

Unintended Intra-arterial injection of Propofol

Case presentation

A child presented for a dental extraction and was initially allowed to breathe nitrous oxide with oxygen whilst a venous cannula was inserted. The type of cannula inserted had a new feature named 'Blood Control (BC)' which is an automatic check valve, designed to stop the flow of blood after the trochar is removed. The cannula is almost identical to another cannula from the same company without the 'Blood Control' feature. There were no difficulties noted during the insertion of the cannula but shortly after the injection of propofol during induction there was sudden severe pain in the arm. It was assumed that an intra-arterial injection of propofol had occurred. The induction was completed with sevoflurane and the cannula re-sited. In stage 2 recovery the patient reported a burning pain down the arm (i.e. distally from the injection site towards the hand) when going to sleep. There was no evidence of ischaemic changes following the injection. Even though intravenous propofol in a small vein can also cause pain up the arm, which is sometimes severe, the anaesthetist submitting the report believed that this was an intraarterial injection.

Other cases in the webAIRS database ^(1, 2)

The webAIRS data ⁽¹⁾ was interrogated and there were nine other cases of suspected unintentional arterial injection identified in the database. One of these was a suspected intraarterial injection by an oral surgeon and this will be analysed separately as it is a different aetiology. This leaves eight for analysis in this report.

| Case | Status | Cannula type | Location | Used for injection | Substance and outcome |
|------|---------------------------|--|---------------|--------------------|---|
| 1 | Confirmed with transducer | 18g Insyte Autoguard with BC | Dorsum Hand | Yes | Intraoperative drugs and fluids. No harm. |
| 2 | Confirmed visually | Not specified | Not specified | Yes | Antibiotics and propofol. Pain but no other harm. |
| 3 | Suspected | Insyte Autoguard with BC | ACF | Yes | Propofol. Pain but no other harm. |
| 4 | Confirmed visually | Not specified. One-way valve attached. | ACF | Yes | Propofol and suxamethonium. No harm. |
| 5 | Confirmed visually | Not specified. | ASB | Yes | Vancomycin via infusion pump. Temporary Harm. |
| 6 | Confirmed visually | Not specified. | ACF | No | Recognised when connected to iv fluids. No harm. |

| | | | | | |
|---|---------------------------|-------------------------|---------------|-----|----------------------------------|
| 7 | Confirmed with ultrasound | PICC line | ACF | Yes | TPN. No harm. |
| 8 | Confirmed visually + ABG | IA cannulation using US | Not specified | No | Recognised immediately. No harm. |

* Abbreviations: Intra-arterial - IA. Ultrasound - US. Arterial Blood Gases - ABG. Blood Control Valve - BC. Anterior Cubital Fossa - ACF. Anatomical Snuff Box - ASB. Total Parenteral Nutrition - TPN. Peripherally Inserted Central Catheter - PICC.

In four cases the ante-cubital fossa (ACF) was the site of the cannulation and in a fifth case it was the anatomical snuff box (ASB) in the hand⁽³⁾.

The anatomical snuff box (ASB) and the ante-cubital fossa (ACF) are both a high risk for inadvertent arterial cannulation. In six of the eight cases the cannula was used for injection before it was recognised to be intra-arterial. The three cases involving propofol did not exhibit signs of temporary ischaemia but the case of vancomycin showed duskeness for 10 minutes followed by redness which was treated with a heparin infusion. TPN was infused in one case and unspecified intraoperative drugs plus fluids in the other case. Temporary harm was noted in three cases. Two cases extracted had pain in the limb after anaesthesia and one experienced ischemia. In the other cases no harm was apparent at any stage. None of the cases experienced permanent harm.

Risk factors identified

In these cases there were two main risk factors that were identified. The first was the proximity of an artery to the cannulation site (ACF). The second was that the use of a one-way valve or a check valve that might have prevented recognition of a greater than usual backflow of blood. It is also not unusual for a well perfused child to have venous blood that resembles arterial blood in colour.

What we already know

- Arterial anatomy in the upper limb is variable
- Intra-arterial injections may cause blockage of distal vasculature ^(4, 5)
- Ischaemia or necrosis of distal tissue might require debridement, skin grafting or amputation of areas affected
- 5% thiopentone solution has been known to cause ischaemia or gangrene. The 2.5% solution appears to be safer
- Intra-arterial injections of propofol may cause distal pain but there do not appear to be any reports of tissue or limb loss ⁽⁶⁾
- Intra-arterial injections of benzodiazepines appear to have a high risk of morbidity ^(4,5)
- Propofol injection can cause severe pain in a small vein

What is new in this report

There were two reports involving a check valve incorporated into cannula design which might obscure a warning sign that the cannula is intra-arterial ⁽⁵⁾. The manufacturer was contacted for a response and supplied the following information.

'The IV catheter that was used on this patient had a blood control valve mechanism to reduce risk of blood exposure. This valve is designed to prevent blood leakage from the IV catheter for 10 seconds after venous insertion with normal venous pressure. It will not stop blood leakage at pressures higher than 60-70 mmHg. This means that at arterial pressures with a systolic pressure greater than 70 mmHg, the blood control system does not prevent leakage.'

However, the lower limit of normal blood pressure for a child is 97 mmHg with a range of 97-155. Also, the application of a venous tourniquet proximally would reduce the distal arterial pressure and if the catheter tip was against the wall of the artery then this would also reduce the pressure at the blood control valve. There is also the possibility that the opening pressure of the valve might be higher than the design pressure due to variability during manufacture.

The second point noted in this series of case reports was that a one-way valve in the intravenous line or attaching a device to a syringe driver or a small diameter catheter such as PICC line, also have the potential to obscure a flashback of bright red pulsatile blood indicating arterial cannulation.

Discussion

Propofol injection causing severe pain could be experienced with an intravenous injection. However, in the initial case reported, the pain was from the injection site to the periphery whereas, normally, pain with intravenous propofol is from the injection site up the arm. Inadvertent intra-arterial injection is an uncommon event and there is no definitive evidence-based protocol for management of which the authors are aware. There is a systematic review which gives detailed information of the current knowledge regarding these events⁽⁴⁾. There is also an article describing complications that might arise⁽⁵⁾. All of the medications that were injected in this series were a low risk for harm after injection other than pain, and no patient suffered from any permanent sequelae.

Lessons that might be learnt for future cases

It may be difficult to detect arterial cannulation when using devices with back check valves (cannulas), one-way valves, or pumps in the intravenous delivery system.

Anaesthetists should have a high index of suspicion if a patient complains of distal pain, or duskiness, on injection. Areas of high risk include, but are not limited to, the ante-cubital fossa and the anatomical snuff box of the hand.

References

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