Managing major vessel injuries with a Fogarty catheter during chest re-opening in children

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Abstract

Injury of structures, leading to a major bleeding during chest opening, is a severe and potentially life-threatening complication, especially in redo cardiac surgery, both in adults and children. In three paediatric redo operations performed via midline sternotomy, we managed this complication successfully and uneventfully by using an inflated Fogarty catheter to plug the blood leak from the injured vessel before repairing the lesion under direct vision in a bloodless surgical field. Herein we report in detail the technique used and a comment on our experience.

Keywords: Re-operation • Surgery for congenital heart defect • Paediatric cardiac surgery

INTRODUCTION

Chest re-opening has been reported to be related to a trend towards increased operative risk, especially in adults [1]. Such risk is mainly due to iatrogenic damage of cardiac structures, either during sternal re-opening or subsequent dissection of great vessels and cardiac structures, often leading to massive bleeding with haemodynamic instability and need for emergency institution of cardiopulmonary bypass.

Having faced such a problem many times during paediatric cardiac re-operations, we report a simple tool for off-pump repair of accidentally damaged structures during chest re-opening after controlling the bleeding with an inflated Fogarty catheter inserted through the lesion.

PATIENTS AND TECHNIQUE

Paediatric patients undergoing chest re-entry procedures did not receive specific preoperative imaging or individual risk stratification. Chest CT scan, which is virtually mandatory in the planning of re-operations in adult cardiac surgery, is institutionally avoided in paediatric patients unless aimed at other anatomical diagnosis, in order to minimize the risk of ionizing radiation; also because many paediatric patients require routine, repeated surgeries. We routinely ensure the patency of inguinal vessels, in order to respect their integrity in view of subsequent procedures, either diagnostic/interventional haemodynamic or surgical. In case of major vessel injury during chest re-opening, we might either proceed to branches dissection and femoral cannulation to start the cardiopulmonary bypass or perform an off-pump control of bleeding using an inflated Fogarty catheter, as herein reported.

The first patient was a 17-year-old female with pulmonary atresia, ventricular septal defect (VSD), hypoplastic defective true pulmonary arteries and major aortopulmonary collateral arteries, who underwent complete unifocalization of the pulmonary circulation and placement of a right-ventricle-to-pulmonary-artery valved conduit, leaving the VSD open as the fifth operation performed via midline sternotomy. During chest re-opening, the patient suffered injuries, first to the left innominate vein and then to the ascending aorta. The second patient was a 14-year-old male with recurrent discrete subaortic obstruction, who underwent subaortic resection and aortic valve repair as the second operation performed via midline sternotomy. During chest re-opening, the left innominate vein was injured at the time of upper sternal division. The last was an 11-year-old boy with primary diagnosis of tricuspid atresia, transposition of great arteries and aortic coarctation, who had previously undergone Norwood, Glenn and Fontan procedures and, at this time, presented for aortic arch plasty. During sternal division, a lesion of the left innominate vein occurred.

In all cases, the lesion was digitally controlled by the first surgeon, while the assistant surgeon arranged to create a proper exposure with limited dissection and blood suction. A 6 Fr Fogarty catheter, connected to a three-way stopcock and a 2.5-ml injector, was quickly inserted by the first operator through the lesion into the damaged vessel; the balloon was inflated by the scrub nurse and the catheter was gently retracted by the first surgeon to tightly plug the leak (Fig. 1A). Under excellent direct vision, with no hurry and in a bloodless surgical field, the lesion was repaired with a 5-0 polypropylene purse string suture (Fig. 1B), taking care to avoid damage to the inflated balloon by the suture needle. During vessel repair, the
gentle traction of the catheter was performed by the assistant surgeon, who also deflated the balloon and withdrew the catheter when the repair was accomplished, while the first surgeon tightened the suture.

All lesions that occurred were successfully repaired, with limited bleeding and complete haemodynamic stability. Further dissection of cardiac structures was performed off-pump and cardiopulmonary bypass was instituted electively.

COMMENT

The prevalence of repeated sternotomies is a peculiarity of congenital heart surgery, related to the complexity of the disease, the use of intermediate palliation and the perishability of prosthetic devices.

Longer life expectancy after neonatal repair or palliation of congenital heart defect increases the incidence of re-operation, with related potential challenges and additional risks. Despite this, the higher risk of redo procedures in paediatric patients remains controversial. The Vancouver experience [2] showed a 5.2% rate of cardiac laceration during chest re-entry, requiring establishment of an emergency femoro-femoral bypass in about half of the cases—but with no significant difference in survival rate compared to a redo cohort without bleeding at re-opening. Preoperative assessment of the retrosternal space on chest X-ray in lateral projection, careful surgical technique and judicious use of elective femoro-femoral bypass may further help to minimize cardiovascular lesions during chest re-entry. The experience of the paediatric group in Houston [3] reported only a 0.3% rate of major bleeding injury during redo sternotomies, without any relevant consequences. Finally, the Emory group [4] identified repeated sternotomies and the presence of a right ventricle-to-pulmonary artery conduit as risk factors for damage at chest re-entry. In spite of that, redo injury is not associated with increased risk of operative mortality.

Higher operative risk associated with redo surgery is especially evident in the adult population [1]. An ingenious use of a Foley catheter to control vessel bleeding in a similar way to our report has already been described in some adult cases [5]. To the best of our knowledge, however, such technique has never been reported in paediatric cardiac cases. We found it reproducible, safe, effective and low-cost. Its only potential drawback is the possibility of enlarging the vessel tear. However, we believe that this can be avoided using a moderate balloon inflation and without exerting improper traction.

The inflated Fogarty catheter may help to control and repair bleeding caused accidentally during chest re-opening in paediatric redo cardiac surgery.

Conflict of interest: none declared.

REFERENCES


eComment. Balloon catheters in cardiac surgery

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We read with great interest the article by Gandolfo et al. [1]. As mentioned, situations may arise during cardiac surgery when vascular control is required but conventional vascular clamps can not be applied. Ballooned catheters (e.g., Foley, Fogarty) are useful for the control of inadvertent perforation of the heart especially in “redo” operations. As Black et al. have reported, balloon catheters are also useful...