CASE REPORT

Bilateral transversus abdominis plane (TAP) catheters for postoperative analgesia in a child with spinal dysraphism

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ABSTRACT

Regional analgesic techniques have become indispensable in the management of adult postoperative pain, and are gaining popularity in the pediatric population. Several case reports have been published describing the use of transversus abdominis plane (TAP) blocks for the provision of analgesia following lower and middle abdominal surgery in the adult population. Although there are several anecdotal reports and a few case series describing TAP blocks in the pediatric population, there are a limited number of reports regarding the use of continuous TAP catheters in the pediatric population. We present our experience with the use of bilateral TAP catheters to provide postoperative analgesia following major abdominal surgery (appendicovesicostomy) in a 5-year old, 17.8 kg pediatric patient with spina bifida. Applications of the technique are discussed and previous reports from the adult and pediatric population regarding the use of TAP catheters are reviewed.

Key words: Regional analgesia; Postoperative pain; Transversus abdominis plane (TAP) blocks; Spina bifida; TAP catheters; Postoperative analgesia

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INTRODUCTION

Regional analgesic techniques have become indispensable in the management of adult postoperative pain. Although there is a greater abundance of literature describing peripheral nerve blockade in adults, the use of regional anesthesia is increasing in neonates and infants[1.] While caudal analgesia remains the most commonly employed regional technique in the pediatric population, there are specific circumstances that limit its use including patients with spinal dysraphism (meningomyelocele or spina bifida), previous surgical procedures on the bony elements of the spine (laminectomy or spinal fusion with instrumentation), bleeding dyscrasias, and infants with vertebral anatomical abnormalities (VATER).[2] The transversus abdominis plane (TAP) block is a peripheral nerve block which can provide sustained abdominal wall analgesia for lower and middle abdominal surgery and offers an alternative to parenteral opioids in these situations. Although originally described in the adult literature, there are several anecdotal reports of its successful application in the pediatric-aged patient.[3-7]

The use of regional anesthetic techniques may be especially beneficial in pediatric patients who may be particularly sensitive to the respiratory depressant effects of opioids. One disadvantage of many regional anesthetic techniques is that they provide only a finite duration of analgesia (6-8 hours) when administered via a single injection. To overcome such problems, there is increasing experience with the use of indwelling catheters in peripheral regional anesthetic techniques for the provision of postoperative analgesia. To date, we could find only one other report of the use of continuous TAP catheters in the pediatric population.[8]

We present our experience with the use of bilateral TAP catheters to provide postoperative analgesia following major abdominal surgery in a 5-year old pediatric patient with spinal dysraphism (spina bifida). Applications of the technique are discussed and previous reports from the adult and pediatric population regarding the use of TAP catheters are reviewed.

CASE REPORT

Institutional Review Board approval is not required at Nationwide Children's Hospital for the presentation of single case reports. A 5-year-old, 17.8 kg child presented for an appendicovesicostomy (Mitrofanoff procedure) in the treatment of neurogenic dysfunction of the urinary bladder. Additional past medical history was significant for spina bifida with hydrocephalus which had required placement of a ventriculoperitoneal shunt. The patient was admitted to the hospital 48 hours prior to the surgical procedure for bowel preparation and intravenous hydration. He was held *nil per* os for 8 hours and transported to the operating room where routine American Society of Anesthesiologists' monitors were placed. Anesthesia was induced with propofol and tracheal intubation facilitated by rocuronium. Prior to the start of the surgical procedure, the abdomen was prepped with betadine. Using a linear, high frequency, ultrasound transducer, the three muscle layers of the lateral abdominal wall were visualized bilaterally. With an in-plane approach, with the ultrasound probe placed in a transverse plane in the region of the anterior axillary line, the potential space between the transversus abdominis muscle and the internal oblique muscle was cannulated with an 18 gauge, 2" Tuohy needle. A 20 gauge catheter was advanced 3-4 centimeters beyond the tip of the needle into the potential space after hydro-dissection. Correct needle tip position was confirmed by observing the internal oblique and the transversus abdominis muscles separating from each other with the formation of a black, lens shaped collection of fluid. The needle was withdrawn and the catheter was secured using sterile bio-occlusive dressing. The procedure was repeated on the opposite side. An initial bolus of 5 mL of 0.25% bupivacaine with epinephrine 1:200,000 was administered on each side followed by a continuous infusion of 0.125% bupivacaine at 1 mL/hr on each side. During the 6-7 hour surgical procedure, anesthesia was maintained with isoflurane. Supplemental analgesia included fentanyl (fentanyl 5-6 μg/kg) and hydromorphone (10 μg/kg). At the conclusion of the surgical procedure, residual neuromuscular blockade was reversed and the patient's trachea was extubated. He was transported to the post-anesthesia care unit (PACU) where he remained for one hour. He denied pain in the PACU and no opioids were removed. The TAP catheters were removed in the recovery room prior to discharge, as our hospital was still in the process of developing the infrastructure of a peripheral nerve catheter service. The patient was admitted to the inpatient ward and required no intravenous analgesic agents for the initial 9 postoperative hours. His postoperative course was uneventful

