

Ultrasound guided transversus abdominis plane block

Postoperative analgesia in children with spinal dysraphism

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ABSTRACT

يستخدم التخدير الناحي للأطفال على نطاق واسع للتخفيف ألم العملية الجراحية بعد جراحة البطن. وتشمل التقنيات المستخدمة للتخدير الناحي تخدير قطني خارج الجافية والإحصار العجزي. ومع ذلك، فإن استخدام الحصار العصبي المركزي لديه قيود. هو بطلان في المرضى الذين يعانون من تشوهات تخثر، خلل في العمود الفقري مع متلازمة الحبل المربوطة، مينينغوميلوسيل، وبعد جراحة العمود الفقري مع الأجهزة. الموجات فوق الصوتية الموجهة للمستعرضة البطنية الطائفة. تعد طريقة جديدة للتخدير الناحي الذي يستخدم في المكان الذي لا يستخدم فيه الحصار العصبي المركزي. في هذه الدراسة، نستعرض 5 حالات أطفال أجري لهم عملية جراحية كبرى في البطن ولم يستخدم الحصار العصبي المركزي بسبب تشوهات العمود الفقري.

Pediatric regional anesthesia is widely used to relieve postoperative pain after abdominal surgery. Commonly used techniques of regional anesthesia include lumbar epidural and caudal block. However, the use of central neuraxial blockade has limitations. It is contraindicated in patients with clotting abnormalities, spinal dysraphism with tethered cord syndrome, meningomyelocele, and following spinal surgery with instrumentation. Ultrasound guided transversus abdominis plane block is a new method of regional anesthesia that can be used in settings where central neuraxial blockade is contraindicated. In this study, we present 5 pediatric cases in which major abdominal surgery was performed but central neuraxial blockade could not be carried out due to spinal abnormalities.

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Regional anesthesia is widely used for postoperative pain control in pediatric patients. Caudal epidural block (CEB) is the most commonly used method for postoperative analgesia in children.¹ Due to its ease of use and high success rate, it is currently considered the gold standard for pain relief after lower abdominal and pelvic surgery in children.¹ However, being a central neuraxial block it may be contraindicated in some cases, including coagulation disorders, spinal malformations including meningomyelocele, tethered cord syndrome and after spinal surgery.² Improved understanding of abdominal wall anatomy has led to the use of transversus abdominis plane block (TAPB) to control postoperative pain after lower abdominal surgery.^{3,4} Rafi⁵ first described a “blind” abdominal field block technique performed through the inferior lumbar triangle (Petit’s triangle). The inferior lumbar triangle is formed inferiorly by the iliac crest, anteriorly by the external oblique, and posteriorly by the latissimus dorsi muscles. This method provides blockade of lumbar anterior spinal nerves from T10–L1. After the introduction of ultrasound-guided techniques in regional anesthesia, Hebbard et al⁶ described the technique of TAPB using real time ultrasound guidance. They placed the ultrasound probe between the costal margin and the iliac crest on the anterior axillary line at the level of the umbilicus. Ultrasound-guided TAPB was performed with local anesthetic administration between the fascial planes of the internal oblique and the transversus abdominis muscles. In this study, we

present the cases of 5 pediatric patients with spinal dysraphism who underwent TAPB for postoperative pain relief after major abdominal surgery.

Case Report. Patient 1. A 12-year-old girl weighing 14 kg presented with lumbosacral meningocele without sensory deficit over the anterior abdominal wall. Her medical history revealed hydrocephalus and spina bifida. She was scheduled to undergo a laparoscopic cholecystectomy. Her physical examination did not reveal any significant findings. Hemoglobin, hematocrit, platelet count, coagulation profile, liver enzymes, bilirubin levels, blood glucose, serum creatinine, serum urea, serum sodium and potassium levels were within normal limits in preoperative investigations. There were no abnormal findings on the preoperative chest x-ray (Table 1). Preoperative investigations revealed no abnormal findings.

Patient 2. A 5-year-old boy weighing 15 kg presented with neurogenic bladder dysfunction due to lumbosacral meningocele. He had no sensory deficit over the anterior abdominal wall. His medical history included hydrocephalus and spina bifida. He was scheduled for bilateral ureteroneocystostomy. The physical examination did not reveal any significant findings. Hemoglobin, hematocrit, platelet count, coagulation profile, liver enzymes, bilirubin levels, blood glucose, serum creatinine, serum urea, serum sodium and potassium levels were within normal limits in preoperative investigations. There were no abnormal findings on the preoperative chest x-ray (Table 1). Preoperative investigations revealed no abnormal findings.

