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CASE REPORT

Lower Extremity Peripheral Nerve Blocks for Post-operative Pain Control in a Multi-trauma Patient With Brugada Syndrome: A Literature Review and Case Report

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Abstract

We describe the case of a 28-year-old man with Brugada syndrome who received single-shot adductor canal and sciatic nerve blocks for the management of post-operative pain related to extensive orthopedic injuries. Low-dose ropivacaine with glucocorticoid additives was administered without any EKG changes, arrhythmias, or syncopal sensations. The patient experienced pain relief for over 24 h and was monitored on telemetry with defibrillator pads as a cardiac precaution. This case adds a valuable data point in the limited canon of information on the safety and efficacy of regional anesthesia in Brugada syndrome for the perioperative physician.

Keywords: Anesthesiology, Regional anesthesiology, Peripheral nerve blocks, Brugada syndrome, Peri-operative medicine, Orthopedic surgery

1. Introduction

Brugada syndrome is a genetic cardiac conduction abnormality that affects cardiac sodium channel transport and may result in sudden cardiac death.[1,2] Intraoperative anesthetic management of patients with Brugada syndrome is a complex issue that requires careful medication selection and titration. Regional anesthetic techniques are a viable alternative to the risks of general anesthesia in this population but have been used sparingly due to the dangers of sodium channel blockade from local anesthetics as well as the significant cardiotoxicity profiles of drugs such as bupivacaine. There is nominal data on regional techniques in Brugada syndrome, all of which derives from primary case reports. Here, we present the case of a young man with Brugada syndrome who required regional anesthetic intervention for the management of intractable post-operative pain and highlight our careful anesthetic planning.

2. Case presentation

A 28-year-old man with a history of Brugada syndrome presented to the trauma resuscitation unit after a head-on motor vehicle collision (MVC) resulting in a traumatic cardiac arrest, pericardial tamponade, SVC injury, right lung contusions, a right tibial plateau fracture, a right femoral condyle fracture, right talus and calcaneus fractures, and right-sided rib fractures. After approximately two weeks of intervention and treatment, the patient was extubated to room air and documented to be at his baseline mental status. Subsequently, the patient complained of constant and intractable right lower extremity pain (RLE) that travelled from his knee to the sole of his foot. Prior to his complaint, the patient had undergone six RLE procedures with orthopedic surgery during the admission, including an external fixation, 4-compartment fasciotomy, and several incision and drainage (I&D) procedures. The regional anesthesiology team was consulted at this point for further interventional management.

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On interview, the patient reported that he was diagnosed with Brugada syndrome as a child after a syncopal episode. A pediatric cardiologist routinely saw him at an out-of-state hospital facility through the age of 18 when he was subsequently lost to follow up. There was no further history of syncopal episodes or sudden cardiac arrests. He had never been treated with medication, undergone a pharmacological challenge, or had an implantable cardioverter-defibrillator (ICD) placed. No genetic work-up could be located nor had he undergone surgery of any kind prior to this admission. A 12-lead EKG was performed at the time of interview and showed possible "coved-type" ST elevations, most notably in lead V3, but was not completely consistent with either type I or type III Brugada syndrome (Fig. 1).

After careful literature review and discussion with both the patient and the orthopedic surgery team, the decision was made to proceed with a single-shot right-sided adductor canal block and a single-shot right-sided sciatic nerve block using a total of 30 mL 0.25 % ropivacaine with 8 mg of dexamethasone and 40 mg of methylprednisolone as additives to prolong the block. Prior to proceeding, the patient was placed on continuous telemetry monitoring with defibrillator pads applied. All vital signs were within normal limits. The skin was prepped in sterile fashion and the nerves were imaged by ultrasound. Approximately 15 mL of 0.25 % ropivacaine with steroid additives was deposited around the saphenous nerve in the adductor canal and the remaining 15 mL of 0.25 % ropivacaine was deposited around the sciatic nerve under ultrasound guidance. Ropivacaine was injected incrementally with no aspiration of blood at any point. The patient remained conscious throughout the procedure and experienced no syncopal sensations or EKG changes. He was monitored at bedside by a member of the regional team for 1 h post-block and remained on telemetry with defibrillator pads for 24 h. A sensory block was noted within 20 min of intervention and the patient reported pain relief that lasted over 24 h.

3. Discussion and literature review

We present the case of 28-year-old male with Brugada syndrome receiving single-shot lower extremity peripheral nerve blocks for the management of intractable post-operative pain secondary to traumatic orthopedic injuries. The safety and efficacy of regional anesthesia amongst Brugada syndrome patients remains a point of interest and debate among practitioners due to the potential dangers of local anesthetic administration in this population. Literature on the subject is limited to primary case reports describing experiences with spinals, epidurals, and single-shot peripheral nerve blocks. This case report represents only the third time successful lower extremity nerve blocks have been reported. To our knowledge, there is no report of continuous peripheral nerve catheters in this patient population. Thus, we cannot comment on or review the safety of this particular intervention.

