Brief Report

Ultrasound-guided abdominal wall nerve blocks in the ED

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Received 14 September 2010; revised 17 February 2011; accepted 15 March 2011

Abstract

Introduction: The anterolateral abdominal wall is innervated by the T7 to L1 anterior rami, whose nerves travel in the fascial plane between the internal oblique and transversus abdominus muscles, known as the transversus abdominus plane (TAP). Ultrasound-guided techniques of regional anesthesia that target the TAP are increasingly relied upon by anesthesiologists for pain management related to major abdominal and gynecologic surgeries. Our objective was to explore the potential utility of these techniques to provide anesthesia for abdominal wall procedures in the emergency department (ED).

Methods: We conducted a prospective, cross-sectional, descriptive case series of ultrasound-guided abdominal wall nerve blocks performed by emergency physicians in the ED.

Results: Between July 1 and September 1, 2010, 4 patients were selected for an ultrasound-guided TAP nerve block or an ilioinguinal/iliohypogastric nerve block. Three patients presented with soft tissue abscesses on the anterior abdomen, and 1 patient presented with postoperative pain and swelling after hernia surgery. Patients were aged 35 to 50 years. Mean time to complete the procedures was 8.5 minutes. All blocks resulted in complete surgical anesthesia sufficient for comfortable incision and drainage or needle aspiration without the need for additional analgesia or sedation. There were no complications.

Conclusions: In a series of 4 ED patients, ultrasound-guided TAP and ilioinguinal/iliohypogastric blocks performed by emergency physicians provided excellent procedural anesthesia. Further study of these techniques as an alternative to sedation for ED patients undergoing abdominal wall procedures is warranted.

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1. Introduction

Painful conditions of the abdominal wall such as wounds and soft tissue abscesses that require incision and drainage are common complaints in the emergency department (ED). Direct infiltration of local anesthetic can be painful, often requires multiple injections, and may not provide adequate anesthesia if large areas of tissue are involved. Sedation in the ED can be resource and time intensive. In addition, sedation is contraindicated in patients with significant comorbidities, may require a 6-hour fast period, and is associated with rare but serious cardiopulmonary complications. There is increasing interest in ultrasound-guided regional nerve blocks as an additional anesthetic option for pain management in the ED [1,2].

Recently described ultrasound-guided techniques have contributed to an increased interest in the clinical applications of abdominal wall nerve blocks for perioperative pain control in patients undergoing major abdominal and gynecologic surgeries [3-5]. However, the use of abdominal

\textsuperscript{\dag} Funding sources: none.

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Ultrasound guidance allows the operator to directly image target nerve structures and visualize in real time both needle insertion and local anesthetic spread [6]. Several recent studies suggest that ultrasound-guided techniques are more easily learned by novice providers, require less time to perform, and are associated with fewer complications and increased efficacy in comparison with landmark-based techniques [7,8]. The 2 most common regional blocks of the abdominal wall are the transversus abdominis plane, or “TAP” block, and the ilioinguinal/iliohypogastric (IL/IH) nerve block. Both the TAP and IL/IH blocks involve injecting local anesthetic into the fascial plane between the internal oblique and transversus abdominis muscles. The anterior rami of the T6 to L1 spinal nerves travel in the TAP before supplying the skin, muscles, and parietal peritoneum of the anterolateral abdominal wall. These nerves branch and communicate widely within the TAP, creating a nerve plexus that, when injected with a local anesthetic, produces a multilevel neuroblockage of the anterior hemithorax from approximately T9 to L1 [5,9,10].

We hypothesized that ultrasound-guided abdominal wall nerve blocks would provide effective pain control for ED procedures related to wounds and soft tissue abscesses of the anterior abdominal wall. Herein, we describe a series of 4 patients for whom ultrasound-guided TAP or IL/IH blocks were successfully performed in the ED by emergency physicians.

2. Methods

This prospective case series was conducted at an urban level II state–designated trauma hospital with both an emergency medicine residency and an emergency ultrasound fellowship program. Blocks were performed by emergency physicians experienced with UGRA who had performed a minimum of 50 previous successful ultrasound-guided nerve blocks in the ED.

2.1. Patient selection

Emergency department patients older than 18 years with an abscess or wound on the anterior abdomen located below the level of the umbilicus and above the pubis symphysis presenting between July 1 and September 1, 2010, were eligible. Patients were selected if it was determined that the patient would likely require more than the standard technique of local anesthetic infiltration for optimal pain control. We excluded patients with a known allergy to local

Fig. 1  A, Block setup. The patient is positioned supine with the ultrasound machine on the side where the block is to be placed. The operator stands or sits on the opposite side of the patient with an unobstructed view of the ultrasound screen, inserting the needle in-plane with the transducer. B and C, Incision and drainage. Abscess incision and drainage with forceps exploration completed without need for additional local anesthetic.
anesthetic agents, hemodynamic instability, or pregnancy. Informed consent was obtained from all patients; those unable to give informed consent because of language barriers or impaired mental status were excluded. This study was approved by the institutional review board at the Alameda County Medical Center.

