In radical pulmonary resection, reconstruction of the pulmonary artery (PA) is occasionally required to avoid pneumonectomy. Direct suturing or a sleeve resection is usually performed. However, the presence of a long defect in the native PA necessitates reconstruction with a conduit. In such cases, a biological conduit is usually used. Prosthetic conduits are rarely used because of post-operative risks including infection and thrombosis. We present two cases in which prosthetic conduits were successfully used for reconstruction of the PA.

Keywords: pulmonary artery reconstruction, conduit, lobectomy

Introduction

In radical pulmonary resection, reconstruction of the pulmonary artery (PA) is occasionally required to avoid pneumonectomy. Direct suturing or a sleeve resection is usually performed. However, the presence of a long defect in the native PA necessitates reconstruction with a conduit. In such cases, a biological conduit is usually used. Prosthetic conduits are rarely used because of post-operative risks including infection and thrombosis. We present two cases in which prosthetic conduits were successfully used for reconstruction of the PA.

Case Report

Case 1

A 75-year-old woman with a 40-mm adenocarcinoma in the left upper lobe (cT2aN0M0) was admitted for surgery (Fig. 1A). Respiratory function showed a forced expiratory volume 1% (FEV1%) of 68% and a % forced vital capacity (%FVC) of 92.2%. She was administered anticoagulation therapy for arterial fibrillation. A left upper lobectomy was planned. Intraoperatively, her PA was accidentally injured around the apical posterior branch. The left PA was clamped proximally and distally to control catastrophic hemorrhage. The PA was completely disconnected and severely damaged between the apical posterior branch and lingular segmental branch. This impairment did not allow direct oversewing or end-to-end anastomosis. Because urgent repair was required and the patient was unfit for pneumonectomy because of poor respiratory function (postoperative predictive VC, 0.964l; %VC, 47.1%; FEV1, 0.681l; and DLCO/VA, 52.8%), we performed a left upper lobectomy with reconstruction by using a prosthetic expanded polytetrafluoroethylene (ePTFE) conduit (12-mm Goretx®).
The patient’s postoperative course was uneventful, and she has been receiving a similar dose of anticoagulation therapy to that used preoperatively. At 12 postoperative months, she underwent irradiation for a small local recurrence in the left lower lobe. At 31 months after surgery, chest computed tomography (CT) showed good patency of the prosthesis and no recurrence (Fig. 1B).

Case 2
A 74-year-old man with squamous cell carcinoma who achieved a partial response after 70 Gy irradiation was referred to our hospital for surgery due to tumor re-enlargement. Respiratory function tests showed an FEV1% and %FVC of 62.7% and 125%, respectively. A chest CT and bronchofiberscopy showed a large mass shadow in the left upper lobe with possible infiltration into the PA in the tangential long distance (Fig. 2A) and an intact upper lobe bronchus (Fig. 2B and 2C). On the basis of a diagnosis of T3N0M0, a left upper lobectomy with PA resection and reconstruction using a prosthetic Dacron conduit (Gelweave®) was planned. There was concern about the condition of the pericardium, which was possibly infiltrated and previously irradiated; therefore, an autologous conduit was considered inappropriate.

A lateral thoracotomy was performed. A large tumor in the left upper division directly infiltrated the PA and the phrenic nerve. The PA was clamped proximally and distally after intravenous injection of sodium heparin (2000 U). A left upper lobectomy was performed with division of the phrenic nerve and a long circumferential resection of the PA between the left main PA and the superior segmental PA. Then, reconstruction with an 18-mm (Gelweave®) conduit was accomplished (Fig. 3A). The patient’s postoperative course was complicated by sputum plugging that required bronchoscopic aspiration and the development of a bilateral jugular vein thrombus on postoperative day 15, which was treated successfully by changing his anticoagulation medication from heparin to warfarin. The patient is free of disease and a whole body CT showed no evidence of recurrence and patency of the prosthesis at 25 postoperative months (Fig. 3B).

Discussion and Conclusion
In case of direct extension of a pulmonary tumor, pneumonectomy is often required. However, pneumonectomy is well known to result in various complications and is inappropriate in cases with limited respiratory function. Several reconstructive techniques allow the preservation of lung parenchyma and respiratory function. PA reconstruction techniques range from direct oversewing, which is appropriate in cases of limited tangential resection, and pericardial patch closure, which is used when more than one third of the arterial circumference has to be resected, to end-to-end anastomosis (sleeve resection), which is used when the defect affects >50% of the arterial wall.1-3) Interposition of a conduit could be required when the extent of the circumferential PA defect

Fig. 1 (A) Chest computed tomography of case 1 shows a 40-mm, irregularly shaped tumor with a cavity in S3. (B) The prosthetic conduit (arrowheads) shows good patency at 31 months after surgery.
PA Reconstruction with a Prosthetic Conduit

Preoperative chest computed tomography of case 2 shows (A) a large mass shadow in the left upper lobe with possible infiltration into the pulmonary artery (*), and (B) an intact upper lobe bronchus (arrow). (C) Preoperative bronchofiberscopy shows an intact second carina and LUB. The slight hemorrhage at the LUB is due to biopsy. LUB: left upper lobe bronchus; LLB: left lower lobe bronchus.

Fig. 3 (A) Intraoperative image of case 2 shows an 18-mm Gelweave conduit (arrow) interposed between the left main pulmonary artery (PA) (#) and superior segmental PA (*). (B) Chest computed tomography of case 2 shows good patency of the conduit (arrowheads) at 25 months after surgery.

pa resection. Various materials are considered for use as conduits. Autologous pericardial roll conduits are popular, with homologous saphenous or pulmonary veins serving as possible alternatives. PA sleeve resection and reconstruction with autologous pericardium is thought to be a safe procedure. Galetta,
et al. reported their experience of using a custom-made heterogeneous bovine pericardial conduit. However, postoperative shrinkage or twisting could occur with the use of these materials. In addition, preparing these conduits is time-consuming.

Prosthetic conduits have not been commonly used due to concerns over infection and thrombosis. However, prosthetic conduits have the advantage of easy availability and handling. These strengths are particularly beneficial in emergencies, and when using an autologous conduit is risky, as in our case. Intraoperative exact repair of air-leakage and anticoagulation therapy are required to prevent complications.

We elected to use a Dacron prosthetic conduit in one of our cases and an ePTFE prosthetic conduit in the other. Even in the field of vascular surgery, it is still controversial whether Dacron or ePTFE is preferable. A randomized controlled trial (RCT) showed superior femoropopliteal bypass graft patency with a Dacron graft as compared to an ePTFE graft. On the other hand, Takagi et al. found no significant differences in patency at 5 years between both materials. Several additional RCTs showed mixed results. Although firm conclusive evidence of an advantage of one material over the other was not obtained, these prosthetic grafts do represent alternatives to autogenous venous conduits in peripheral vascular surgery. There is also no significant difference in anti-infection, handling, and cost between both materials. Given these findings, either one could be selected for pulmonary reconstruction. Berther et al. recently demonstrated the feasibility of cryopreserved allografts. This novel conduit appears to offer various advantages compared to conventional methods, and therefore, further clinical experiences are expected.

In conclusion, when the interposition of a conduit is required for PA reconstruction, the use of a prosthetic conduit should be considered in selected cases.

Disclosure Statement

None declared.

References