Patient 3. A 12-year-old girl weighing 17 kg presented with lumbosacral meningocele. She had no sensory deficit over the anterior abdominal wall. Her medical history included scoliosis, hydrocephalus, and spina bifida. She was scheduled for laparoscopic insertion of a peritoneal dialysis catheter. Her physical examination did not reveal any significant findings. Hemoglobin, hematocrit, platelet count, coagulation profile, liver enzymes, bilirubin levels, blood glucose level, serum sodium and potassium levels were within normal limits in preoperative investigations. Blood urea level was 80 mg/dl and serum creatinine level was 2.4 mg/dl. There were no abnormal findings on the preoperative chest x-ray (Table 1). Preoperative

investigations revealed elevated urea and creatinine levels.

Patient 4. A 10-year-old boy weighing 35 kg presented with lumbosacral meningocele. He had no sensory deficit over the anterior abdominal wall. His previous medical history included spina bifida. He was scheduled for laparoscopic intraabdominal testis exploration. There were no significant findings on physical examination. Hemoglobin, hematocrit, platelet count, coagulation profile, liver enzymes, bilirubin levels, blood glucose, serum creatinine, serum urea, serum sodium and potassium levels were within normal limits in preoperative investigations. There were no abnormal findings on the preoperative chest x-ray (Table 1). Preoperative investigations revealed no abnormal findings.

Patient 5. A 13-year-old girl weighing 18 kg presented with lumbosacral meningocele. She had no sensory deficit over the anterior abdominal wall. Her medical history included scoliosis, hydrocephalus, and spina bifida. She was scheduled for laparoscopic insertion of a peritoneal dialysis catheter. Her physical examination did not reveal any significant findings. Hemoglobin, hematocrit, platelet count, coagulation profile, liver enzymes, bilirubin levels, blood glucose level, serum sodium and potassium levels were within normal limits in preoperative investigations. Blood urea level was 74 mg/dl and serum creatinine level was 2.1 mg/dl. Her preoperative chest x-ray revealed scoliosis. Pulmonary function tests were within normal limits (Table 1). Preoperative investigations revealed elevated urea and creatinine levels.

Therapeutic intervention. All patients received sedation with a routine 1 mg of midazolam in the operation room. During the surgery, heart rate (HR), arterial oxygen saturation, end-tidal carbon dioxide, and non-invasive blood pressure (BP) were monitored. After commencement of monitoring, anesthesia was induced with intravenous administration of propofol 2 mg/kg; fentanyl, 2 mcg/kg; and mivacurium, 0.2 mg/kg; followed by endotracheal intubation. Anesthesia was maintained with a 50/50% mixture of oxygen/nitrous oxide and sevoflurane at 1-1.5 vol %. The concentration of sevoflurane was decreased towards the end of surgery until patients were awake. No intraoperative complications were encountered. After surgery, bilateral TAPB was carried out under ultrasound guidance. Using an in-plane approach, a high-frequency, 7.5 MHz linear probe (Esaote, My Lab 30cv, Florence, ITALY) was placed in the mid axillary line between the costal margin and the

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Table 1 - Timeline including diagnostic tests, interventions, and follow ups.

Cases	Patient information	Preoperative diagnostic tests*	Preoperative clinical findings	Intervention	Follow-up
Patient 1	12-year-old girl, lumbosacral meningocele, spina bifida, hydrocephalus	All tests were in normal range	No abnormal findings	Laparoscopic cholecystectomy+TAPBC for postoperative analgesia	Postoperative FPS-R, HR, systolic and diastolic pressure, analgesic requirement at 0, 1, 4, 6, 12 and 24, hours.
Patient 2	5-years-old boy, lumbosacral meningocele, spina bifida, hydrocephalus neurogenic bladder dysfunction	All tests were in normal range	No abnormal findings	Bilateral ureteroneocystostomy+TAPBC for postoperative analgesia	
Patient 3	12-year-old girl, lumbosacral meningocele, spina bifida, hydrocephalus	Only urea: 80mg/dl, creatinine: 2,4 mg/dl	No abnormal findings	Laparoscopic peritoneal dialysis catheter insertion+TAPBC for postoperative analgesia	
Patient 4	10-years-old boy, lumbosacral meningocele, spina bifida	All tests were in normal range	No abnormal findings	Laparoscopic abdominal testis exploration+TAPBC for postoperative analgesia	
Patient 5	12-year-old girl, lumbosacral meningocele, spina bifida, hydrocephalus, scoliosis	Only urea:74mg/dl, creatinine: 2,1 mg/dl	No abnormal findings	Laparoscopic peritoneal dialysis catheter insertion+TAPBC for postoperative analgesia	

*Diagnostic tests: hemoglobin, hematocrit, platelet, coagulation tests, liver enzymes, bilirubin levels, blood glucose, serum creatinine, serum urea, serum sodium and potassium levels, chest x-ray. FPS-R - faces pain scale-revised, HR - heart rate TAPBC - transversus abdominis plane block catheter

Table 2 - Postoperative faces pain scale-revised score.

