

Low-dose dexmedetomidine as adjuvant to serratus anterior plane block for chest trauma in critically ill patient: Three case reports

Yoğun bakım hastasında toraks travması için serratus anterior plan blokuna adjuvan olarak düşük doz deksmedetomidin: Üç olgu sunumu

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ABSTRACT

Serratus anterior plane block (SAPB) is an effective regional anesthesia technique for chest wall analgesia. In this article, we report three cases of critically ill patients with chest trauma in whom a single-shot SAPB combined with low-dose dexmedetomidine (DEX) was used as part of a multimodal analgesia strategy. In all cases, SAPB with DEX provided effective and prolonged analgesia, with pain relief lasting up to 72 hours. The technique also contributed to improved respiratory function and facilitated clinical decision-making during the weaning process in one patient by helping to distinguish pain-related respiratory limitation from diaphragmatic dysfunction. In conclusion, SAPB with low-dose DEX may be a safe and effective option for chest wall analgesia at T3-T8 levels, even in polytrauma patients.

Keywords: Chest trauma, intensive care unit patient, locoregional anesthesia, multimodal analgesia, polytraumatized, rib fractures, serratus anterior plane block.

Chest wall trauma with multiple rib fractures is a typical presentation in polytraumatized patients entering intensive care unit (ICU) with a major trauma diagnosis. Pain management should commence either from the prehospital or from the emergency department because inadequate analgesia in patients with thoracic trauma has a significant impact on morbidity and mortality, thereby leading to consequences such as hypoventilation, atelectasis,

ÖZ

Serratus anterior plan bloku (SAPB), göğüs duvarı analjezi için etkili bir rejyonel anestezi tekniğidir. Bu makalede, göğüs travması olan kritik durumdaki üç hastada, multimodal analjezi yaklaşımının bir parçası olarak düşük doz deksmedetomidin (DEX) ile kombine edilen tek doz SAPB uygulaması sunuldu. Tüm olgularda SAPB ile DEX kombinasyonu, 72 saate kadar süren etkili ve uzamış analjezi sağladı. Ayrıca bu teknik, solunum fonksiyonlarının iyileşmesine katkıda bulundu ve bir hastada mekanik ventilasyondan çekilme sürecinde, ağrıya bağlı solunum kısıtlılığı ile diyafragmatik disfonksiyonun ayırt edilmesine yardımcı olarak klinik karar verme sürecini kolaylaştırdı. Sonuç olarak, düşük doz DEX ile SAPB, özellikle politravmalı hastalarda dahi T3-T8 düzeylerinde göğüs duvarı analjezi için güvenli ve etkili bir seçenek olabilir.

Anahtar sözcükler: Göğüs travması, yoğun bakım ünitesi hastası, lokal anestezi, multimodal analjezi, çoklu travma, kaburga kırıkları, serratus anterior düzlem bloğu.

insufficient coughing and clearance of secretions, and ventilator-acquired pneumonia (VAP).^[1]

As part of multimodal analgesia, it is desirable to reduce opiates, which can exacerbate hypoventilation, sedation, increase the risk of nausea and vomiting, and hinder early patient mobilization. Multimodal analgesic strategies should encompass acetaminophen, non-steroidal anti-inflammatory drugs (NSAIDs), adjuvants, and locoregional

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analgesia techniques, including thoracic epidurals, paravertebral blocks, and intercostal nerve blocks. However, the use of these techniques may not always be feasible due to trauma-induced coagulopathy, exposed wounds, spine injury, active infections, or difficulties in positioning the patient in a lateral or sitting decubitus posture.^[2]

Serratus anterior plane block (SAPB) is gaining increasing importance as a regional anesthesia technique. It involves the injection of a long-acting local anesthetic into the fascial plane between the serratus anterior and latissimus dorsi muscles, resulting in blockade of the lateral intercostal nerves and their lateral cutaneous branches, as well as providing analgesia to branches of the thoracodorsal and long thoracic nerves (T3-T8).^[3] Addition of adjuvants such as dexmedetomidine (DEX) can improve duration and effectiveness of analgesia, at the time of writing of this case report, the literature suggests 1 µg/kg/min, but in polytraumatized patient, caution must be taken to monitor possible systemic reabsorption or interference/summation effect with systemic analgesation.^[4]

In this article, we present three cases in whom ultrasound-guided SAPB was performed upon admission to ICU, with addition of DEX 0.4 µg/kg.

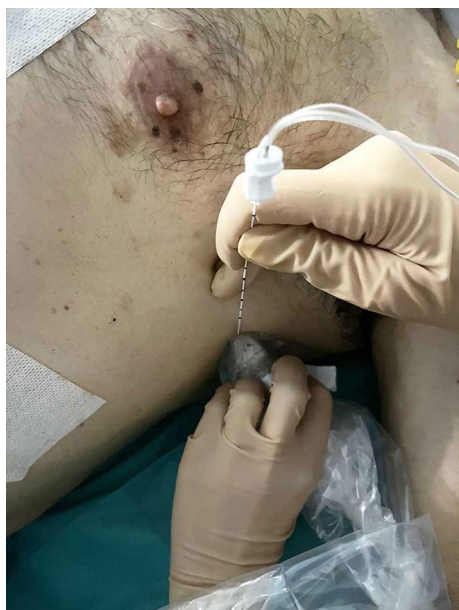


Figure 1. Ultrasound guided mediolateral approach to SAPB. At fifth-sixth rib level, in sterile condition, a linear probe (Samsung HS50™) positioned transversally to midaxillary line, echogenic needle 100 mm 22 Gauge (Temena Ultrasound SAS™) inserted in medio-lateral direction with in-plane technique.