Epidural and spinal anesthesia are mainstays of anesthetic management for both obstetric and

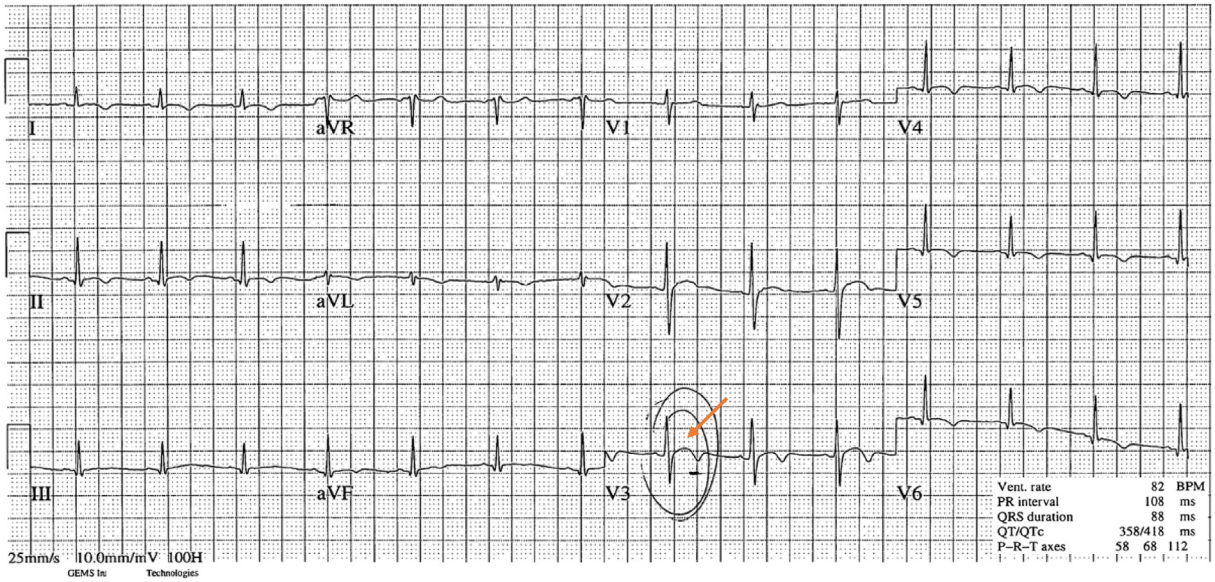

Fig. 1. The 12-lead EKG collected the day prior to regional intervention. It is notable for "coved-type" ST elevations, most notably in lead V3 (orange arrow, circle). However, consultant cardiologists did not find this EKG completely consistent with either type I or type III Brugada syndrome.

surgical cases. However, spinal anesthesia presents two concerns for Brugada syndrome: a profound sympathectomy with an increase in vagal tone, a known trigger for Brugada syndrome, and the administration of cardiotoxic triggering medications such as bupivacaine.[1,3,4] We found published records of seven single-shot spinals administered for surgical anesthesia. Five of these spinals were not associated with any post-operative complications, arrhythmias, or EKG changes.[5-9] Although bupivacaine is generally considered a drug to avoid in Brugada syndrome, for four of these five successful spinals, hyperbaric bupivacaine was used.[5-7,9] The other spinal was reliant on low dose ropivacaine.[8] Practitioners in these cases noted the use of lower doses of hyperbaric local anesthetic than they would normally have used, and none reported profound or concerning hypotension as a result of the sympathectomy.

We could only locate two reported cases of spinal anesthesia in Brugada syndrome with adverse outcomes. The first was reported by Olivan et al. in 2016 and noted that 40 mg of prilocaine administered intrathecally unmasked Brugada syndrome in an undiagnosed 66-year-old man. The intraoperative EKG revealed ST elevations > 2 mm and a right bundle branch block in V1–V3.[10] The second case was a report of cardiac arrest after 15 mg of hyperbaric, intrathecal 0.5 % bupivacaine. The arrest occurred 20 min after the intrathecal dose, preceded by profound bradycardia, and the patient had a T10 sensory level.[11] The authors noted that it was uncertain if the cardiac arrest was due to vagal tone, loss of cardiac accelerators, or bupivacaine toxicity. Nevertheless, single-shot spinals appear safe for Brugada syndrome patients if there is close monitoring, aggressive avoidance of hypotension, and cautiously low doses of local anesthetic used.

With regards to combined spinal-epidurals (CSE), we could only locate three reports. The earliest was reported in 2012 and noted that 12 mg of intrathecal bupivacaine was administered as well as 2 % lidocaine through the epidural later in the case.[12] The patient remained hemodynamically stable and was discharged without any cardiac issues. Two subsequent case reports described intrathecal doses of bupivacaine followed by epidural lidocaine for obstetric cases.[8,13] Both were similarly unremarkable and add further support to the case that spinals are likely safe in Brugada syndrome if hypotension is avoided and lower doses of local anesthetic are used.