Cases	FPS-R 0.h	FPS-R 1.h	FPS-R 4.h	FPS-R 6.h	FPS-R 12.h	FPS-R 24.h
Patient 1	0	3	2	0	0	2
Patient 2	3	3	1	1	0	0
Patient 3	0	4	2	2	0	0
Patient 4	0	1	3	0	0	0
Patient 5	0	3	2	2	0	0

FPS-R - Faces Pain Scale-Revised, h - hours

Table 3 - Postoperative hemodynamics values (mmHg per minutes).

Cases	BP (HR) 0.h	BP (HR) 1.h	BP (HR) 4.h	BP (HR) 6.h	BP (HR) 12.h	BP (HR) 24.h
Patient 1	120/62 (150)	131/60 (128)	127/80 (107)	120/84 (84)	121/77 (87)	134/92 (110)
Patient 2	90/60 (100)	113/67 (122)	104/72 (74)	110/68 (87)	102/78 (88)	112/83 (88)
Patient 3	90/60 (130)	85/65 (109)	96/60 (135)	88/54 (112)	93/65 (127)	90/60 (125)
Patient 4	80/40 (88)	90/60 (90)	88/59 (89)	90/60 (88)	95/62 (87)	90/60 (90)
Patient 5	90/60 (130)	85/65 (109)	96/60 (135)	88/54 (112)	93/65 (127)	90/60 (125)

BP - blood pressure, HR - heart rate, h - hours

iliac crest and moved forward towards the umbilicus (Figure 1). A mixture of 2 ml of 0.125% bupivacaine and 2 ml of 0.2% lidocaine diluted in 4 ml of normal saline was injected on each side. After performing the block, patients were extubated awake in the operating room and followed up after recovering from anesthesia.

Follow up and outcomes. Pain scores were assessed at 0, 1, 4, 6, 12, and 24 hours postoperatively using the Faces Pain Scale-Revised (FPS-R). Systolic and diastolic BP and additional analgesic requirements were recorded

(Table 2). Blood pressure and HR were recorded postoperatively for 24 hours (Table 3). If the pain score was more than 5, 10 mg/kg of paracetamol was administered intravenously for additional pain relief.

Discussion. There is increasing research evaluating the efficacy of TAPB for postoperative analgesia following lower abdominal surgery. In a study by Sethi et al,⁴ TAPB resulted in less pain compared to caudal epidural 6 hours postoperatively; there was

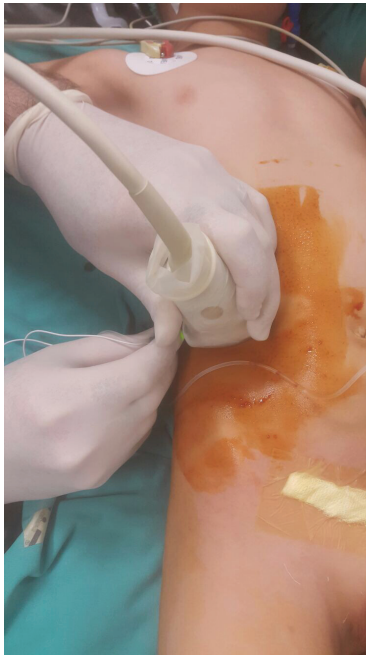


Figure 1 - Ultrasound guided transversus abdominis plane block.

no difference in opioid use between groups block; although no difference was observed in the first 12 hours, postoperative morphine requirement at 24 hours was less in patients who had TAPB than in those who underwent caudal epidural block.⁷ In another study, Kendigelen et al³ compared TAPB with wound infiltration and found that postoperative pain scores and analgesic requirements were higher in the wound infiltration group. In our study, adequate analgesia was achieved in all patients in the first 24 hours after ultrasound-guided TAPB and no additional dose of analgesics was required.