CASE REPORT

Case 1– A 73-year-old male patient weighing 80 kg, with Injury Severity Score (ISS) 27, presented multiple rib fractures (II-VIII) in left hemithorax, compound sternum fracture, splenic rupture, femur and humerus discomposed fractures, and an L2 soma fracture. He was spontaneously breathing with a Ventimask® (Flexicare Medical Limited, UK) delivering fraction of inspiratory oxygen (FiO₂) 50%. He was hemodynamically stable and mildly sedated with a continuous intravenous infusion of morphine. On Day 2, ultrasound-guided SAPB block was performed, with a mediolateral approach, injecting 30 mL of ropivacaine 0.375 mg and 30 µg of DEX, at the VI intercostal space (Figure 1). The patient reported immediate pain relief, with the Numeric Rating Scale (NRS) score decreasing from 9 to 3, accompanied by resolution of functional movement limitations and improvement in respiratory mechanics and oxygenation. Morphine infusion was gradually reduced and eventually discontinued, and the patient was continued on paracetamol and ketorolac as needed. Block lasted for 72 hours. A written informed consent was obtained from the patient for publication of this case report.

Case 2– A 72-year-old female patient weighing 65 kg, with ISS 50, experienced polytrauma due to a car accident, resulting in a left diaphragmatic lesion, pneumothorax with III-IX rib fractures, splenic laceration, and left ankle fracture. She underwent diaphragmatic suture and had two thoracic tubes, as

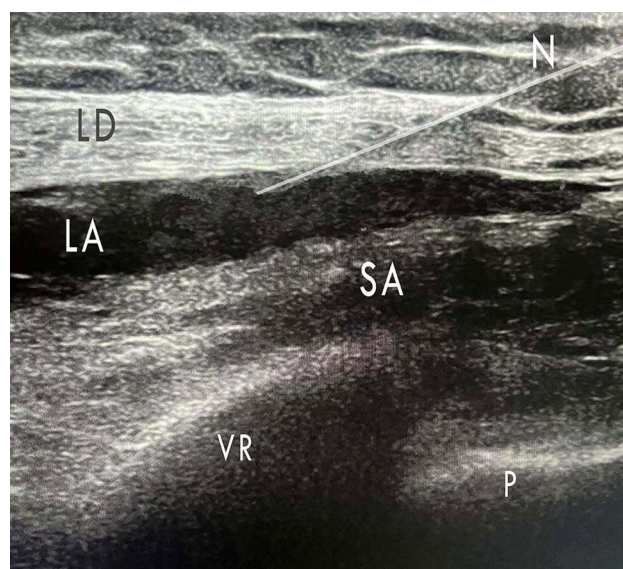


Figure 2. Ultrasound visualization of SAPB block. LD, latissimus dorsi muscle; SA, serratus anterior muscle; VR, fifth rib, P: pleura; SAPB, serratus anterior plane block; LA, anesthetic pouch on fascial plane of SAPB, N, needle.

well as a splenectomy. She was mechanically ventilated with FiO₂ 45% and was analgosedated with morphine and propofol, while maintaining pharmacological hemodynamic stability. An ultrasound-guided SAPB was performed in anticipation of the weaning process. Using a mediolateral approach, 30 mL of ropivacaine 0.375% and 25 µg of DEX, were injected at the V intercostal space (Figure 2). This resulted in reduced opiate usage and successful weaning, leading to extubation. The NRS was 1 for approximately 65 hours, after which non-invasive ventilation was initiated. However, due to left hemi-diaphragmatic paralysis, reintubation was required. The SAPB aided in differentiating between pain and diaphragmatic paralysis as potential causes for weaning failure. A written informed consent was obtained from the patient for publication of this case report.

Case 3– A 45-year-old male patient weighing 75 kg was admitted with a diagnosis of mild head injury, ISS 27, and Glasgow Coma Scale (GCS) 13 (E3V4M6). He was spontaneously breathing with high-flow nasal cannula providing FiO₂ 60% at a flow rate of 60 L/min, thoracic trauma with multiple bilateral rib fractures (II-V on the left and III-VIII on the right), bilateral lung contusions, non-surgical hepatic laceration, splenic contusion, and a foot fracture. Norepinephrine support was administered at a rate of 0.3 µg/kg/min. Bilateral SAPB blocks at the V-VI ribs were performed, as soon as he was admitted to ICU, injecting 25 mL of ropivacaine 0.375% and 25 µg of DEX for each hemithorax. A catheter with a multi-orifice-tip was placed in the serratus anterior muscle plane to facilitate patient-controlled analgesia (PCA). Interestingly, there was no necessity for local anesthetic boluses in the subsequent three days. After a period of 72 hours, the catheter was removed. The patient reported immediate pain relief NRS 2 and improved oxygenation, allowing for a reduction in FiO₂ to 40%. Acetaminophen and NSAIDs provided sufficient analgesic relief. The effect of the block lasted for 72 hours. A written informed consent was obtained from the patient for publication of this case report.