Epidurals appear to be a complex issue and point of uncertainty for Brugada syndrome as they require higher doses of local anesthetic than a single-shot spinal and result in higher plasma levels, increasing the risk of toxicity. In our literature review, we found seventeen recorded epidurals in this patient population, fourteen of which were uneventful. Duque et al. collected six cases of ropivacaine epidurals for labor analgesia and caused no cardiac arrhythmias.[14] Similarly, Ojaimi et al. noted the success of four ropivacaine epidurals with no subsequent complications.[8] Of the remaining four cases, two were individual reports of ropivacaine epidurals that provided effective labor analgesia and were uneventful.[15,16] The final two individual cases reported the use of epidural bupivacaine, one for labor which was uneventful and the other placed in the thoracic region and combined with GA.[17,18] All authors noted the use of low dose or specially concocted infusions in addition to careful titration of local anesthetic, especially when redosing.

There are three cases of epidural complications reported in the known literature. All three are fairly old and the patients had gone undiagnosed. The first, published in 2003, notes that epidural bupivacaine produced Brugada-like EKG changes that resolved with bupivacaine discontinuation.[19] The second, published in 2006, describes ventricular tachyarrhythmias and electrical storm that resolved once epidural bupivacaine was discontinued.[20] A final report, in fact the earliest published of the three, describes post-operative ventricular fibrillation as a result of epidural anesthesia but does not provide details on the local anesthetic or the dose.[21] It has been theorized that epidural bupivacaine may unmask the condition of Brugada syndrome as the adverse events often occur in patients who have gone undiagnosed.[22] Bupivacaine's ability to unmask Brugada by inducing arrhythmogenic changes has been supported by *in vitro* experiments including whole-cell patch clamp and RV wedge models.[20] Thus, the drive to avoid bupivacaine in regional anesthesia for Brugada syndrome continues to seem logical, especially from a molecular perspective.

The remaining published cases of regional anesthesia in Brugada syndrome all pertain to single-shot peripheral nerve blocks. Two uneventful interscalene blocks have been performed, one using ropivacaine and other using mepivacaine.[23,24] However, an interscalene block using 30 mL of 0.5 % bupivacaine did result in a ventricular fibrillation arrest.[25] An axillary block has been successfully preformed using ropivacaine and coinciding empiric intralipid treatment.[26] An ilioinguinal block, sub-tenon's block, peribulbar block, and intraoral injection for tooth extraction have all been unremarkable with no arrhythmias or EKG changes.[27-30] Yet, notably, bilateral paravertebral blocks with 40 mL of 0.5 % ropivacaine led to polymorphic ventricular tachycardia.[31] Finally,

in addition to our case of combined adductor and sciatic nerve blocks, there have been two other reported cases of successful and safe lower extremity blocks. Tavoletti et al. reported the uneventful use of 22 mL 0.5 % levobupivacaine for femoral and sciatic nerve blocks as surgical anesthesia and Choi et al. preformed a similarly uneventful 5-point lower extremity block using a 55 mL local anesthetic cocktail (15 mL 0.75 % ropivacaine, 25 mL 2 % lidocaine with epinephrine, 15 mL normal saline).[32,33] We remain the only report of a peripheral nerve block in Brugada Syndrome to use steroid additives to prolong the overall sensory block.

Our primary concerns in clinical decision-making for this case pertained to choice of local anesthetic, selected dose, methods to safely prolong the block, and cardiac precautions. We erred against placing a peripheral nerve catheter due to fears of continuous local anesthetic administration in a setting where nursing was not trained to monitor the catheter or screen for early signs of local anesthetic toxicity and Brugada-like EKG changes. Ropivacaine was selected as our local anesthetic as it is less cardiotoxic than bupivacaine but still displays a prolonged length of action. We also chose to dilute our ropivacaine to 0.25 % and only administered a total of 30 mL where we might usually administer 40−50 mL, placing us well below the patient's maximum allowable dose. Finally, we chose to add dexamethasone and methylprednisolone to our local anesthetic to further prolong the sensory block. Steroids are safe to use in Brugada Syndrome and several studies have been published recently identifying this as a method for prolonging single-shot blocks.[34-38] Overall, we believe this case provides a significant data point supporting the safety and efficacy of thoughtful regional anesthesia in this unique patient population for both anesthesiologists and other peri-operative physicians.

Prior presentations

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Author contributions

E.A.S. Bergbower performed the regional blocks, conducted the literature review, and wrote the manuscript.

A. Lorico participated in patient care and edited the manuscript.

K. Kaur participated in patient care and edited the manuscript.

J. Brookman provided expert clinical advice prior to performing the blocks and edited the manuscript.

G. Weinberg provided expert clinical advice prior to performing the blocks, corresponded with the primary author (E.A.S. Bergbower), and edited the manuscript.

S. Onyewu was the attending regional anesthesiologist that oversighted the primary author and this case. He also edited the manuscript.

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