Journal of Emergency Medicine
Case Reports

J Emerg Med Case Rep 2016 | DOI: 10.5152/jemcr.2016.1677

Use of Continuous Brachial Plexus Blockade for Treatment of Accidental Intra-Arterial Injection

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ABSTRACT

Introduction: Unintentional intra-arterial injection of drugs has serious problems and morbidity such as pain, ischemia, gangrene, and infection. Aberrant vascularization is a frequent cause of intra-arterial injection.

Case Report: We describe a pediatric case of accidental cannulation of aberrant arterial vessel during venous insertion and our brachial plexus block treatment to obtain continuous vasodilatation to prevent ischemic effects.

Conclusion: Sympatholysis with peripheral nerve blocks may decrease morbidity providing an additional benefit to pharmacological treatment by increasing blood flow to the tissue after the intra-arterial injection.

Keywords: Pediatric, intra-arterial injection, brachial plexus block

Received: 01.03.2016 **Accepted:** 16.06.2016 **Available Online Date:** 24.10.2016

Introduction

Accidental intra-arterial drug injection can cause serious ischemia and tissue necrosis. These kind of events are particularly reported during the intravenous application to the antecubital fossa vessels into aberrant branch of artery or during arterial line insertion (1). Vasodilatation with drugs and peripheral nerve block are suggested effective methods to prevent ischemia and side effects (2, 3).

We report an unintentional arterial injection and our management strategy with continuous peripheral nerve blockade in addition to pharmacological therapy.

Case Report

After patient consent was obtained, a 12-year-old 25-kg female patient was scheduled for endoscopic esophagus dilatation following colon transposition and stricture. A regular balloon dilatation procedure was planned for the patient. Electrocardiogram, oxygen saturation, and noninvasive blood pressure monitoring were applied in the operating room. The patient received inhalation induction with sevoflurane (Adeka, Samsun, Turkey), oxygen, and nitrous oxide mixture. A 22-G cannula was inserted in an easily visible vessel on the ventral part of the left hand. After the sufficient blood flow was obtained thiopental (İE Ulugay, İstanbul, Turkey) 1.5 mg/kg and atracurium (GSK, Parma, Italy) 0.5 mg/kg were administered. The patient was intubated, and anesthesia maintenance was performed with sevoflurane (Adeka, Samsun, Turkey), oxygen, and nitrous oxide mixture. The cannula was connected with 250 mL saline of infusion system. It was observed that there was a back flow of blood to i.v. tubing. The patient's hand swelled and became cyanotic in a short time. Blood sample was taken for blood gas analysis, and invasive monitoring was performed for confirming the arterial placement. A typical arterial wave was obtained from the monitor. The blood gas analysis revealed pH 7.35, PCO_2 35 mmHg, and PO_2 250 mmHg. The infusion was stopped, and 40-mg lidocaine and low-molecular-weight heparin was administered; then cannula was removed. We decided to perform the interscalene block for increasing the blood flow in the hand with sympathetic vasodilatation. The block was performed with 10 mL 0.5% bupivacaine diluted to a total volume of 20 mL 0.9 % sodium chloride solution. The hand edema had diminished in short time and discoloration was becoming normal. After the procedure to maintain the sympathetic block, an axillary catheter was inserted because

This study was presented at the 48th National Congress of Turkish Society of Anaesthesiology and Reanimation, 25-29 October 2014, Ankara, Turkey.

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of the failure of interscalene placement. A continuous infusion was prepared with 0.125% bupivacaine with 3 mL/hour for venodilatation and arterial dilatation for 24 hours.

Discussion

Iatrogenic intra-arterial injection of drugs has been reported since the 1940s (4). These drugs were mostly barbiturates and benzodiazepines (5). Unintentional intra-arterial injection may result both acute and chronic ischemic changes. Many factors are also thought to be responsible for symptoms. These are drug-mediated arterial spasm leading to vasoconstriction and thrombosis by release of epinephrine or endogenous substances. The other possible mechanisms are chemical arteritis and tissue destruction of endothelium, subendothelium, or muscle layers of vessel (1, 6, 7).

Thiopental is one of the first and most risky drugs in which severe damage and limb loss was described (8). It was demonstrated that it had toxic effects to the vascular endothelium even in lower concentration, with strong alkaline property, crystal formation of thiopentone precipitate due to changes in pH when injected into artery (1, 7). Several other accidental intraarterial anesthetics injections have been published, although ischemic and necrotic changes were reported with high lipid-soluble drugs such as propofol, diazepam, and etomidate (2). More hydrophilic drugs such as fentanyl, midazolam, atropine seems to be safer for intra-arterial effects (1). Another dangerous drug for intraarterial injection is atracurium. Local extremity cooling and mottling but not irreversible ischemic changes were reported after the injections (7).

