Citation

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Full Text

An anesthesiologist inserted a 14-gauge peripheral intravenous (I.V.) catheter into a patient's left antecubital fossa in preparation for coronary artery bypass graft surgery. Induction was uneventful, and the patient's arms were tucked. One liter of fluid and approximately 1.5 liters of cell saver were given via the 14-gauge I.V. After the four-hour procedure, the left arm and hand were found to be dusky and tense. The surgeon then performed an emergent fasciotomy. Despite the fasciotomy, the patient lost the ability to produce a strong grip. The case was settled with a payment to the patient of $75,000. Was this preventable?

Complications secondary to peripheral I.V. and arterial line catheters are a significant source of liability for anesthesiologists. These liabilities ranged from frivolous to morbid claims. The ASA Closed Claims Project database has been invaluable in identifying important anesthetic complications and mechanisms of injury.[1,2] The Closed Claims Project database consists of a standardized summary of data collected from 35 professional liability carriers insuring approximately one-half of practicing anesthesiologists in the United States. Complications specifically due to peripheral catheters were analyzed from the database from 1970 to 2001. Currently 140 claims for injuries are related to peripheral catheters (2.1 percent of 6,894 claims), with 127 I.V. claims (91 percent) and 13 claims related to arterial lines (9 percent).

Claims Related to Arterial Catheters (n = 13)

Arterial catheter claims involved radial (n = 7), femoral (n = 5) and brachial (n = 1) arteries and most frequently resulted from arterial thrombosis (31 percent) and iliac artery puncture (31 percent) [Table 1]. The claims associated with radial artery cannulation involved a retained catheter or wire (n = 2), radial nerve damage from multiple punctures (n = 2), arterial occlusion and hand ischemia (n = 2) (one in a smoker with severe peripheral vascular disease and another in a patient with Raynaud's syndrome) and carpal tunnel syndrome from a hematoma (n = 1). Of 13 arterial catheter claims, there were two pediatric claims (15 percent). The largest payments were the result of complications secondary to femoral arterial lines. In one pediatric case, a clot developed in the femoral artery, and the patient's limb required a subsequent amputation ($1.2 million). In another femoral arterial line case, the right iliac artery was lacerated secondary to the a-line placement ($10 million). The patient later developed hypotension postoperatively and eventually had a cardiac arrest. The patient survived after surgical intervention but suffered severe brain damage.

Table 1: Arterial Catheter Claims (n=13)

Arterial Catheter Complications	n	(%)
Iliac artery dissection/puncture	4	(31)
Clot/occlusion	4	(31)
Nerve damage	3	(23)
Retained catheter/wire	2	(15)
Location of Arterial Catheter		
Radial	7	(54)
Femoral	5	(38)
Brachial	1	(8)

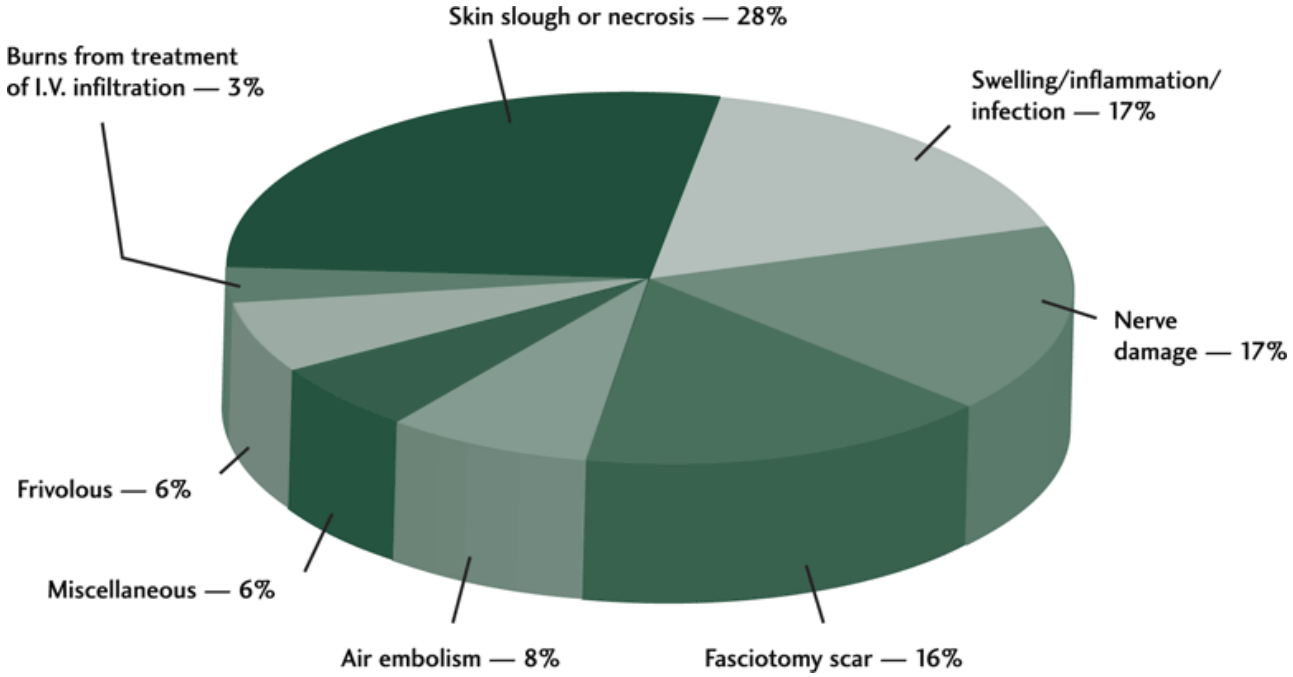
Claims Related to I.V. Catheters (n = 127)