The term “spinal dysraphism” describes any abnormality of the spinal cord, cauda equina and overlying tissues, including skin, muscles and vertebrae.⁸ Spinal dysraphism includes meningocele, meningomyelocele, tethered cord, sacral agenesis, and spina bifida.⁷ Several neurological, orthopedic, cardiac, urological, and vertebral defects are commonly observed in these patients.⁸ Central neuraxial blockade for postoperative analgesia is contraindicated in patients with spinal dysraphism.⁸ Wild et al⁹ used a subcutaneous catheter for continuous local anesthetic infusion in patients with spinal dysraphism and provided effective postoperative analgesia. However, subcutaneous infected seromas were observed as a complication in these patients. Taylor et al¹⁰ also performed continuous

TAPB using ultrasound guided catheters in patients with spinal dysraphism. John et al¹¹ conducted a multi-center study (1994) to investigate the safety of TAPB in children and found a 0.3% incidence of block-related complications. These complications were minor and no further intervention was needed. In bilateral blocks, median dose of bupivacaine was found to be one (0.47–2.29) mg/kg. In our study, the bupivacaine dose used in bilateral blocks was comparatively less; a single dose of local anesthetic for TAPB did not lead to any complications.

In conclusion, our patients received a single bolus dose of ultrasound-guided TAPB; and the maximum pain score reported was 4 out of 10 points on the Visual Analog Scale for Pain. Further, no additional dose of analgesics was required. No side effects related to TAPB were observed in these patients. We believe that TAPB may be an efficient technique of postoperative analgesia in spinal dysraphism. Larger series comparing TAP block with other method of postoperative analgesia are warranted in patients with spinal dysraphism.

References

1. Ecoffey C, Lacroix F, Giaufre E, Orliaguet G, Courrèges P; Association des Anesthésistes Réanimateurs Pédiatriques d'Expression Française (ADARPEF). Epidemiology and morbidity of regional anesthesia in children: a follow-up oneyear prospective survey of the French-Language Society of Paediatric Anaesthesiologists (ADARPEF). *Paediatr Anaesth* 2010; 20: 1061-1069.
2. Neal JM, Barrington MJ, Brull R, Hadzic A, Hebl JR, Horlocker TT, et al. The second ASRA Practice Advisory on Neurologic Complications in Regional Anesthesia and Pain Medicine. *Reg Anesth Pain Med* 2015; 40: 401-430.
3. Kendigelen B, Tutuncu AC, Erbabacan E, Ekici B, Köksal G, Altundas F, et al. Ultrasound-assisted transversus abdominis plane block vs wound infiltration in pediatric patient with inguinal hernia: randomized controlled trial. *J Clin Anesth* 2016; 30: 9-14.
4. Sethi N, Pant D, Dutta A, Koul A, Sood J, Chugh PT. Comparison of caudal epidural block and ultrasonography guided transversus abdominis plane block for pain relief in children undergoing lower abdominal surgery. *J Clin Anesth* 2016; 33: 322-329.
5. Rafi AN. Abdominal field block: a new approach via the lumbar triangle. *Anaesthesia* 2001; 56: 1024-1026.
6. Hebbard P, Fujiwara Y, Shibata Y, Royse C. Ultrasound-guided transversus abdominis plane (TAP) block. *Anaesth Intensive Care* 2007; 35: 616-617.
7. Bryskin RB, Londergan B, Wheatley R, Heng R, Lewis M. Transversus abdominis plane block versus caudal epidural for lower abdominal surgery in children: A double-blinded randomized controlled trial. *Anesth Analg* 2015; 121: 471-478.

8. Thompson D. Spinal dysraphic anomalies; classification, presentation and management. *Paediatrics and Child Health* 2014; 24: 431-438.
9. Wild TT, Chalmers DJ, Bielsky A, Wilcox DT. How do I do it: Continuous local anesthetic infusion for children with spinal dysraphism undergoing major reconstruction of the lower urinary tract. *J Pediatr Urol* 2014; 10: 394-395.
10. Taylor LJ, Birmingham P, Yerkes E, Suresh S. Children with spinal dysraphism: transversus abdominis plane (TAP) catheters to the rescue! *Paediatr Anaesth* 2010; 20: 951-954.
11. Long JB, Birmingham PK, De Oliveira GS Jr, Schaldenbrand KM, Suresh S. Transversus abdominis plane block in children: a multicenter safety analysis of 1994 cases from the PRAN (Pediatric Regional Anesthesia Network) database. *Anesth Analg* 2014; 119: 395-399.