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Complications of intrathoracic lines placed during cardiac surgery

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See related commentary on page 1214.

Intracardiac catheters are frequently used in pediatric patients for monitoring intracardiac pressures and to provide vascular access. Data are scarce on the incidence of complications related to use of such catheters.¹⁻³

Since January 2005, all health data for patients transiting the intensive care unit of the Royal Children's Hospital (Melbourne, Australia) have been entered into our database

for that unit, with 1 entry being devoted to the following catheter line–related complications: migration (inadvertent extrusion of the line outside its desired location) or premature removal (earlier than planned removal); bleeding after line removal (unexpected drain output or substantial pericardial collection after planned line removal); line occlusion (absent waveform tracings); thrombosis (echocardiographic demonstration of thrombus in the cardiac chamber containing the line); and failed removal. The files of all patients recorded as having a line-related complication were reviewed.

Left atrial (LA) and right atrial (RA) lines were inserted through their respective appendages and secured with 2 purse-strings of Prolene 6-0 (polypropylene) (Covidien, Mansfield, Mass) placed around the entry point of the line, with the addition of a silk suture per surgeon preference. To avoid migration of the RA lines, 1 surgeon additionally secured the line by looping the ends of the purse-string suture along the extracardiac portion of the line and tying it off near the entry point. The other 2 surgeons left a long loose segment of lines between the entry in the chest and the insertion in the RA appendage (Figure 1).

Right atrial lines were pediatric multilumen central venous catheters (Arrow International, Inc, Reading, Pa); LA lines were polyurethane umbilical vessel catheters (Tyco Healthcare Group LP, Mansfield, Mass). Pressure catheter placement sets (Medtronic, Inc, Minneapolis, Minn) were used as

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FIGURE 1. Techniques of insertion of a direct right atrial line to prevent the line from being pulled off by lung inflation. A, A long loop is left on the line before the entry point into the right atrium. B, A 7-0 polydioxanone suture is secured between the entry point of the line into the skin and its entry point into the right atrium.

TABLE 1. Line usage and complications

Complication	LA line (n = 724)	PA line (n = 413)	RA line (n = 267)	Total (n = 1404)
Migration and/or premature removal	2	3	12	17
Bleeding	2	2	0	4
Thrombosis	0	1	3	4
Occlusion	1	1	2	4
Failed removal	1	0	0	1
Total	6 (0.8)	7 (1.6)	17 (6.3)	30 (2.1)

For total, values are n (%); all other values are n. LA, Left atrial; PA, pulmonary artery; RA, right atrial.

pulmonary artery (PA) lines; they were inserted through the pulmonary infundibulum and secured by 1 or 2 pledgeted sutures placed around the entry point of the line.

As a blanket policy, all patients in the intensive-care unit were maintained on continuous infusion of heparin at 10 units/kg/hour until line removal, without any targeted anticoagulation level. The center policy was to remove lines on postoperative day 4, unless the lines were still in use or the coagulation profile of the patient was impaired. Heparin infusion was stopped 4 hours before removal of lines. After line removal, a focused echocardiography study was always performed to screen for any mediastinal bleeding.

Between 2005 and 2013, a total of 1404 intracardiac lines were inserted in 1118 patients: 224 (20%) patients had 2 lines, and 31 (2.7%) patients had 3 lines. Ninety-four (8.4%) patients were newborn (underwent operation on the first day of life), and 464 (41.5%) were neonates (aged ≤ 28 days). Direct RA lines were systematically inserted during the first procedure for a single-ventricle palliation pathway, to avoid damage to the superior vena cava. PA and LA lines were inserted selectively when the possibility that the patient might display elevated measurements was anticipated. We documented 30 (2.1%) instances of complications directly attributable to these lines (Table 1). No line-related deaths occurred.

MIGRATION AND/OR PREMATURE REMOVAL

Migration of RA lines occurred in 12 of 267 line insertions (4.4%), necessitating a return to the operating room in 5 cases. In 2 of these 5 cases, sudden bleeding occurred after Norwood surgery and necessitated extracorporeal membrane oxygenation support. Five of these 12 migrations occurred in patients for whom the technique of using the extra securing of the line was applied (Figure 1). Two of the 724 LA lines (0.2%) migrated, with 1 necessitating a reoperation for bleeding. A PA line was prematurely removed in 3 instances: once because of a

crack in the line hub, once because entrapped air was identified in the line, and once for an unidentified reason.

BLEEDING AFTER LINE REMOVAL

Significant bleeding after planned removal was identified in 2 LA and 2 PA lines by echocardiography. The bleeding was managed conservatively in 2 cases and necessitated reintervention in 2 cases, including extracorporeal membrane oxygenation support in 1 case before the patient reached the operating area.

SURGICAL INTERVENTION FOR LINE-RELATED COMPLICATIONS

Altogether, 9 of 1404 (0.8%) cases required surgical interventions, including extracorporeal membrane oxygenation support in 3 cases (0.3%). Eight of these interventions were for life-threatening bleeding, and 1 was to retrieve a retained LA line.

A total of 8 (0.6%) patients required intervention for bleeding (6 after line migration and 2 after line removal). This rate is higher than the one quoted in a historical series² from 1986, and lower than a more recent estimate.¹ Flori and colleagues¹ demonstrated in this latter study that younger age is a risk factor for reintervention after insertion of an intracardiac line. Our series included younger patients than the ones in the historical series,² which likely explains our higher rate of bleeding. We encountered less bleeding from LA lines than was found in the series by Flori and colleagues,¹ a difference that may be related to the fact that they inserted these lines in the junction between the right pulmonary veins and the atrium.¹ We believe that more complications were encountered with RA lines than with LA and PA lines because of the thinner wall and higher fragility of the right atrium.

In conclusion, the use of intracardiac lines is safe. In rare instances, it can result in dramatic bleeding and reintervention. The RA lines are more at risk of migration than the LA and PA lines.

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