The most common I.V. complications included skin slough or necrosis (28 percent) followed by swelling/inflammation/infection (17 percent), nerve damage (17 percent) and fasciotomy scars from compartment syndrome (16 percent) [Figure 1]. Burns due to heat compresses used to treat I.V. infiltrations accounted for 3 percent of claims [Figure 1].

Compartment Syndromes: Compartment syndromes accounted for 22 percent of all I.V.-related nerve damage cases. In addition, scars from fasciotomies for treatment of compartment syndromes also accounted for 16 percent of I.V. catheter claims. Many of these claims related to compartment syndromes involved cardiac cases in which the arms were tucked. Because of this, the anesthesiologist could not visually or tactilely monitor the peripheral I.V.

Skin Slough: The most common claim related to I.V. catheters involved skin slough or necrosis [Figure 1]. Of the reported drugs involved with skin slough, the most commonly reported drugs causing skin slough were thiopental (31 percent), vasopressors (11 percent) and calcium chloride (9 percent).

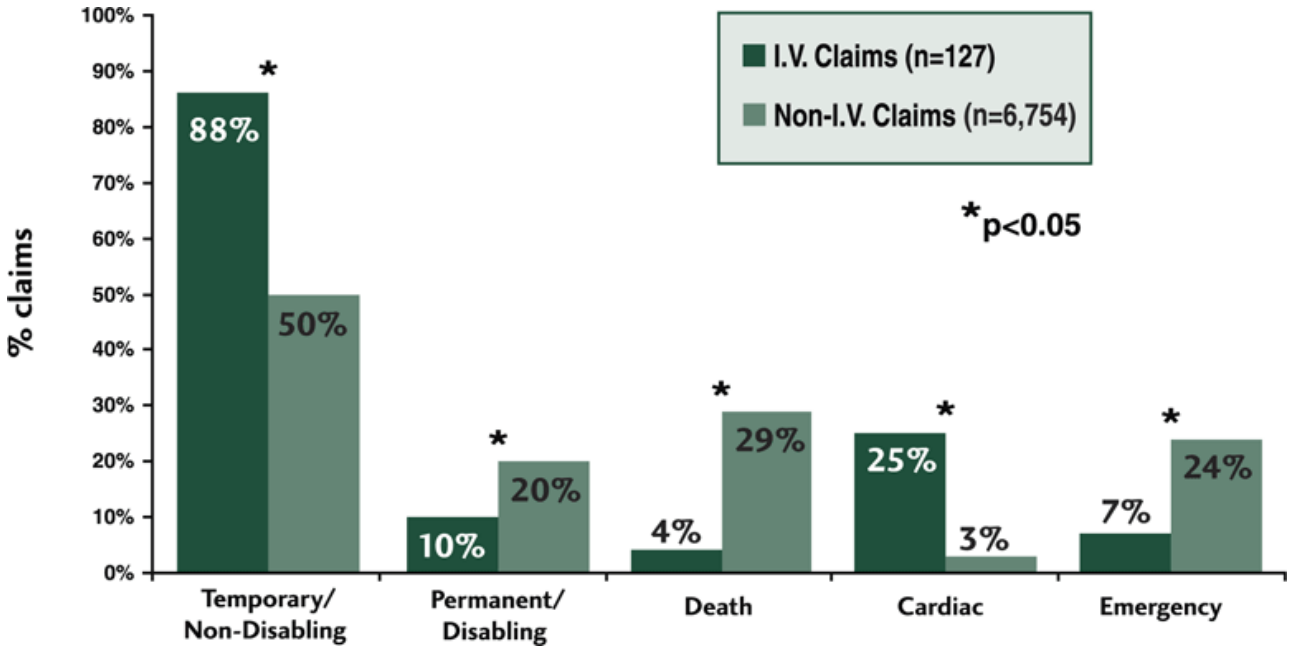
Figure 1: Intravenous Catheter Complications (n=127)



