

## CASE REPORT

# Transversus abdominis plane block for placement of a paracentesis catheter with failed Fontan physiology

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## ABSTRACT

Despite the successful palliation of patients with complex CHD, long term consequences may occur related to the chronically elevated venous pressures or failing ventricular function following total cavopulmonary anastomosis in patients with single ventricle anatomy. We present a 33-year-old adult woman with Fontan physiology who presented with recurrent ascites requiring insertion of a tunneled abdominal drain. Given her co-morbid conditions, the procedure was accomplished using a transversus abdominis plane (TAP) block placed with ultrasound guidance. Although generally used for the provision of postoperative analgesia following lower abdominal procedures, the TAP block may also be used in specific scenarios instead of general anesthesia in high risk patients. The anatomy of the TAP block is reviewed, its perioperative applications discussed, and its potential use instead of general anesthesia presented.

**Key words:** Fontan physiology; Transversus abdominis plane (TAP) block; Postoperative analgesia

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## INTRODUCTION

Palliation of complex congenital heart disease (CHD) with single ventricle physiology generally includes a staged approach with the goal of eventually achieving total cavopulmonary connection (Fontan anatomy).<sup>1,2</sup> Despite the successful palliation of these conditions and the likelihood of survival beyond the teenage years, long term consequences may occur related to increased venous pressures and portal hypertension.<sup>3</sup> With improved survival, these long term consequences, most importantly, hepatic insufficiency and failure with the development of ascites and protein losing enteropathy, have been recognized as a more frequent complication of the disease process.<sup>4</sup> Although treatment of such problems may be possible via interventional catheterization procedures such as

creation of an atrial level fenestration or dilatation of stenosis in the Fontan conduit, progressive ventricular dysfunction may require palliation with placement of a peritoneal drain.<sup>5,6</sup> In such patients, the presence of complex CHD with progressive dysfunction of the single ventricle significantly increases the morbidity and mortality associated with general anesthesia. In such patients, regional anesthetic techniques may eliminate the need for general anesthesia and provide an effective alternative for the provision of intraoperative surgical anesthesia. We present a 33-year-old woman with complex CHD and failing Fontan physiology who presented with progressive ascites, protein losing enteropathy, and hepatic insufficiency. Previous cardiac catheterization failed to reveal treatable anatomic causes for the problem and therefore she was scheduled for placement of a peritoneal drain for palliation. To

avoid the need for general anesthesia, a transversus abdominis plane (TAP) block was performed. The anatomy, history, and previous applications of the TAP block are discussed. Although generally used for the provision of postoperative analgesia following lower abdominal procedures, the TAP block may also be used in specific scenarios instead of general anesthesia in high risk patients. The anatomy of the TAP block is reviewed, its perioperative applications discussed, and its potential use instead of general anesthesia presented.

### CASE REPORT

Institutional Review Board approval is not required for single case reports at Nationwide Children's Hospital (Columbus, Ohio). The patient was a 33-year-old, 84 kg woman with a history of complex CHD consisting of an unbalanced atrioventricular canal, large inlet ventricular septal defect, moderate sized atrial septal defect, D-malposition of the great arteries, and pulmonic stenosis. She had undergone a modified Fontan procedure in the past and now presents with worsening abdominal distension due to ascites and a protein losing enteropathy. She was admitted several times recently for exertional dyspnea, chest pain, and ascites. Treatment had included intermittent paracentesis and chronic diuretic therapy. Previous cardiac catheterization had revealed moderate ventricular dysfunction, elevated Fontan pressures since 2007, and no evidence of anatomic obstruction to the Fontan conduit or pulmonary circulation. During the past 12 months, she was having more issues with increasing abdominal distention. Over the past week during her most recent hospitalization, paracentesis had been performed on 3 separate occasions during a 7 day period, the last one yielding 4 liters of fluid. She was evaluated by cardiology and was labeled as unfit for general anesthesia. Her examination revealed edematous feet and shins with severe abdominal distension and orthopnea. Her oxygen saturation was 80-84% on 2-3 liters of supplemental oxygen delivered via nasal cannula. She was unable to lie flat and slept sitting up. She was being evaluated for cardiac transplantation, but had not been placed on the transplant list. The plan was for palliation of the abdominal distention and ascites with placement of a permanent abdominal drain in the right side of her abdomen at the level of the umbilicus. The patient was held *nil per os* for 6 hours and was transported to the interventional radiology suite where standard American Society of Anesthesiologists' monitors were placed. The patient was kept sitting up and supplemental oxygen was delivered via the nasal cannula. Midazolam (total of

