



# A Case Report From the Anesthesia Incident Reporting System

Detailed review of unusual cases is a cornerstone of anesthesiology education. Each month, the AQI-AIRS Steering Committee will abstract a case and provide a detailed discussion based on a submission to the national Anesthesia Incident Reporting System. Feedback regarding this item can be sent by email to [r.dutton@asahq.org](mailto:r.dutton@asahq.org). Report incidents to [www.aqiairs.org](http://www.aqiairs.org).

## Case 2013-4: Mis-Infusion Confusion

A 12-year-old girl presented for spinal fusion. Past history was significant for thrombocytopenia, but otherwise unremarkable. A hematology consultant recommended perioperative infusion of aminocaproic acid, which was obtained from the pharmacy while preparing the operating room. Following uneventful induction of general anesthesia and placement of a left radial arterial line, the provider could not find the aminocaproic acid infusion bag and requested another. The surgical procedure was uneventful, and the aminocaproic acid was administered by intravenous bolus

and subsequent infusion as planned. Blood loss for the procedure was within expected limits.

On arrival to the PACU, the patient's nurse noted aminocaproic acid in the arterial line pressure infusion bag. This was replaced with an infusion of normal saline with heparin. The patient's arm was assessed for signs of ischemia, and consultation with a vascular surgeon was requested. There were no signs of injury and no evident impairment of coagulation. The patient's subsequent course was uneventful.

**Table 1: Side-effects of intra-arterial injected anesthetic drugs, sorted by pH.** Used with permission from: Fikkers BG, Wuis EW, Wijnen MH and Scheffer GJ. Intra-arterial injection of anesthetic drugs. *Anesth Analg*. 2006;103:792-4.

Drug	Side Effect	Solvent	pH	References
Propofol	Hyperemia, Distal Blanching	Soya Oil		(9,10)
Midazolam	None reported	Aqueous <sup>b</sup>	3	(11,12)
Atropine	None reported	Aqueous <sup>c</sup>	3-6	(13)
Atracurium	Ischemia	Aqueous <sup>b,d</sup>	3.3-3.7	(14,15)
Succinylcholine	None reported	Aqueous <sup>b,c</sup>	3.5	(15)
Ketamine	Necrosis	Aqueous	3.5-5.5	(16)
Pancuronium	None reported	Aqueous <sup>b</sup>	4	(5)
Fentanyl	None reported	Aqueous	4-7.5	(5,7)
Thiopental	Ischemia, Necrosis and Death	Aqueous	10.5	(8)
Phenytoin	Ischemia, Necrosis and Death	Propylene Glycol	11-12	(17)

<sup>a</sup> Differences between countries/pharmaceutical companies may exist.

<sup>b</sup> Vials may contain benzyl alcohol.

<sup>c</sup> Vials may contain paraben.

<sup>d</sup> Contains benzenesulfonic acid.

**Table 2: Symptoms of intra-arterial injections over time.** Adapted with permission from: Sen S, Chini EN, Brown MJ. Complications after unintentional intra-arterial injection of drugs: risks, outcomes, and management strategies. Mayo Clinic proceedings Mayo Clinic. 2005; 80:783-795.

Symptom	
Pain on injection Flushing Numbness Weakness	Initial Injection
Nail bed Pallor Decreased capillary refill	30 minutes–2 hours
Skin mottling Cramping Phlebitis Paresthesias Motor Deficit	Within 24 hours
Muscle Swelling Digital Edema Ischemic contractures Functional hand deficits	24–36 hours
Symptoms of compartment syndrome	Within 48 hours
Permanent contractures Clinical and laboratory evidence of rhabdomyolysis	Within 1 week
Necrosis Gangrene Autoamputation	10–14 days

### Discussion: Inadvertent Arterial Infusion

Inadvertent arterial injection has been reported since the 1940s and occurs from one in 3,440 to one in 56,000 cases.<sup>1-3</sup> These injections can occur for a variety of reasons, including but not limited to: unrecognized placement of a venous line in an artery; mislabeling of invasive catheters; connection of an infusion to an arterial stopcock; mislabeled infusions or pressure bags; time pressure of emergency procedures; and patient risk factors such as obesity, dark pigmented skin and vascular anatomic variation.<sup>3-5</sup> There can be very brief exposures to the injectate or very long exposures, as when a central venous line is inadvertently placed in an artery. This can easily occur during trauma management or

in patients with difficult vascular access. To date, it is not clear if widespread use of ultrasound during line placement will decrease the risk of this occurrence. There have been several other safety initiatives instituted to address this issue, including mandatory catheter labeling and protocolized communications during at-risk procedures.<sup>6</sup>