Patient and Case Characteristics

Claims for I.V. catheter complications were more likely to involve patients with ASA Physical Status scores of 3-5 compared to other claims ($p<0.05$). No statistically significant difference was found based on body habitus (obesity). I.V. catheter claims had a higher proportion of cardiac surgery and a lower proportion of emergency procedures than other claims [$p<0.05$, Figure 2]. Claims for I.V. catheter complications were more likely to involve temporary nondisabling injury than other claims [$p<0.05$, Figure 2].

Figure 2: Intravenous Catheter vs. Other Claims



Monetary Compensation

Roughly 54 percent of all peripheral catheter claims resulted in payment for injury. Monetary compensation ranged from $275 to $10,050,000 (median $38,400) [Table 2]. Claims related to air embolism had the highest median payment as well as a 100-percent payment-per-claim [Table 2].

Table 2: Outcome and Payment by Peripheral Catheter Complication

Complications	n	Number of Deaths	Number (%)* Claims Resulting in Payment	Median Payment†	Payment Range†
Arterial catheter	13	1	8 (62%)	$39,200	$7,800 - $10,050,000
Skin slough or necrosis	35	1	19 (58%)	$53,233	$1,680 - $123,826
Swelling/inflammation/infection	22	0	8 (38%)	$9,300	$275 - $35,397
Nerve damage	22	0	12 (55%)	$39,725	$3,100 - $973,250
Fasciotomy scar	20	0	9 (47%)	$34,375	$11,200 - $112,800
Air embolism	10	4	8 (100%)	$260,000	$20,800 - $3,302,700
Burn from treatment of I.V. infiltration	4	0	3 (75%)	$60,800	$16,000 - $168,000
Frivolous	7	0	1 (14%)	$8,000	$8,000 - $8,000
Miscellaneous	7	0	4 (57%)	$55,850	$832 - $9,300,000
Total	**140**	**6**	**72 (54%)**	**$38,400**	**$275 - $10,050,000**

** Claims with missing payment data were excluded from the calculation of percentages.* *† Payment amounts were adjusted to 1999 dollars using the consumer price index.*

Discussion

Complications secondary to I.V. catheters cause significant injuries to patients and financial liability to practicing anesthesiologists. Although limits inherent to the Closed Claims Project exist,[2,3] this analysis of peripheral catheter complications has identified important mechanisms, demographics and types of complications.

Skin slough cases had the highest percentage of I.V. catheter claims. Thiopental was the most commonly reported drug in skin slough claims. As the use of thiopental as an induction agent declines, claims related to skin slough may show a proportionate decrease. Also an easily avoidable complication of thrombophlebitis/swelling is burn injury due to heat compresses. Claims due to air embolism had the highest median compensation and a 100-percent rate of payment-per-claim. This also is likely due to substandard care and the preventable nature of air embolism. Several of these resulted from air in the blood from the cell saver.

Because of arm tucking and the resulting inability to monitor I.V. lines during cardiac cases, this group represented the largest single case type. In the opening vignette, the anesthesiologist was found liable in that cardiac case. According to the claims file, there were no reports of signs of an infiltrating I.V. other than post facto visual and tactile inspection. Although the anesthesia provider's care was found to be appropriate by peer review, the claim nevertheless resulted in payment. There were other cases of compartment syndrome in which there were warning signs of infiltration such as a slowly dripping I.V. Perhaps a low threshold to visually check the arms when the I.V. is dripping slower than normal is the best defense against I.V. infiltrations and compartment syndromes.

There were surprisingly few claims for arterial catheters, although some of the largest payments were due to complications from femoral arterial cannulation. Our findings of limited liability associated with radial arterial cannulation is consistent with prospective reports of the safety of radial artery cannulation.[4] Although partial or complete radial artery occlusion after decannulation

occurred in a quarter of almost 1,700 patients, no ischemic damage to the hand or disability occurred in any of the patients. In contrast, liability associated with femoral lines may be greater.

Previous studies have shown the beneficial effect of analysis of the Closed Claim Project database.[1,2,3] Although it cannot be used for establishing cause-and-effect relations,[3] patterns of injury in this study of peripheral catheter complications have identified important preventable patient complications such as air embolism, burn injuries due to heat compresses for infiltrations/thrombophlebitis and compartment syndromes.

References

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