2 mg) and ketamine (total of 20 mg) was delivered in increments over 5-10 minutes. Using real-time ultrasound guidance, a right sided TAP was placed using a 22 gauge Stimuplex® block needle and 10 mL of 0.5% ropivacaine with 1:200,000 epinephrine. The patient did not respond to the placement of the TAP block. Following this, the peritoneal drain was placed and tunneled subcutaneously without complaint or response to surgical manipulation. The procedure lasted approximately 30-45 minutes. Following the procedure, the patient was transported to the post anesthesia care unit. The peritoneal drain functioned well postoperatively. It was drained once a day yielding 1 to 1.5 liters of fluid daily. The remainder of her postoperative course was unremarkable.

### DISCUSSION

The transversus abdominis plane (TAP) block was first described by Rafi and then later by McDonnell et al as a means of providing analgesia following lower abdominal procedures.<sup>7,8</sup> Following this initial report, the TAP block has been used to provide analgesia to the anterior abdominal wall following several different abdominal surgical procedures including appendectomy, cholecystectomy, Cesarean section, and most laparoscopic incisions.<sup>9-12</sup>

With a TAP block, analgesia is provided by the placement of the local anesthetic solution between the internal oblique and the transversus abdominis muscle layers (figure 1). The triangle of Petit is bounded posteriorly by the latissimus dorsi muscle, anteriorly by the external oblique muscle, and inferiorly by the iliac crest. The injection can be made laterally in the triangle of Petit or more anteriorly along the abdominal wall. The lateral abdominal wall contains three muscle layers and their associated fascial layers including the external oblique, the internal oblique, and the transversus abdominis muscles. The thoracolumbar nerve roots of T<sub>8</sub>-L<sub>1</sub>, which course in a plane between the transversus abdominis and internal oblique muscles, provide sensory innervation of the skin, muscles, and parietal peritoneum of the anterior abdominal wall. Prior to its use clinically, the potential utility of the TAP block was demonstrated in a cadaveric and radiological evaluation.<sup>13</sup> Using a double pop or loss of resistance technique, the authors demonstrated that methylene blue dye could be placed between the transversus abdominis and internal oblique muscles. The correct anatomic location of the dye was demonstrated by dissection of the cadaver specimens. The initial success in a cadaveric model was subsequently followed by computed tomography

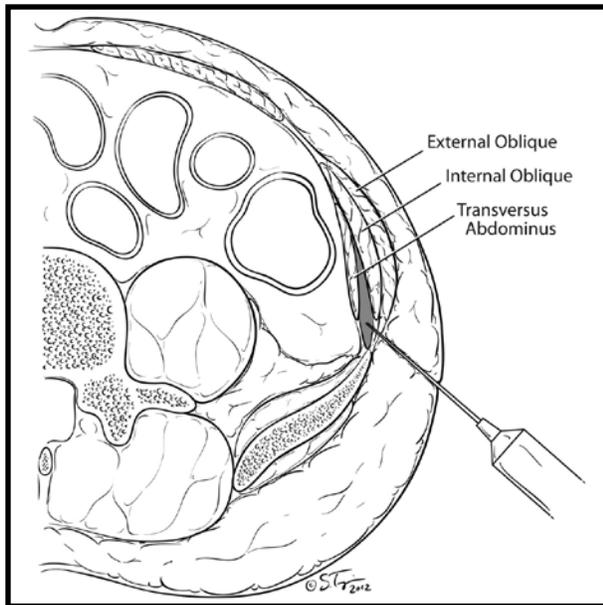


Figure 1 : Demonstration of the anatomy for placement of a transversus abdominis plane block at the lumbar level. The local anesthetic solution is deposited in the plane between the transversus abdominis and internal oblique muscle layers

demonstration of radiopaque dye in the correct fascial in 3 healthy, adult volunteers.

The clinical utility of the TAP block as a means of providing postoperative analgesia and limiting the need for postoperative opioids has been demonstrated in several studies. In a prospective randomized trial of 50 adults following Cesarean delivery, a bilateral TAP block decreased postoperative pain scores, delayed the request for postoperative analgesia, and decreased morphine use during the initial 48 postoperative hours.<sup>9</sup> The median time to first request for postoperative analgesia was 90 minutes in the control group compared to 220 minutes in patients who received a TAP block. Morphine use during the initial 48 hour postoperative period was decreased by 70% in patients who received a TAP block ( $66 \pm 26$  mg in control patients versus  $18 \pm 14$  mg in patients who received a TAP block,  $p < 0.001$ ).

