Massive Hemorrhage From the Posterior Intercostal Artery Following Lower Partial Sternotomy: a Case Report

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Case report

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Abstract

Background: In recent years, partial sternotomy has been adopted as an approach for minimally invasive cardiac surgery. Lower partial sternotomy is considered a superior approach compared to full sternotomy in terms of postoperative sternum fixation. We reported a very rare complication of posterior intercostal bleeding after aortic valve replacement with lower partial sternotomy.

Case presentation: A 79-year-old man underwent aortic valve replacement using lower partial sternotomy involving the right second intercostal space. The surgery was completed without any problem. However, a postoperative chest radiograph indicated a hematoma in the right upper chest wall and pleural effusion. Therefore, we inserted a drainage tube immediately. His blood pressure gradually decreased despite not having much drainage from the chest tube. Contrast-enhanced computed tomography revealed a huge hematoma and hemorrhage from the fourth right posterior intercostal artery. Immediately, we performed an emergency lower partial sternotomy again. We detected the origin of the bleeding in the right fourth posterior intercostal artery and obtained hemostasis with direct suture. The postoperative course was uneventful.

Conclusions: This case highlights the possibility of intraoperative bleeding from the intercostal artery, even in the absence of a clear rib fracture. In our case, we did not identify the cause of the bleeding. However, we suggest that the inhomogeneous stress on the posterior ribs upon attaching the sternal retractor for lower partial sternotomy may have affected the posterior intercostal artery.

Background

Median sternotomy remains the most common approach in cardiovascular surgery. In recent years, partial sternotomy has been adopted as an approach for minimally invasive cardiac surgery. Lower partial sternotomy is a superior approach compared to full sternotomy in terms of sternum fixation, infection, and cosmetic reasons. However, several complications, such as infection, bleeding, pain, and fracture, were associated with full sternotomy in previous reports [1, 2]. To the best of our knowledge, only a few cases of post-sternotomy hemorrhage from the posterior intercostal artery have been reported [3, 4].

We report a very rare complication of posterior intercostal bleeding after aortic valve replacement with lower partial sternotomy.

Case Presentation

A 79-year-old man had a history of hypertension, chronic kidney disease, distal gastrectomy due to gastric cancer at 62 years of age, and right spontaneous pneumothorax at 63 years of age. Aortic regurgitation was identified from a heart murmur and was followed up by a primary care doctor. He had no shortness of breath; however, he had gradually decreasing cardiac function and exhibited significant depression of aortic valve regurgitation. He was referred to our hospital for cardiac surgery. Doppler echocardiography showed severe aortic regurgitation and the right coronary cusp prolapsed toward the
left ventricular outlet trunk in diastole and aortic valvular prolapse. There was no cutaneous abnormality upon physical examination. No major abnormality was found in the preoperative laboratory results.

We performed aortic valve replacement via a lower partial sternotomy involving the right second intercostal space with division of the internal thoracic artery. Cardiopulmonary bypass was established with right atrial drainage and ascending aorta return. After cooling to 33°C, the ascending aorta was clamped under ventricular fibrillation. An aortotomy was made, and the selective coronary perfusion resulted in cardiac arrest without problems. We replaced the aortic valve with a 23-mm bioprosthetic valve. Weaning from the cardiopulmonary bypass was without difficulty. The surgery was completed without blood transfusion and any problem. The patient’s postoperative blood pressure and heart rhythm were stable. However, a postoperative chest radiograph indicated a hematoma in the right upper chest wall and pleural effusion (Fig. 1). This site did not appear to be damaged during the operation, although it was thought that the cause was blood dripping due to damage to the pleura during the operation. Therefore, we inserted a drainage tube immediately and transferred him to the intensive care unit.

Approximately 2 hours after the surgery, the patient became anemic, and his blood pressure gradually decreased. This prompted us to transfuse blood and repeat chest radiography. The radiograph indicated enlargement of the hematoma (Fig. 2). Considering the possibility of iatrogenic bleeding due to central venous cannulation, we removed the central venous catheter and the Swan-Ganz catheter immediately. His blood pressure gradually decreased despite not having much drainage from the chest tube; however, we performed contrast-enhanced computed tomography (CT). This revealed massive hemorrhage and extravasation from the fourth right posterior intercostal artery (Fig. 3), and no obvious fractures were found under bone condition of the CT. The patient was in shock; thus, we had to immediately perform emergency surgery. Since the location of the bleeding could be identified from the CT image and it was expected that it could be visually detected even with median sternotomy, we decided to perform emergency lower sternotomy. We made an incision in the right visceral pleura, evacuated the 275-g hematoma from the cavity, and examined it carefully. The origin of the bleeding was identified in the fourth right posterior intercostal artery, although no rib fracture was noted on palpation of the lesion. The artery was cauterized with an electric scalpel and direct suture. The patient’s postoperative course was uneventful, with no resumption of bleeding, and he was discharged 11 days after the surgery.