DISCUSSION

While neuraxial analgesia including caudal epidural analgesia has been the standard alternative to parenteral opioid for the provision of postoperative analgesia in pediatric patients, there is a subset of patients in which caudal analgesia cannot be employed including patients with spinal dysrhaphism. In this population, alterative peripheral techniques of regional anesthesia would be beneficial.[6,7]

The TAP block may offer an alternative in these situations. The intercostal, subcostal, and first lumbar nerves that contribute to the innervation of the anterior abdominal wall run in a neurovascular plane known as the transverses abdominis plane which is located between the internal oblique muscle and the transversus abdominis muscle. Blockade of these nerves can be achieved with a single injection of local anesthetic administered in this plane. Correct identification of the fascial plane can be facilitated by the use of ultrasound guidance.[9] Given that there is bilateral innervation, both sides must be approached to achieve effective analgesia for midline procedures. Performed using ultrasound guidance, this block can be used to provide sustained abdominal wall analgesia and limit the need for postoperative opioid analgesia. The latter may be especially beneficial in the pediatric population with co-morbid conditions, as they are particularly sensitive to the respiratory depressant effects of these medications. In our patient, there was the presence of spina bifida with previous instrumentation to his vertebral column, which was a relative contraindication to neuraxial analgesia. The placement of TAP catheters allowed for the provision of intraoperative analgesia and the continuation of the analgesia throughout the 6-7 hour surgical procedure.

Unlike neuraxial techniques, the TAP block cannot be used instead of general anesthesia. In patients undergoing lower and mid-abdominal surgical procedures, the addition of a TAP block to the general anesthetic technique provides effective postoperative analgesia while decreasing total opioid consumption.[4] In a prospective, randomized trial following total

Table 1: Previous reports of TAP catheters in the adult population

Authors / reference	Type of study	Cohort size	Surgical procedure	Dosing regimen (per side)	Outcome
Bielsky A et al[2]	Case series	N=2; 5 year old, 15.7 kg child and 7 year old, 17.2 kg child	Appendicovesicostomy	5 mL of 0.125% bupivacaine with repeat dose of 2 mL every 6 hours intraoperatively followed by infusion of 4 mL/hour of 0.1% bupivacaine.	Effective postoperative analgesia provided with the TAP catheters for 92 hours in one patient and 48 hours in the second patient. Minimal use of PCA opioids in one patient and no opioids used in second patient.
Hebbard P et al[10]	Case series	N= 42	Abdominal incisions and large herniorrhaphy	Bolus of 20-40 mL of ropivacaine (0.2%) followed by infusion (28 mg/ hour or 14 mL/hour).	Not clearly defined.
Bollag L et al[11]	Case report	N=5	Cesarean section	Bolus of 20 mL of 0.375% bupivacaine with intermittent bolus of 10 mL of 0.25% bupivacaine with epinephrine (1:200,000) when requested by patient.	TAP catheters offer an alternative or adjuvant to intrathecal morphine.
Alcock E et al[12]	Case report	N=2	Trauma and war casualties	Bolus of 20 mL of 0.5% bupivacaine with epinephrine (1:400,000). Infusion of 0.125% bupivacaine at 8 mL/hr.	TAP catheters provided excellent postoperative analgesia after abdominal surgery when coagulapathy limited neuraxial approach.
Forero M et al[13]	Case report	N=1	59 year old with multiple comorbid conditions for TAH.	Bolus of 20 mL of 0.5% ropivacaine. Infusion of 0.125% bupivacaine at 5 mL/hr.	Patient required no systemic opioids for 81 hours.
Jankovic Z et al[14]	Retrospective review	N=7	Renal transplant recipients	Bolus of 20 mL of 0.375% levobupivacaine Infusion of 0.15% bupivacaine at 10 mL/hr.	TAP catheters reduced morphine requirements by more than 80% and halved PCA duration while pain scores were similar
Heil J et al[15]	Case report	N=3	Ambulatory hernia surgery	Bolus of 30 mL of 1.5% mepivacaine. Infusion of 0.2% ropivacaine at 8mL/hr with 4 mL PCA.	No opioids were required postoperatively. Patient satisfaction was rated as high.
Niraj G et al[16]	Case report	N=3	Upper abdominal surgery	Bolus of 20-25 mL of 0.375-0.5% bupivacaine every 12 hours.	TAP catheters provided a significant opioid sparing effect
Niraj G et al[16]	Prospective, randomized trial	N=29 (TAP) N=33 (epidural)	Upper abdominal surgery	Bolus of 1 mg/kg 0.375% bupivacaine Intermittent bolus of 0.375% bupivacaine every 8 hours.	No difference was found between VAS at rest and during coughing between TAP catheters and epidural analgesia.