In all three patients, we achieved the desired dermatomeric extension from T3 to T9, resulting in an average reduction of NRS from 8 to 3, a 60% reduction in opioid dosages for those undergoing analgosedation or sedoanalgesia. This significant analgesic effect led to improvements in respiratory function, respiratory drive, depth of breathing, and hematology, subsequently reducing FiO₂ in all three cases. It played a decisive role in facilitating weaning

process, particularly notable in weaning success of Patient No. 2, where adequate analgesia was a fundamental discrimin amongst the differential diagnosis of failed weaning. Furthermore, employing DEX at 0.4 µg/kg proved to be both safe and effective, no side effects such as hypotension or bradycardia followed, there were no interference with sedative plan or systemic reabsorption. It ensured the desired analgesia with a prolonged duration of 65 to 72 hours for each single-shot administration. No early or late complications were observed, and all three patients expressed satisfaction with the provided care.

DISCUSSION

In our all three cases, we chose to perform a superficial SAPB in a mediolateral direction, allowing the anesthetic to widely spread within the fascial compartment between serratus anterior muscle and latissimus dorsi muscle, approximately around T3-T8. This approach primarily targets lateral cutaneous branches and, secondarily, rami of long thoracic nerve and thoracodorsal nerve. Consequently, this approach is considered more effective in terms of analgesia and in preventing development of chronic neuropathy of intercostal nerves.^[5]

For all patients, we reported a significant 60% reduction in the NRS score, subsequently limiting the administration of opioids. We maintained intravenous analgesia in accordance with multimodal protocols applicable in our trauma center. The SAPB also facilitated patient mobilization and nursing without any complications or a prolonged length of stay in the ICU. In all cases we observed no immediate complications during block performance.

The most notable finding of this report is the substantial prolongation of analgesia achieved using DEX at a lower dose than typically reported in the literature. While previous studies have suggested doses of approximately 1 µg/kg as adjuvants in fascial plane blocks, our experience indicates that a reduced dose of 0.4 µg/kg provided effective analgesia for more than 72 hours, adequately covering the most painful period associated with this type of trauma. This prolonged effect was sufficient to obviate the need for fascial catheter placement in one of the cases. In this context, potential risks, including infection, catheter dislodgement, management difficulties, and proximity to chest drainage systems, were considered to outweigh the anticipated benefits. The analgesic effects of DEX have been proposed to be mediated by peripheral mechanisms, primarily due to its highly selective affinity for alpha-2 adrenergic receptor (α₂AR). Secondly, it

acts on presynaptic neuronal receptors, resulting in a reduction of norepinephrine release at peripheral afferent nociceptors. Additionally, DEX has been found to inhibit delayed rectifier K⁺ current and Na⁺ current, effectively reducing overall neuronal activity.^[6] On the other hand, the optimal dose of DEX in chest wall blocks for polytraumatized patients has not been thoroughly examined yet. While there are few cases in the literature studying DEX at a dosage of 0.5 µg/kg/min in patients undergoing thoracic surgery,^[7] a recent meta-analysis suggests that dosage of DEX (0.5/> 1 µg/kg) did not significantly affect duration or effectiveness of the blockade.^[8] This rationale could potentially extend to SAPB, although further studies are warranted.

Another notable finding was the improvement in respiratory drive observed in all three patients. It proved particularly valuable during weaning process, particularly aiding in the differential diagnosis of weaning failure in Patient No. 2.

In conclusion, SAPB may be considered for the management of chest trauma in critically ill patients. We regard it as a viable and low-risk procedure that contributes to reducing opioid requirements without interfering with the patient's overall analgesia and sedation strategy. Moreover, SAPB may support the weaning process through multiple mechanisms. Based on our clinical experience, we also support the use of low-dose DEX in this setting, given its observed efficacy and lack of adverse effects. Nevertheless, further randomized-controlled trials are needed to determine the optimal dosing strategy and to confirm its clinical effectiveness.

Author Contributions

F.D.S., P.F., G.F.: Idea/concept, writing the article; F.D.S., G.M.P.: Design, data collection and/or processing; F.D.S., G.M.P., E.A., P.F.: Control/supervision; L.G., G.F., R.C.: Analysis and/or interpretation; L.G., G.F., E.A.: Literature review; E.A., B.C.: Critical review, materials; F.D.S., P.F., G.F.: References and fundings.

Conflict of Interest

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Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

AI Disclosure

The authors declare that artificial intelligence (AI) tools were not used, or were used solely for language editing, and had no role in data analysis, interpretation, or the formulation of conclusions. All scientific content, data interpretation, and conclusions are the sole responsibility of the authors. The authors further confirm that AI tools were not used to generate, fabricate, or 'hallucinate' references, and that all references have been carefully verified for accuracy.

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