Case Report

Thrombus Formation in the Pulmonary Vein Stump after Left Upper Lobectomy: A Report of Four Cases

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Left upper lobectomy may be followed by complications such as thrombus formation in a stump of the left superior pulmonary vein (LSPV), which may cause systemic embolization. We have encountered four such cases, which account for 3.4% of all left upper lobectomies performed at our institution. Right renal infarction was observed in one of these four cases; the remaining cases were asymptomatic, with the thrombus incidentally detected by enhanced computed tomography (CT). The postoperative duration for the detection of the thrombus varied from 4 days to 24 months. Even in a case in which the superior pulmonary vein (PV) was divided by posterolateral thoracotomy, CT showed that the stump was long enough intrapericardially for thrombus formation. Anticoagulant therapy was administered in all the cases, resulting in dissipation of the thrombus. Therefore, when a thrombus is detected in a pulmonary stump, an anticoagulant should be administered.

Keywords: left upper lobectomy, pulmonary vein, stump, thrombus, anticoagulant

Introduction

Thrombus formation in the pulmonary vein (PV) stump is one of the causes of systemic thrombosis1–3) and has been more frequently reported after left upper lobectomy than after anatomical pulmonary resection at other sites. We encountered four such cases of thrombus formation in the PV stump, and, in this report, we present the clinical course and computed tomography (CT) findings in these four cases.

Case Report

Case 1: A 61-year-old woman underwent a left upper lobectomy for lung adenocarcinoma, which was detected as an abnormal shadow on CT during mass screening (Fig. 1A). The left superior PV (LSPV) was divided by an endoscopic linear stapler with a built-in blade (ENDO-PATH® stapler, echelon flex™: Ethicon Endo-surgery, Tokyo, Japan). On postoperative day 4, she complained of right abdominal pain. We did not observe any deterioration in the blood oxygenation level or vital signs of shock. Her abdomen was soft with no tenderness. An enhanced CT scan showed a right renal infarction and thrombus formation in the stump of the LSPV (Fig. 1B and 1C). We administered anticoagulation therapy using warfarin and heparin. Heparin was discontinued when the international normalized ratio level reached approximately 2.0 with warfarin. She was discharged on
postoperative day 14. No further occurrences of systemic embolism were reported, and she remained well without any sign of cancer recurrence 15 months after surgery. The thrombus disappeared 1 month after administration of warfarin, which was discontinued 6 months after the onset of renal infarction. After the cessation of warfarin therapy, no recurrence of the thrombus had been found.

Case 2: A 70-year-old man underwent a left upper lobectomy for clinical stage IB adenocarcinoma. The LSPV was divided by an endoscopic linear stapler with a built-in blade (ENDOGIA™ with a white cartridge; Covidien Japan, Tokyo, Japan). A follow-up CT performed 24 months after surgery (Fig. 2A) showed thrombus formation in the LSPV without any systemic thrombosis. He received a 6-month course of anticoagulation therapy with warfarin that dissipated the thrombus. The patient had shown no recurrence of either lung cancer or thrombus 48 months after the surgery.

Case 3: A 76-year-old man underwent a left upper lobectomy for clinical stage IB adenocarcinoma. The LSPV was divided after triple ligation with silk sutures. A follow-up CT performed 3 months after the surgery (Fig. 2B) revealed thrombus formation in the LSPV. The patient received a 6-month course of warfarin. He received stereotactic radiotherapy for a solitary brain metastasis 1 year after the surgery; nevertheless, he remained well 60 months after the surgery, without any recurrence of the thrombus or any additional metastatic relapse.

Case 4: A 71-year-old man underwent a left upper lobectomy via postero-lateral thoracotomy after concurrent chemoradiotherapy for lung cancer with mediastinal invasion. The LSPV was divided by an endoscopic linear stapler with a built-in blade (ENDOPATH® stapler).
A follow-up CT performed 3 months after the surgery (Fig. 2C) incidentally detected thrombus formation in the LSPV. The patient received and finished a 6-month course of warfarin that dissipated the thrombus.

Discussion

We presented four cases of thrombus formation in the LSPV after a left upper lobectomy, which constitutes 3.4% of the total number of left upper lobectomies \( n = 117 \) performed at our institution between 1999 and 2012. This relatively high incidence could be attributed to the routine use of enhanced CT for follow-up up to 2 years after the operation; however, it is difficult to fully elucidate the factors responsible for the relatively high incidence of thrombus formation.

To investigate the mechanisms underlying thrombus formation, we reviewed the surgical approach and LSPV division technique used in our four cases. Ohtaka, et al. proposed that the increased length of the stump of the
LSPV, compared with that of the other sites of lobectomy, facilitated thrombus formation.\(^1\) In addition, there is a concern that the proximal exposure and encirclement of the LSPV using the minimal invasive approach is inadequate and could result in a long stump. Of the four reported cases, three involved our standard less-invasive approach with a 10-cm axillary incision and two surgical ports, and one case involved posterolateral thoracotomy. Therefore, thrombus formation was not associated with any particular type of surgical approach. In case four, although the stump was divided by posterolateral thoracotomy, it was long enough intrapericardially. It is important to note that in order to shorten the stump to the maximum extent, the LSPV must be divided in the intrapericardial space for all left upper lobectomies. However, this is not practically possible. Moreover, since the technique and device used to divide the LSPV varied in all four cases, it is difficult to determine the exact risk factor in this respect.

With respect to a long vascular stump, we often find long vascular stumps unintentionally at other sites, e.g., at the first branch of the right main pulmonary artery or at the common basal pulmonary artery. Therefore, factors other than the length of the stump may be responsible for thrombus formation. We noted the anatomical course of the LSPV: it runs dorsally toward and crosses the left main bronchus. After a left upper lobectomy, all left hilum structures move ventrally and cranially. We speculate that this anatomical characteristic and adaptive postoperative relocation also affects thrombus formation.

Although, the time of onset of systemic infarction or thrombus formation after a left upper lobectomy varies from 3 days to 24 months postoperatively in several reported cases, including ours,\(^1\)–\(^4\) it is important to note that the thrombus dissipated in our series after the administration of warfarin. Therefore, anticoagulant therapy should be administered as soon as a thrombus is detected. In three cases, the thrombus did not relapse after cessation of warfarin. Therefore, we believe that a 6-month course of anticoagulation therapy with warfarin is enough if the case is not accompanied by any other indication such as atrial fibrillation.

**Conclusion**

We present four cases of thrombus formation in the stump of the LSPV after left upper lobectomy. It appears difficult to avert this complication; however, on detection, a 6-month warfarin course should be immediately administered.

**Disclosure Statement**

The authors have no conflicts of interest to declare.

**References**