In our case, the arterial injection of thiopental and atracurium were accidently applied from the superficial ventral area of the hand. The anatomical location is important to inadvertent injections. Antecubital fossa is a potentially dangerous area for accidental injections (1). The radial artery abnormality is the most common arterial variation of the upper limb. The superficial radial arteries in the forearm and hand are found in 1% of all cases. The arterial injection can cause severe pain, but we started anesthesia induction with inhalation agent. We determined the arterial injection with discoloration, edema in the hand, and arterial wave forming in the monitor. Signs of arterial cannulation include absence of pulsation, pallor, distal signs of ischemia, cyanosis of the affected limb, and severe pain during cannulation. The most important index is suspicion and being alert during cannulation for anatomical location, presence of pulsatile movement of blood, signs of ischemia, bright color of blood, and severe pain during injection. Monitoring for arterial waveform and arterial blood analyzing may support certain recognition of arterial cannulation. Keep the cannula may be a practical approach for administration of the rescue medications and blood sampling to verify the arterial insertion

Because of the various possible mechanism of the pathophysiology, there was no preferential specific treatment. Reducing the arterial vasospasm, maintaining the blood flow, treating the eventual chronical ischemic impact of the tissue such as necrosis, gangrene, infection should be main goal of the therapy (1, 7).

Anticoagulant administration is an important step of early treatment for intra-arterial injection to prevent thrombosis, although no consensus exists for initial and bolus doses of heparin (7). It was reported that fibrin formation begins within hours in early period and continuous for 4 to 5 days. Decreasing fibrin and thrombin formation with heparin and dextran with elevation of the extremity to avoid the venous congestion are suggested methods for clinical and pharmacological treatment (3).

Arterial vasodilators (reserpine, papaverine, tolazoline), specific thromboxane inhibitors (methimazole, iloprost), and nonspecific thromboxane inhibitors (aspirin, methylprednisolone) are also recommended to prevent edema, thrombosis, and vasospasm (6).

Although papaverine, tolazoline, and reserpine are good vasodilators, they have side effects in large doses and are less effective than sympatholysis (3).

Sympatholysis with peripheral nerve blocks provides arterial and venous vasodilation and attenuates reflex vasospasm. This effect increases tissue perfusion and, at the same time, relieves ischemic pain. Many authors reported different types of sympatholysis such as axillary plexus blocks, stellate ganglion blocks, and even a caudal block was preferred to avoid the complications of femoral arterial injection (7, 9).

We performed interscalene block urgently after the injection. The recovery of the hand with reducing the edema and discoloration was remarkable in minutes and we decided to insert continuous catheter to start the local anesthetic infusion. The catheter stayed for 24 hours with patient. After the infusion was stopped there was no neurological damage, motor weakness, or ischemic changes.

The tissue damage after the intra-arterial injection may have different exact mechanism but thrombosis is playing major role at the clinical outcome (1, 7). The continuous sympathetic blockade with a catheter may be an effective additional technique to the pharmacological treatment. Arterial vasospasm and following potential ischemic side effects are alleviated with increasing blood flow to the tissue.

Conclusion

Inadvertent intra-arterial injection is a medical emergency, it can be seen either in the operating room or emergency services. Careful observation, being alert and suspicion of the blood colour and pulsatile appereance are the important steps of arterial injection recognition. ABG, monitoring and Doppler check also can help the establishment of the diagnosis and progress. The brachial plexus block may be a convenient additional therapy to maintain tissue perfusion combined with anticoagulants and vasodilators drugs after the intra-arterial injection.

Informed Consent: Written informed consent was obtained from patients' parents who participated in this study.

Peer-review: Externally peer-reviewed.

Author contributions: Concept - A.Ç.T., G.K., P.K.; Design - A.Ç.T., P.K., F.A., G.K.; Supervision - A.Ç.T., F.A., G.K.; Resource - A.Ç.T., F.A., G.K.; Materials - A.Ç.T., F.A., G.K.; Data Collection and/or Processing - A.Ç.T., F.A., G.K.; Analysis and/or Interpretation - A.Ç.T., F.A., G.K.; Literature Search - A.Ç.T., F.A., G.K., P.K.; Writing - A.Ç.T., F.A., G.K., P.K.; Critical Reviews- A.Ç.T., F.A., G.K., P.K.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

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