



Rare but serious complications of central line insertion

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KEYWORDS

Central venous catheter;
 Pediatric;
 Fatal;
 Complication

Discussions on the complications of central venous catheterization in children typically focus on infectious and the more common mechanical complications of pneumothorax, hemothorax, or thrombosis. Rare complications are often more life-threatening, and inexperience may compound the problem. Central venous catheter complications can be broken down into early or late, depending on when they occur. The more serious complications are typically mechanical and occur early, but delayed presentations of pericardial effusions, cardiac tamponade, and pleural effusions may be of equal severity, and delay in diagnosis can be catastrophic. Careful insertion techniques, as well as continued vigilance in the correct position and function of central venous catheters, are imperative to help prevent serious complications.

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Central venous catheters have greatly improved the care of critically ill neonates and children over the past 30 years. The availability and variety of central venous catheters have also increased, making their placement one of the most frequent procedures performed on children.¹ The common complications related to catheter insertion and maintenance that are discussed with parents or guardians who are making medical decisions for their children typically include pneumothorax, hemothorax, hematoma, thrombosis, and infection. Although these are the most frequently encountered complications, pediatric surgeons must be ready to recognize rare and often more serious life-threatening events and be prepared to act quickly to promote the best outcome for the patient.

For the basis of discussion, complications related to catheter insertion can be broadly divided into early and late, based on the timing of their occurrence. Early complications are those that occur either during line (Table 1) placement or within 24 hours after the catheter is in place. These are

typically due to mechanical events that may be life-threatening if not recognized and corrected immediately. In a study of 322 central vein cannulations in 272 pediatric patients, Casado-Flores and coworkers reported a 13% rate of early complications, 4% overall being mechanical in nature and 2.8% overall requiring urgent surgical intervention for pneumothorax, hemothorax, and hydrothorax.² Another study of 587 central venous cannulations in 460 newborns and infants reported overall complications in 28% of lines; however, the breakdown of early versus late complications was unclear.³ Of these complications, 76% were mechanical in nature and 6.7% were thrombotic complications (including in this report tamponade, pleural effusion, and caval thrombosis).³ Early complications have a higher ratio of associated fatal to nonfatal events than do late complications (Table 2).

Late complications develop 24 hours after catheter placement and are usually a function of the line duration and patient clinical status. Infectious, thrombotic, and embolic complications are more common within this category; however, there are a significant number of serious mechanical problems that can occur after 24 hours (Table 3). The following discussion will highlight the early injuries that occur during or just after central line insertion. In addition,

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Table 1 Classification of central line complications that have been reported in the English literature into early (≤ 24 hours after insertion) and late (>24 hours after insertion) complications^{1-4,8-11,14-21,25,28,32-34,39,40}

Early*				Late				
Cardiac injuries	Vessel injuries	Lung injuries	Device	Septic	Thrombotic	Embolic	Device	Vascular/cardiac erosion
Rhythm	Arterial	Hydrothorax	Break/Leak Discontinuity	Fever	DVT	Air	Occlusion	Hydrothorax
Perforation	Venous	Hemothorax		Bacteremia	Occlusion	Blood	Break	Cardiac perforation Tamponade†
Tamponade†	Air emboli Malposition	Pneumothorax Phrenic nerve paresis		Line infection		Septic	Malposition	Intra-abdominal infusion Intra-abdominal abscess Adherence to vein

*Minor early complications that were not tallied in this review include:

- Arterial punctures, unless associated with subsequent arterial injury or hemothorax
- Catheter malposition that did not incur any damage or sequelae
- Hematoma
- Premature ventricular contractions or other dysrhythmias caused by the guidewire that resolved with removal of the guidewire and did not recur or require intervention.

†Cardiac tamponade can be an early or late complication of CVC insertion, and may be fatal with either early or late presentations.

the serious late complications will be discussed as they relate to issues in catheter maintenance practices.

A thorough review of the English literature was performed as it pertained to life-threatening and fatal complications of central venous catheters (including uncuffed, cuffed, and totally implanted catheters) in pediatric patients. Some of the neonatal and infant central catheter reviews contained information and complication rates on peripherally inserted central catheters (i.e., PICC lines) and umbilical vein catheters. We have endeavored to focus our attention on surgically placed catheters, either percutaneous or cut-down methods; however, it was not always possible to

exclude PICC lines and other peripherally placed central catheters from the reported incidence, complication, or mortality rates. We have also focused on the rare and serious complications that may occur and will not address minor, and often more common, complications, such as catheter thrombosis or infection.

Method of catheter placement

Before we embark on our discussion, it is worth describing the method of central line insertion in relation to the potential for complications. Percutaneous catheters appear to be as safe and effective as surgically placed catheters.^{4,5} Surgical cut-downs

Table 2 Early complications (occurring ≤ 24 hours after insertion) reported in the English literature in order of decreasing frequency^{1-4,8-11,14-21,25,28,32-34,39,40}

Fatal	Non-fatal	
Hemothorax	8	Pneumothorax 26
Cardiac tamponade	4	Hemothorax 21
Hydrothorax	2	Cardiac tamponade 17
Pneumothorax	1	Catheter leak/discontinuity/ rupture 5
Arrhythmia	1	Dysrhythmia 3
Internal jugular injury	1	Phrenic nerve paresis 3
Internal mammary artery injury	1	Malposition 3
Cerebral edema	1	SVC syndrome 2
Accidental injection	1	Hydrothorax 1
		Internal mammary artery injury 1
		Quadriplegia 1
		Mediastinal hematoma 1
		Transient venous occlusion 1
		Subclavian vein thrombosis 1
		Air embolism 1

Table 3 Late complications (occurring >24 hours after insertion) reported in the English literature in order of decreasing frequency^{1-4,8-11,14-21,25,28,32-34,39,40}

Fatal	Non-fatal	
Cardiac tamponade	10	Septic* N/A
		Embolic* N/A
		Dislodgment 69
		Cardiac tamponade 45
		Catheter disruption 39
		Thrombotic 26
		Pleural effusion 17
		Intra-abdominal infusion 2
		Air embolism 1
		Intra-abdominal hemorrhage 1
		Vessel perforation 1
		Abscess 1
		Penile slough 1
		Adherence to vein 1

*Septic and embolic complications occurred with highest frequency, and their numbers were not tallied.

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