**Discussion And Conclusions**

Trauma including blunt chest and iatrogenic injuries is the most common cause of intercostal artery bleeding [5]. Spontaneous intercostal artery bleeding is generally observed in patients with disorders, such as neurofibromatosis type 1, systemic lupus erythematosus, or coarctation of aorta [6, 7, 8]. In our case, the CT did not reveal any rib fractures or evidence of trauma. Moreover, the patient did not have any remarkable medical history, and his physical examination and laboratory data did not suggest the presence of the above-mentioned diseases.
Median sternotomy has been the most common approach in cardiovascular surgery. Complications related to median sternotomy have been reported previously. However, intercostal artery bleeding following median sternotomy is extremely rare. To our knowledge, only two reports have described intercostal artery bleeding following median sternotomy. Alonso et al. reported the first case of intercostal artery bleeding [3]. In their case, the left second anterior intercostal artery developed a pseudo-aneurysm involving a sternal wire during sternotomy closure. Soquet et al. described two cases of intercostal artery bleeding [4]. The bleeding in the first case was from the left ninth posterior intercostal artery, and the other was from the right 12th posterior intercostal artery. The bleeding in these cases was spontaneous following cardiac surgery via a median sternotomy and was stopped by repeated sternotomy or transcatheter arterial embolization (TAE). In their cases, the authors could not identify the cause of the bleeding. In previous reports, most intercostal artery bleeding due to causes other than trauma was from the lower intercostal artery of the ninth or lower. Jang et al. showed the risk factors of intercostal artery bleeding, such as being elderly, female, and on anticoagulation medication and having a cough [9]. In our case, only being elderly is applicable. Soquet et al. suggested that the vessel wall weakness of the lower intercostal artery contributes to bleeding [4]. However, in our case, bleeding was from the fourth intercostal artery and higher intercostal artery than previous reports. Thus, it may be a different cause than those in the previous reports. Here, the bleeding site was not the surgical operation site, and the intraoperative hemodynamics were stable. Considering that postoperative hemodynamics became unstable, the bleeding may have occurred between the end of the cardiopulmonary bypass and the end of the surgery. This anatomically superior source of bleeding may be due to the incision associated with lower partial sternotomy. It is plausible that inhomogeneous stress on the fourth posterior intercostal artery when we attached the sternal retractor for lower partial sternotomy. Another cause of the bleeding may be the pleural adhesions that formed following spontaneous pneumothorax, which may have generated tension on the fourth posterior intercostal artery. If these are the causes, traumatic and iatrogenic bleeding is possible, although the cause remains unknown after all. Therefore, the possibility of bleeding should be considered when lower partial sternotomy is performed, and surgeons should be prepared to stop the bleeding, if necessary.

In our case, contrast-enhanced CT was used to accurately diagnose the bleeding source, which led to prompt treatment thereafter. Although there are various diagnostic modalities, we consider that contrast-enhanced CT is mandatory. For the treatment of intercostal artery bleeding, several reports have recently underscored the efficacy of TAE for hemostasis [10, 11]. Indeed, it is useful that TAE is a minimally invasive procedure and could be performed immediately under local anesthesia. However, the possibility of rebleeding remains. In fact, Soquet et al. had a rebleeding case after TAE, and they performed thoracotomy for hemostasis following TAE [4]. We consider that TAE might be useful if CT images show a small amount of bleeding and a patient is not in shock. If the patient is in shock and it could be judged from the CT images that the location of the bleeding could be visually detected even with median sternotomy, or it could be done so that the dorsal intercostal artery bleeding could not be detected from median sternotomy, intercostal thoracotomy is also considered a good approach method.
In conclusion, post-sternotomy hemorrhage from the posterior intercostal artery is extremely rare. Although the cause of the bleeding was not identified in our case, the inhomogeneous stress on the posterior ribs when we attached the sternal retractor for lower partial sternotomy may have affected the fourth posterior intercostal artery.

List Of Abbreviations

CT – computed tomography

TAE – transcatheater arterial embolization

Declarations

Ethics approval and consent to participate:

Not applicable

Consent for publication:

Consent for publication is obtained from the patent.

Availability of data and materials:

The datasets supporting the conclusions of this article are included within the article.

Competing interests:

The authors declare that they have no competing interests.

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MH drafted the paper. YM and FY critically revised the article. All authors read and approved the final manuscript.

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Figures
Figure 1

Postoperative chest radiograph showed a hematoma on the right upper chest wall and hemothorax.
Figure 2

Enlargement of the hematoma before the re-operation.
Figure 3

Contrast enhanced computed tomography showed hemothorax with bleeding from the right fourth posterior intercostal artery (arrow).