2.2. Data collection

Patient demographics, medical history, and clinical presentation were documented. The number of attempts, amount and type of local anesthetic, adequacy of pain control, need for rescue analgesia, any complications, and time required to complete the procedure were recorded.

2.3. Technique

All TAP blocks were performed using a modified version of the ultrasound-guided technique first described by Hebbard et al [5]. We used the ultrasound-guided block technique originally described by Willschke et al [11] for all IL/IH blocks. The patient should be supine with the abdomen fully exposed from the inferior costal margin to the iliac crest. A large footprint high-frequency linear transducer provides optimal visualization of the relevant anatomical structures. The skin is prepared in standard sterile fashion, and a sterile probe cover may be used. The inferior costal margin and the iliac crest are located by palpation along the midaxillary line. For the TAP block, the transducer is placed in transverse orientation just above the iliac crest at the midaxillary line (Figs. 1A and 2). At this position, the layers of the abdominal wall are typically well visualized with ultrasound even in obese patients. The most superficial layer is the subcutaneous tissue followed by the external oblique, internal oblique, and transversus abdominis muscle layers [10]. Finally, beneath the transversus abdominis muscle is the parietal peritoneum and underlying peristaltic bowel. Muscle fascia is hyperechoic and stands out prominently against the hypoechoic muscle belly, facilitating identification of the TAP between the internal oblique and transversus abdominis muscles (Fig. 3A). When this plane is targeted for injection above the iliac crest, it is referred to as the TAP block [5]. Sliding the transducer inferior and medial to the TAP block position to bring the iliac crest into view above the anterior superior iliac spine allows direct visualization of the neurovascular bundle containing the IL/IH nerves (Figs. 4 and 5). At this position, the block is referred to as the IL/IH block and provides anesthesia to the skin of the lower abdominal wall (L1 distribution) including the inguinal crease, upper hip, and upper thigh [12,13].

Under real-time ultrasound guidance, a 3.5-in, 22-gauge spinal needle readily available in most EDs is inserted parallel...
to the long access of the transducer (in-plane) at a point on the skin 1 to 2 cm medial to the probe. The needle tip should be visualized throughout the procedure and targeted to the TAP between the internal oblique and transversus abdominis muscles. With the needle tip visualized in the TAP, 20 mL of local anesthetic is injected in 3 to 5 mL of aliquots after a negative aspiration [5]. The TAP will readily expand with injection creating an elliptical hypoechoic collection of local anesthetic (Fig. 3A). At the IL/IH position, the neurovascular bundle is more easily identified because it separates from surrounding fascial tissue and because it becomes surrounded by local anesthetic [12] (Fig. 4).

Although infection related to abdominal wall blocks is very rare, blocks should not be performed in patients with signs of skin or soft tissue infection overlying the injection site. In addition, these blocks should be performed with great caution in patients with a coagulopathy who are at increased risk of significant bleeding complications should vascular puncture occur.

3. Results

Ultrasound-guided TAP and IL/IH blocks were performed on 4 patients aged 35 to 50 years. Between 15 and 20 mL of either 1% lidocaine with epinephrine or 0.25% bupivacaine was used for each block. All blocks were performed on the first attempt, and the mean time to complete the procedure was 9.5 minutes (range, 5-15 minutes). Rescue analgesia or anesthesia was not needed for any patient. There were no complications (Table 1).

3.1. Case 1

A 35-year-old man with diabetes mellitus and asthma presented to the ED with a painful infection in the abdominal wall soft tissue. Bedside ultrasound revealed a 2 × 3-cm abscess approximately 1 cm deep to the skin surface. The patient was determined to be at increased risk for procedural sedation complications caused by his comorbidities. In addition, he refused attempts to locally anesthetize the area because of severe pain. An ultrasound-guided TAP block was performed with 20 mL of 0.25% bupivacaine, and after 25 minutes, the patient reported complete resolution of his pain. The abscess was incised and drained comfortably without additional analgesia or anesthesia (Fig. 1).

3.2. Case 2

A 50-year-old woman presented to the ED with a painful infection in the abdominal wall soft tissue just lateral and
inferior to her umbilicus. Bedside ultrasound revealed a 3 × 3-cm abscess approximately 1.5 cm beneath the skin surface. Initially, the patient refused local anesthetic infiltration and described previous painful experiences with standard local anesthetic infiltration techniques. After the risks and benefits were discussed, the patient elected to have an ultrasound-guided TAP block. The block was performed under ultrasound guidance with 20 mL of 1% lidocaine with epinephrine. Fifteen minutes after the injection, the patient reported complete resolution of her pain. Incision and drainage was performed, and 5 mL of purulent material was expressed. There was no need for additional analgesia or anesthesia.

### 3.3. Case 3

A 36-year-old man with a history of methamphetamine abuse presented with 7 days of worsening pain and swelling in his right groin. Bedside ultrasound revealed a large 3 × 4-cm abscess at the inguinal crease. An ultrasound-guided IL/IH block was performed with 20 mL of 0.25% bupivacaine. Thirty minutes after the injection, his pain had reduced from 8/10 to 1/10 in severity. The abscess was incised, and 6 mL of purulent material was drained comfortably without the need for additional analgesia or anesthesia.