Although used more frequently to provide postoperative analgesia, there are limited data regarding the applications of TAP blocks instead of general anesthesia. When compared with neuraxial techniques, TAP blocks do not provide effective surgical anesthesia for intra-abdominal manipulation. However, when compared with neuraxial techniques, the TAP block can potentially be used in patients with altered coagulation function, intracranial hypertension, abnormal vertebral anatomy, those who may not

tolerate positioning for a neuraxial blockade, and those who may not tolerate the hemodynamic consequences of the sympathectomy.<sup>14,15</sup>

As demonstrated in our patient, the technique does provide cutaneous and dermal coverage for superficial procedures and manipulations. Although it may have been feasible to provide effective analgesia using subcutaneous infiltration of local anesthetic, given our patient's tenuous status and the need for subcutaneous tunneling of the catheter, we felt that a single injection for the TAP block offered a significant advantage over the use of local anesthetic infiltration. The efficacy of the block was demonstrated by the lack of hemodynamic changes or complaints of pain with the initial placement of the catheter or its subsequent subcutaneous tunneling. This was accomplished despite the use of minimal intravenous sedation (midazolam 2 mg and ketamine 20 mg). Alternative regional anesthetic techniques such as a neuraxial approach were contraindicated due to the ongoing presence of anticoagulation with coumadin (necessitated by her complex CHD and Fontan physiology), potential problems with positioning related to her respiratory compromise and ascites as well as the concern of the hemodynamic consequences of a sympathectomy.

Our review of the literature revealed only one other report of the use of a TAP block instead of general anesthesia.<sup>16</sup> O'Connor and Renfrew used a TAP block instead of general anesthesia to provide surgical anesthesia for an elderly patient with co-morbid cardiac disease who was anticoagulated with coumadin.<sup>16</sup> A modified TAP block was placed to allow for placement of an ileostomy for treatment of a bowel obstruction. A low dose remifentanyl infusion was administered to provide coverage for visceral stimulation. The patient was comfortable throughout the procedure. Others have reported the use of a TAP block placed postoperatively in patients who were experiencing opioid-related adverse effects as well as one anecdotal report demonstrating its efficacy to treat chronic abdominal wall pain related to a malignancy.<sup>17-19</sup>

The preliminary literature has demonstrated that the TAP block provides effective analgesia following various umbilical and lower abdominal procedures including laparoscopy. We found that a TAP block provided effective surgical anesthesia for placement of a peritoneal drain in a patient with chronic ascites related to failed Fontan physiology. 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 while limiting the potential for the inadvertent damage

to intraperitoneal structures. To date, adverse effects have been relatively limited included anecdotal reports of hepatic damage related to the needle.<sup>20,21</sup> One other report describes the inadvertent placement of a catheter into the peritoneal space.<sup>22</sup> It is anticipated that the likelihood of such events should be decreased by the use of ultrasound guidance. Absolute contraindications to the technique include patient refusal, soft tissue infection or anatomic abnormalities of the abdominal wall and skin at the needle insertion site. Although

we placed the TAP block in our patient receiving therapeutic anticoagulation with coumadin, this remains an area of uncertainty with the TAP block and requires further investigation. As with any regional anesthetic technique, one of the most likely serious adverse events remains local anesthetic toxicity. Attention to volume and concentration is suggested with limitation of the total dose of bupivacaine or ropivacaine to less than 3 mg/kg.

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## Nanoparticles May Improve Arthritis Pain Management

People who suffer from arthritis pain in their knees may get longer-lasting relief and require fewer shots at the doctor's office. Scientists announced that tiny particles called nano particles that they have developed can deliver pain medicine to the inside of the knee and keep it there longer. The study led by Michael Morgan of Bend Research has not yet been peer-reviewed, but he believes his work showed progress in pre-clinical trials.

Researchers said the nanoparticles do two things. Pain medication sticks to them, drugs are then carried into the knee joint. The sphere-shaped particles stay in the knee to slowly release pain medication. If the nano particles work in humans as Morgan expects they will, patients would only have to get injections to manage their pain every few months instead of every week.