TAP = transversus abdominis plane; TAH =total abdominal hysterectomy; PCA = patient controlled analgesia; VAS = visual analogue score

abdominal hysterectomy, a bilateral TAP block decreased postoperative pain scores, delayed request for postoperative analgesia, and decreased morphine use during the initial 48 postoperative hours (55 $\pm$ 17 mg in control patients versus 27 $\pm$ 20 mg in patients who received a TAP block, $p < 0.001$). However, with a single shot technique, the duration of analgesia will be limited. As with other regional anesthetic techniques, there is anecdotal experience with placement of a TAP catheter to allow for the delivery of prolonged postoperative analgesia. Anecdotal success with the use of TAP catheters has been reported in a limited number of adult patients and in one previous report from the pediatric population (Table 1).[8]

In summary, we report for the second time in the literature, placement of TAP catheters to provide intraoperative and postoperative analgesia in a 5-year-old undergoing major reconstructive urologic surgery. Given the prolonged duration of the surgical procedure (6-7 hours), the decision was made to place catheters with the benefit of being able to run an infusion intraoperatively and thereby affording ongoing intraoperative analgesia and postoperative analgesia. When compared with the usual practice of caudal epidural analgesia, the TAP block offers the advantage of being feasible even in patients with vertebral anomalies such as was present in our patient with spinal dysraphism. The block may also be preferred over caudal epidural analgesia in older pediatric patients who weigh more than 20-25 kg and as the block does not involve needle placement near the neuraxial space or peripheral motor nerves, even

in the adult population, the block has been performed following the induction of general anesthesia. Use of a TAP block has also been reported in a patient with an intracranial lesion which would preclude the use of neuraxial blockade due to concerns of increasing intracranial pressure with epidural anesthesia.[18]

The limited data in the pediatric literature suggest the use of a bolus dose of 0.2-0.3 mL/kg per side of either 0.25% bupivacaine or 0.2% ropivacaine. However, future studies are needed to determine the optimal dosing regimen. As with many other regional anesthetic techniques, the use of ultrasound guidance should be considered to ensure correct needle location and improve the accuracy of the technique.[19] In the pediatric population, the most likely serious adverse event is local anesthetic toxicity and attention to volume and concentration is suggested with limitation of the total dose of bupivacaine or ropivacaine to less than 3 mg/kg and limitation of the infusion to less than 0.3 mg/kg/hr. In our choice, we used an infusion of 0.1% bupivacaine at 0.1 mL/kg/hour on each side thereby providing 0.2 mg/kg/hour. The only other adverse event reported in the literature is a single case of inadvertent trauma to the liver with the blunt regional needle.[20] A review by Dario Galante and his colleagues in this issue of 'Anesthesia, Pain & Intensive Care' amply describes various aspects of TAP in adult as well as in pediatric patients.[21]

While continuation of the infusion postoperatively would aid in further decreasing opioid requirements, qualified personnel must be available at all times to manage potential complications. Although our hospital did not have the personnel to manage peripheral nerve catheters postoperatively at the time of this case report, our acute pain and regional anesthesia service have completed the needed administrative and educational components and we now offer the use of continuous peripheral nerve catheters for the treatment of postoperative pain.

CONCLUSION

Our case demonstrates that TAP catheters can be safely used in pediatric patients and offer an alternative when neuraxial analgesia is contraindicated.

Conflict of interests: None

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