In the case where an inadvertent injection has occurred, assessing the severity of the potential injury to the patient and the ultimate outcome can be dependent on many factors. Some of these include the location of the injection, the type of medication incorrectly administered, and the speed and duration of injection.<sup>5</sup> In the present case, the arterial infusion of aminocaproic acid likely occurred at a low rate over the entire O.R. course, amounting to 50-100 ml of additional aminocaproic acid. This amount of overdosing would not likely be harmful, but the implications of erroneous arterial infusion are of greater concern.

Symptoms of injury can vary considerably, according to what was injected, and some may be masked by general or regional anesthesia. Substances associated with severe complications include benzodiazepines, radiographic contrast, phenothiazines, barbiturates, amphetamines, antibiotics, muscle relaxants, phenytoin, parenteral nutrition, sodium bicarbonate and dextrose.<sup>5</sup> An important component of this complication is the pH of the injectate. Table 1 illustrates the side effects of arterial mis-infusion of several common anesthesia drugs.

An essential part of addressing an inadvertent intra-arterial injection is assessing the severity of the symptoms and the timeframe in which they appear. The spectrum of symptoms is wide, as highlighted in a summary of unintentional intra-arterial injections that appeared in Mayo Clinic Proceedings (Table 2).<sup>5</sup>

Once an intra-arterial injection has occurred, there are a variety of treatment steps. First, if the event was an iatrogenic injection in a known arterial line, the catheter should be left in place. The catheter provides direct access to the artery for additional diagnostic tests or treatment.<sup>5</sup> The next step is to identify progression of injury. After assessment of the symptoms and the substance injected, anticoagulant therapy may be initiated. The decision to initiate anticoagulation is best made in conjunction with a vascular consultation team, with a risk-benefit analysis based on the symptoms, substance and overall patient condition. There are very little evidence-based data available to guide therapy, so most treatment recommendations are on the basis of pathophysiologic reasoning and consensus experience. Other treatment modalities can improve symptoms or outcomes, such as elevation of the extremity, massage, local anesthetic

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infiltration and sympathectomy. Other medication-specific interventions include administration of arterial vasodilators, thromboxane inhibitors, iloprost, papaverine, selective thrombolytics, hyperbaric oxygen and corticosteroids.<sup>5</sup>

## Conclusions

The case under discussion carried a significant potential for disaster. The fact that the arterial infusion was very slow, combined with the relative dilution and non-toxicity of aminocaproic acid, led to a fortunate lack of harm. Human factors contributing to this error include the obvious time pressure of preparing an operating room for a complex case, the similarity of size and labeling of the aminocaproic acid to the normal heparinized saline infusion, and the compatibility of arterial and venous infusion equipment. In reviewing the event, the anesthesia team considered these factors, as well as the obvious need to check the arterial infusion set-up from top to bottom when first attaching it. They felt a question should have been raised when the original aminocaproic acid infusion bag could not be located.

One other question, not answered by the AIRS reporters, was what happened to the infusion bag originally intended for the arterial line, and whether this could have provided another clue to earlier detection.

## References:

1. Macintosh RR, Heyworth PSA. Intra-arterial injection of pentothal. *Lancet*. 1943;242(6271):571.
2. Fikkers BG, Wuis EW, Wijnen MH, Scheffer GJ. Intraarterial injection of anesthetic drugs. *Anesth Analg*. 2006;103(3):792-794.
3. Stone HH, Donnelly CC. The accidental intraarterial injection of thiopental. *Anesthesiology*. 1961;22(6):995-1006.
4. Kjaergaard M, Rosing ML. Accidental intra-arterial propofol injection [in Danish]. *Ugeskr Laeger*. 2010;172(18):1383-1384.
5. Sen S, Chini EN, Brown MJ. Complications after unintentional intra-arterial injection of drugs: risks, outcomes, and management strategies. *Mayo Clin Proc*. 2005;80(6):783-795.
6. Santhirapala R, Carter JJ, Young PJ. Safer arterial access. *Med Device Technol*. 2009;20(6):36-37.

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