Severe refractory hypertension during shoulder arthroscopy

ABSTRACT
The use of epinephrine-containing saline irrigating solutions during arthroscopic shoulder surgery gained popularity after it was reported that the addition of epinephrine reduced bleeding and improved visualization without adverse cardiovascular effects. We share a case of a patient undergoing shoulder arthroscopy who received a standard intra-articular infusion of epinephrine-containing normal saline (1 mcg/mL) and experienced severe hemodynamic consequences.

Key words: Epinephrine-containing irrigant, refractory hypertension, inadvertent epinephrine administration, shoulder arthroscopy

Introduction
The use of epinephrine-containing saline irrigating solutions during arthroscopic shoulder surgery gained popularity after Jensen et al. reported that the addition of epinephrine reduced bleeding and improved visualization without adverse cardiovascular effects. We share a case of a patient undergoing shoulder arthroscopy who received a standard intra-articular infusion of epinephrine-containing normal saline (1 mcg/mL) and experienced severe hemodynamic consequences. This is unique in that no case reports exist in which this has occurred in the absence of intraosseous injection or inappropriately prepared irrigant.

Case Report
A 52-year-old, 90 kg man was scheduled for shoulder arthroscopy for repair of a right rotator cuff tear. His past medical history was significant for:
1. Obstructive sleep apnea,
2. Hypothyroidism, and
3. Mild gastroesophageal reflux.

The patient had undergone the three prior surgeries and reported no problems with anesthesia. At 11:10, he received an uneventful preoperative interscalene block with 30 ml of 0.5% ropivacaine with 1:300,000 epinephrine using nerve stimulation and ultrasound guidance.

At 11:46, induction of general anesthesia was performed with intravenous fentanyl (75 mcg), lidocaine (80 mg), propofol (200 mg), and intubation was facilitated with rocuronium (50 mg). The patient was intubated without difficulty and general anesthesia was maintained with isoflurane (at 0.8-1%) in O2 and air. After induction, the patient’s blood pressure (BP) and heart rate (HR) were 150s/70s and 80s, respectively. The surgical incision was made at 12:36 and shortly thereafter the patient’s BP decreased to the 70s/30s with a HR in the 40-50s. A total of two doses of intravenous ephedrine (10 mg and 5 mg) and glycopyrrolate (0.4 mg)
were administered without achievement of normotension. At 13:02, a continuous intravenous phenylephrine infusion was started at 0.2 mcg/kg/min and the patient’s BP and HR returned to baseline values by 13:05.

At 13:20, with an end-tidal isoflurane concentration of 0.87%, surgical irrigation for arthroscopy was initiated. The patient’s BP abruptly rose to 229-234/111-116 with a sinus tachycardia of 115-125 bpm. The phenylephrine infusion was discontinued and an evaluation of potential causes was undertaken. The patient received a total of 2 mg of midazolam, two doses of propofol (30 mg and 40 mg), two 30 mg doses of esmolol, and the end-tidal concentration of isoflurane was increased to (1.4%) with minimal change in BP or HR.

At 13:34, it was noted that the surgeon’s arthroscopic infusion solution contained epinephrine. The solution consisted of a standard mixture of 3 ml of epinephrine 1:1000 (1 mg/ml) added to a 3 L bag of normal saline (final epinephrine concentration = 1 mcg/ml). The anesthesia team requested that the epinephrine-containing solution be discontinued immediately. At 13:36, with the patient’s BP 253/127 and HR 117, the irrigation infusion was discontinued after approximately 2 L had been infused. At 13:39, with no other anesthetic or surgical changes, the patient had a BP of 97/53 and HR of 83. The case was completed using an epinephrine-free irrigation infusion and no further hemodynamic irregularities were observed. The original irrigation solution was analyzed by our hospital laboratory and was confirmed to contain the standard 1 mcg/ml of epinephrine.

**Discussion**

Differential diagnoses for this marked hypertension and tachycardia during shoulder arthroscopy included inadequate anesthetic depth, medication error (in either the irrigation solution or anesthetic medications), malignant hyperthermia, local anesthetic toxicity, and direct intravascular infusion of the irrigation solution. Inadequate depth of anesthesia was unlikely as the patient had a functional interscalene block and his hyperdynamic state was minimally responsive to a combination of midazolam, propofol, and a supra-minimum alveolar concentration level of isoflurane. Although tachycardia and hypertension can be presenting signs of malignant hyperthermia, this patient did not exhibit a significant increase in end-tidal carbon dioxide, muscle rigidity, or elevated temperature. Hypertension and tachycardia can also be a result of local anesthetic toxicity, but this was highly unlikely secondary to the timing of the symptoms: Onset over an hour after the interscalene block. The timing of the event also makes it unlikely that the hemodynamic changes were a result of an anesthetic medication error as, if an infusion of epinephrine had been administered instead of phenylephrine, the hemodynamic effects would not have taken 15 min to manifest.

There are two case reports documenting suspected epinephrine-induced arrhythmias during arthroscopic shoulder surgery. The first, described by Karns,[2] reports an abrupt onset of ventricular tachycardia following likely intraosseous injection of epinephrine-containing irrigation solution after a trocar injury to the posterior humeral cortex. The second report, by Cho et al.,[3] described two cases of ventricular tachycardia when the concentration of epinephrine in the irrigating solution was changed from 0.3 ml of epinephrine in a 3 L bag of normal saline to the same dose in a 1 L bag of normal saline. The assumption in these cases was that the epinephrine was not mixed properly, and highly concentrated epinephrine was infused rapidly into the joint space.

In our case, there was no bone trauma during trocar placement and the epinephrine-containing irrigant was a lab-verified standard concentration of 1mcg/ml hung from the typical height. This case of a 52-year-old man who developed severe refractory hypertension and tachycardia secondary to the intra-articular infusion of a standard epinephrine-containing solution during shoulder arthroscopy highlights the importance of constant vigilance during cases in which such infusions are used.

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**Conflicts of interest**

There are no conflicts of interest.

**References**

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