and LVED), so in order to let the two groups comparable (eliminate the select

bias and intergroup differences) and enhance the statistical power, PSM was used.

In our study, all patients underwent postoperative cardiac echocardiography before discharge. Additionally, we instructed patients to return for follow-up examinations at 3 months, 6 months, and 1 year after surgery. Specifically, we emphasized the need for CT angiography within 3 months postoperatively. Based on the CT results, we assessed the presence of contrast extravasation, thoracic aortic or coronary pseudoaneurysm, or persistent shunt after Bentall procedure and recorded the findings.

However, it should be noted that there were indeed a small number of patients who lacked postoperative follow-up aortic CT angiography. This is a reflection of the real-world nature of our study, where various factors may have influenced patient compliance with follow-up visits. For example, during the follow-up period, the use of available CT scans has been impacted by the COVID-19 pandemic. Additionally, some patients from other regions may have been unable to return for follow-up due to the pandemic's effects and other reasons. As a result, a small proportion of patients may have lacked postoperative CT follow-up results.

However, it is true that some patients may not have returned for follow-up examinations at our institution. Nevertheless, it is important to mention that although these patients lacked postoperative CT angiography, they did undergo pre-discharge cardiac echocardiography. The echocardiography results indicated that almost all of these patients recovered well and were discharged in good condition. As a national cardiac center, we have strict requirements for surgical quality, and we maintain rigorous records and follow-up for every patient, including those who unfortunately passed away. Out of our 159 patients, only one patient died during hospitalization, and this patient was not excluded from our study. Furthermore, there were no patients discharged with clinically poor conditions. However, it is worth noting that it is not uncommon for patients to be lost to follow-up in clinical practice. Our loss to follow-up rate was 14%, which falls below the standard of 20% for acceptable loss to follow-up.

We appreciate your kind reminder. In response to your request, we have attached a supplementary table file that includes baseline preoperative data, intraoperative details, and postoperative outcomes of all patients. From this table, it can be observed that the clinical outcomes of all patients are more significant. The ventilation time (21.36 ± 22.98 vs. 15.04 ± 11.34 hours, $p=0.063$) and postoperative hospital stay (9.71 ± 5.09 vs. 8.19 ± 2.63 days, $p=0.046$) is longer in the C-Bentall group, and the incidence of contrast extravasation or pseudoaneurysm (18 (20.0%) vs. 1 (2.2%), $p=0.01$) and persistent shunt (9 (10.0%) vs. 0 (0.0%), $p=0.064$) are also more frequency in C-Bentall group. Changes in the text: Details can be seen in the method part- Postoperative Follow-up part (see in the Page 9, line 12-19) and supplement table.

Comment 3: A table summarizing the clinical outcomes of the entire 159 patients is necessary (even if it needs to be included as a supplementary table due to limitations on the number of tables allowed).

Reply: We agree with your perspective, and your suggestions have greatly improved the quality and persuasiveness of our article. In the Results section, we have

included the overall clinical results of all patients. We have followed your advice and included an additional supplementary table. From this table, it can be observed that the clinical outcomes of all patients are more significant. The ventilation time (21.36 ± 22.98 vs. 15.04 ± 11.34 hours, $p=0.063$) and postoperative hospital stay (9.71 ± 5.09 vs. 8.19 ± 2.63 days, $p=0.046$) is longer in the C-Bentall group, and the incidence of contrast extravasation or pseudoaneurysm (18 (20.0%) vs. 1 (2.2%), $p=0.01$) and persistent shunt (9 (10.0%) vs. 0 (0.0%), $p=0.064$) are also more frequency in C-Bentall group. But there were bias in baseline data (Aortic sinus diameter and LVED). From a methodological standpoint, as described in our study, we employed propensity score matching to balance the baseline characteristics between the two groups of patients. This approach enhances the statistical power and provides more compelling conclusions compared to comparing the entire populations of unmatched or imbalanced baseline groups.

Thank you once again for your valuable input.

Changes in the text: we have modified our text as advised (see in the supplement table).

Comment 4: There are several errors in Table 1. The values for NYHA and Aortic insufficiency are incorrect. Also, there is no list of abbreviations included in the table. The total number after matching is not indicated. It would be advisable to refer to other papers to organize the contents of the table.

Reply: We apologize for the confusion. NAHY and aortic insufficiency are ranking variables, requiring non-parametric tests. We have carefully reviewed our statistical methods and sought the expertise of statisticians for verification and correction. Additionally, based on your suggestion, we have supplemented the abbreviations with their respective definitions in article table following the format provided in JTD and have included the total count after matching.

Changes in the text: we have modified our text as advised (see in Table 1).

Comment 5: Total numbers need to be added to Table 2. In addition, a clarification of the abbreviations is necessary. Explanation of abbreviations used separately from the main text is needed below the table. The values indicated in the table are incorrect. Overall, it requires thorough verification and modification

Reply: We have included the total numbers in Table 2 as you suggested. Thank you for your valuable advice on improving the writing quality of our manuscript. Furthermore, we have added explanations for the abbreviations according to the journal's format. We have also double-checked the units of our variables, and we are grateful for pointing out our shortcomings once again.

Changes in the text: we have modified our text as advised (see in Table 2).

Comment 6: It would be advisable to consolidate Figures 1, 2, and 3 into a single figure.

Reply: Thanks for your advice, according to your advice, we consolidate Figures 1, 2, and 3 into a single figure.

Changes in Figure.

Comment 7: As mentioned earlier, if the clinical outcomes of excluded patients are not presented, it would be difficult to draw conclusions about the safety and efficacy of the M-bentall procedure. It is necessary to mention the overall clinical results of all 159 patients, and it would be preferable to describe both the crude and matching results together

Reply: We greatly appreciate your suggestions. In the Results section, we have mentioned the overall clinical results of all patients. Additionally, as per your request, we have uploaded the supplementary table. In fact, the results are even more significant without PSM in overall study population. But there were bias in baseline data (Aortic sinus diameter and LVED), so in order to let the two groups comparable (eliminate the select bias and intergroup differences) and enhance the statistical power, we used this propensity match method to eliminate the bias and get reliable results, which proved to be more strongly encouraged to draw conclusions about the safety and efficacy of our modified cuff wrapping Bentall procedure. And after propensity may it is more reasonable to compare the two matched groups (for matched baseline condition), and the unmatched group with differently baseline may not able to compare directly and draw a reliable conclusion. We have attached the supplement table of all enrolled patients in supplement materials. From this table, it can be observed that the clinical outcomes of all patients are more significant. The ventilation time (21.36 ± 22.98 vs. 15.04 ± 11.34 hours, $p=0.063$) and postoperative hospital stay (9.71 ± 5.09 vs. 8.19 ± 2.63 days, $p=0.046$) is longer in the C-Bentall group, and the incidence of contrast extravasation or pseudoaneurysm (18 (20.0%) vs. 1 (2.2%), $p=0.01$) and persistent shunt (9 (10.0%) vs. 0 (0.0%), $p=0.064$) are also more frequency in C-Bentall group. But there were bias in baseline data (Aortic sinus diameter and LVED). So, our PSM analysis is a more scientific method.

Changes in the text: we have modified our text as advised (see in the result part, Page 10 line 20 to Page 11, line 3).