### 3.4. Case 4

A 46-year-old woman presented to the ED with severe incisional pain after inguinal hernia repair 6 days prior. She refused to allow palpation or examination with ultrasound because of her pain. An ultrasound-guided IL/IH block was performed with 10 mL of 0.25% bupivacaine. After 15 minutes, the patient’s pain resolved completely, and she permitted a full physical examination of the incision. Ultrasound revealed a small fluid collection that was needle aspirated and found to be nonpurulent. The patient was discharged on an improved oral analgesic regimen. At follow-up 24 hours later, the incisional pain had returned but was diminished and adequately controlled with oral analgesics.

### 4. Discussion

The efficacy of ultrasound-guided TAP and IL/IH blocks for surgical anesthesia and postoperative pain control has been well described in the anesthesia literature [3,13,14]. Herein, we describe the first successful use of these blocks in a busy urban ED as the sole method of anesthesia for abdominal wall procedures. In all cases, the blocks successfully provided adequate anesthesia for either incision and drainage or needle aspiration without the need for additional analgesia or anesthesia. In our experience, the ultrasonographic anatomy for ultrasound-guided abdominal wall blocks is not complex, and emergency physicians with

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**Table 1** Characteristics of ultrasound-guided abdominal wall nerve blocks for procedural pain management in the ED

<table>
<thead>
<tr>
<th>Case</th>
<th>Condition</th>
<th>Procedure</th>
<th>Block</th>
<th>Anesthetic</th>
<th>Block procedure time</th>
<th>Rescue anesthetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Soft tissue abscess</td>
<td>Incision and drainage</td>
<td>TAP</td>
<td>20 mL of 1% lidocaine with epinephrine</td>
<td>15</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>Soft tissue abscess</td>
<td>Incision and drainage</td>
<td>TAP</td>
<td>20 mL of 0.25% bupivacaine</td>
<td>5</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>Soft tissue abscess</td>
<td>Incision and drainage</td>
<td>IL/IH</td>
<td>20 mL of 0.25% bupivacaine</td>
<td>10</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>Surgical wound</td>
<td>Needle aspiration</td>
<td>IL/IH</td>
<td>15 mL of 1% lidocaine with epinephrine</td>
<td>8</td>
<td>No</td>
</tr>
</tbody>
</table>

*a* For all procedures, an ultrasound-guided abdominal wall nerve block was the sole method of anesthesia used.

*b* Time in minutes required to perform the nerve block after necessary supplies were assembled.

*c* At any time was additional local analgesia or analgesia required to complete procedure.
previous training in sonography can quickly identify relevant structures and perform the block efficiently at the bedside. The ultrasound-guided block technique we describe uses direct visualization of the intramuscular TAP at the midaxillary line just above the iliac crest. This ultrasound-guided technique for the TAP block has several advantages over landmark-based techniques that are based on palpation of the lumbar triangle of Petit. The triangle of Petit is formed posteriorly by the lateral border of the latissimus dorsi muscle, anteriorly by the posterior border of the external oblique, and the base is formed by the iliac crest. In our experience, palpation of this landmark can be difficult in obese patients. In addition, the triangle of Petit is often several centimeters posterior to the midaxillary line, making it a more awkward injection point on supine patients. Finally, because in some patients, the iliohypogastric nerve enters the TAP anterior to the triangle of Petit, injections at midaxillary line may more directly target the relevant nerves [14].

Ours is a small pilot study involving emergency physicians with extensive experience in ultrasound-guided anesthesia and as such has several limitations. Physicians without experience in ultrasound-guided nerve blocks may be challenged by the depth of the target TAP, which could lead to longer procedural times and higher failure rates than we observed in our study. The visceral innervation of the peritoneal cavity remains unaffected by TAP or IL/IH blocks, and in certain instances, such as some postoperative inguinal herniorrhaphy patients with viscerally mediated pain, additional analgesia may be necessary. Patients with wounds or abscesses that cross midline require bilateral blocks leading to an increased total local anesthetic dose and increased procedural time. Further prospective study is needed to more comprehensively evaluate the practicality and utility of ultrasound-guided abdominal wall blocks vs the already well-established techniques of local infiltration and procedural sedation.

Complications associated with the ultrasound-guided technique are very rare [15]. With the blind technique, penetration of the peritoneal cavity leading to bowel and liver injury has been reported [16]. Local anesthetic spread to the femoral nerve sheath with resulting palsy has also been reported [17]. Local toxicity could occur if very large volumes are used for bilateral blocks, but it can be easily avoided using standard dosing guidelines. Given the anatomy of the TAP, nerve injury and intravascular injection are unlikely if standard precautions are used.

5. Conclusion

In our case series of 4 patients, ultrasound-guided abdominal wall blocks provided excellent anesthesia for abdominal wall procedures in the ED. The ultrasound-guided TAP block and IL/IH block may be attractive alternatives to procedural sedation for ED treatment of large abdominal wall wounds or abscesses for some patients. Further prospective investigation of these promising techniques is warranted.

References