Bowdle, TA: Central Line Complications From the ASA Closed Claims Project: An Update. *ASA Newsletter* 66(6): 11-12 & 25, 2002.

Full Text

We previously reported on central line complications from the ASA Closed Claims Project in 1996 from a database of 3,533 claims of all types.1 There were 48 claims related to central venous or pulmonary artery catheters, including 20 fatalities. Seventy-five percent of the fatalities were due to cardiac tamponade or vascular injury. We have now undertaken re-evaluation of central line complications from the ASA Closed Claims Project, from a database of 5,475 claims of all types, including 75 claims related to central lines. Analysis of the claims reported since 1996 reveals some interesting differences from the previous analysis.

In this most recent analysis, we have divided the claims into two groups, those with clinical events occurring prior to 1990 and those occurring in 1990 or later [Table 1]. The set with event dates prior to 1990 corresponds very closely, although not precisely, to the claims that we reported on in 1996. (There is a lag time between the clinical event and the legal process that ultimately results in a closed claim.) A few cases have been added as the closed claims database has been refined, and a few cases have been excluded because the central line complication was due to the actions of someone other than the anesthesiologist, usually the surgeon.

Table 1: Overall Complications and Fatalities for the Periods 1978-89 and 1990 and Later

Complication	1978-89	1978-89 fatalities	1990 & later	1990 & later fatalities
Cardiac tamponade	10	8	2	2
Wire or catheter embolism	10	0	0	0
Vascular injuries	16	9	16	7
Hemothorax	6	6	5	3
Hydrothorax	3	1	1	1
Carotid artery injury	5	1	9	3
Subclavian artery injury	2	1	1	0
Pulmonary artery rupture	4	4	1	1
Pneumothorax	7	1	3	0
Air embolism	2	1	1	1
Fluid extravasation in neck	0	0	3	1
Total	**49**	**23**	**26**	**12**

In the analysis of closed claims with clinical events prior to 1990 (essentially our 1996 report), three classes of complications of central lines were most important: perforation of the heart with pericardial tamponade (10 out of 49 claims), catheter or wire embolism (10 out of 49 claims) and injury to veins or arteries other than the pulmonary artery (16 out of 49 claims). These complications accounted for 17 out of the 23 deaths.

Interestingly, the closed claims for central line complications with event dates of 1990 and later have a somewhat different distribution compared to those with event dates preceding 1990 [Figure 1]. Cardiac tamponade accounts for only two of 26 claims and catheter or wire embolism for zero out of 26. Unfortunately, injury to veins or arteries other than the pulmonary artery resulting in hemothorax, hydrothorax or injury to the carotid or subclavian arteries continues to be a major problem. Sixteen of 26 cases, including seven fatalities, were accounted for by this class of complication. As in the analysis from 1996, the inadvertent placement of a large-bore catheter or an introducer sheath into an artery instead of a vein was a prominent cause of morbidity and mortality.

Several methods have been used to distinguish vein from artery, including the subjective evaluation of the pressure of blood spurting from the needle, the color of the blood, assessment of blood gases, deliberate stimulation of arrhythmias by the guidewire and transduction of a pressure waveform. Some of these methods have major drawbacks. The subjective evaluation of the pressure of blood spurting from the needle depends upon the size of the needle, the pressure in the vessel and perhaps even the position of the needle bevel in the vessel. The color of the blood depends upon the ambient lighting and the characteristics of the syringe and the oxygen saturation. A high FiO2 may make venous blood appear very much like arterial blood, and conversely, hypoxemia may make arterial blood appear venous. Blood

gases may be helpful but are relatively impractical because of the time required to receive the result. The onset of arrhythmia with advancement of the guidewire into the heart is indirect evidence of venous placement but carries the hypothetical risk of inducing a potentially harmful arrhythmia or even of perforating the heart with the guidewire. By contrast, transduction of a pressure waveform safely and instantaneously identifies the vessel as artery or vein; only very rarely will there be any ambiguity in the recognition of arterial and venous waveforms.

Jobes et al. performed a retrospective review of 1,021 cases of internal jugular cannulation and found 43 cases of arterial puncture, five of which were unrecognized by blood flow and color criteria, resulting in inadvertent placement of 8.5 French introducer sheaths in the carotid arteries. One patient suffered a hemothorax and died.2 Subsequently they performed a prospective study of 1,284 patients using transduction of the pressure waveform to positively identify the vein.2 Arterial puncture was unsuspected in 10 patients until it was detected by inspection of the pressure waveform. Consequently there were no inadvertent arterial cannulations.

Compact, portable two-dimensional (2D) ultrasound devices also have proven useful in locating central veins and distinguishing them from arteries.3,4 A recent report from the Agency for Healthcare Research and Quality reviewed the clinical evidence related to the use of ultrasound for placement of central lines and concluded that ultrasound improved catheter insertion success rate, reduced the number of venipuncture attempts and reduced the number of complications.5 2D ultrasound is particularly useful when the internal jugular vein cannot be located easily and quickly using standard anatomical landmarks. However, consideration should be given to transducing a waveform even when the 2D ultrasound is used to identify the vein because the needle, which is nearly parallel to the ultrasound beam, is often not clearly seen in the ultrasound image.

Analysis of complications of central lines from the ASA Closed Claims Project confirms that the placement and use of central lines are associated with the possibility of serious morbidity or mortality. Fortunately, many of these complications may be preventable by positively identifying the vessel as a vein prior to inserting a wire or large-bore catheter. As in 1996, the author recommends examination of the pressure waveform as the most convenient and reliable method for distinguishing the vein and artery. 2D ultrasound devices also may be useful aids to locating the vessels and may help to reduce complications, especially in cases where locating the vein is difficult.

References

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