Agri 2024;36(4):276–280
doi: 10.14744/agri.2022.47750

CASE REPORT

Early diagnosis and treatment management with USG in a patient who developed unilateral diaphragmatic paralysis after interscalene block

İnterskalen blok sonrası tek taraflı diyafram paralizisi gelişen hastada USG ile erken tanı ve tedavi yönetimi

Zülfü ÇEVİK,* Deniz KARA, Ayda TÜRKÖZ§

Summary

Interscalene brachial plexus block is frequently used for anesthesia and analgesia in shoulder, clavicle, and humerus surgeries. However, complications such as infection, hematoma, vascular injury, local anesthetic toxicity, nerve damage, total spinal anesthesia, diaphragmatic paralysis, and Horner syndrome may occur after an interscalene block. In this case report, a case of unilateral diaphragmatic paralysis that developed after an ultrasound-guided interscalene brachial plexus block for intraoperative and postoperative analgesia, which was rapidly diagnosed and treated bedside with ultrasound, is presented and discussed. We believe that ultrasound has become an indispensable means of monitoring anesthesia practice, both in peripheral nerve block and in the diagnosis and treatment of complications, in recent years.

Keywords: Diaphragmatic paralysis; interscalene brachial plexus block; perioperative analgesia; phrenic nerve palsy; thoracic ultrasonography.

Özet

İnterskalen brakiyal pleksus bloğu, omuz, klavikula ve humerus ameliyatlarında anestezi ve analjezi amacıyla sıkça kullanılmaktadır. Ancak, interskalen blok sonrası enfeksiyon, hematom, vasküler yaralanma, lokal anestezik toksisitesi, sinir hasarı, total spinal anestezi, diyafram paralizisi ve Horner sendromu görülebilmektedir. Bu olgu sunumunda, intraoperatif ve postoperatif analjezi amacıyla ultrason rehberliğinde yapılan interskalen brakiyal pleksus bloğu sonrasında gelişen ve ultrason ile hızla yatak başı tanı ve tedavisi uygulanan tek taraflı diyafram paralizisi olgusu, literatür eşliğinde sunularak tartışılmıştır. Son yıllarda ultrasonun anestezi pratiğinde, hem periferik sinir bloğu uygulamalarında hem de komplikasyonların erken tanı ve tedavisinde önemli bir yatak başı monitörizasyon yöntemi olduğunu düşünmekteyiz.

Anahtar sözcükler: Diyafram paralizisi; frenik sinir palsi; interskalen brakiyal pleksus bloğu; toraks ultrasonografisi.

Introduction

Interscalene brachial plexus block is the most frequently used peripheral nerve block method. It is used for anesthesia and analgesia in shoulder, clavicle, and humerus surgeries.[1] The advantages, arising from the fact that it is an effective anesthesia and analgesia method that can reduce the amount of perioperative general anesthetics and opioids and decrease the duration of hospital stay, make it a commonly used method.[1] However, major complications can often be encountered due to the anatomical proximity of the application site to the stellate ganglion, phrenic nerve, recurrent laryngeal nerve, spinal cord, subclavian artery, and pleura.[2]

In spite of varied local anesthetic volume/concentration applications of different levels such as upper trunk/lower trunk, neurological complications such as paresthesia, numbness, and motor weakness are seen in three out of every 1000 cases,[3] and phrenic nerve palsy can occur although the volume is reduced down to 5 ml.[4]

Department of Anesthesiology and Reanimation, Bezmialem Vakıf University Faculty of Medicine, İstanbul, Türkiye

The current affiliation of the authors:
***: Department of Anesthesiology and Reanimation, Acıbadem Fulya Hospital, İstanbul, Türkiye**
§: Department of Anesthesiology and Reanimation, Medipol Acıbadem Regional Hospital, İstanbul, Türkiye

Submitted ***(Başvuru):*** **16.12.2021** **Revised** ***(Revize):*** **27.01.2022** **Accepted** ***(Kabul):*** **01.02.2022** **Available online** ***(Online yayımlanma):*** **07.10.2024**

Correspondence: Dr. Deniz Kara. Bezmialem Vakıf Üniversitesi Tıp Fakültesi, Anesteziyoloji ve Reanimasyon Anabilim Dalı, İstanbul,Türkiye
Phone: +90 - 212 - 523 22 88 **e-mail:** drdenizkara83@gmail.com

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Early recognition and treatment of complications are necessary to prevent potentially fatal outcomes.[5] The fact that ultrasonography is commonly used in regional blocks, especially in recent years, helps decrease the major complications arising due to plexus block and allows for correct follow-up and treatment through a quick diagnosis at the bedside. Diaphragmatic ultrasound has been shown to have high sensitivity (93%) and specificity (100%) in diagnosing phrenic nerve dysfunction.[6]

This case report aims to present and discuss a case of unilateral diaphragmatic paralysis that developed after an ultrasound-guided interscalene brachial plexus block for intraoperative and postoperative analgesia.

Case Report

A 37-year-old male patient, who was scheduled for surgery due to a left clavicle fracture by the orthopedic clinic, applied to the anesthesia outpatient clinic for preoperative evaluation. An interscalene block was scheduled for general anesthesia and perioperative analgesia as an anesthesia method, with the American Society of Anesthesiologists (ASA) risk of 1. An informed consent form was obtained from the patient for general anesthesia and block application. Preoperative intravenous (IV) 2 mg midazolam (Zolamid, Vem İlaç) was administered to the patient. The patient, who was taken to the operating room, was monitored noninvasively in accordance with the ASA standards. The patient, whose initial blood pressure, heart rate, and oxygen saturation (SpO_2) values were normal, was intubated during anesthesia induction with 100 mcg fentanyl (Fentaver, Haver), 200 mg propofol (Propofol, Polifarma), and 50 mg rocuronium (Esmeron, Merck). The anesthesia maintenance of the patient, to whom volume-controlled ventilation was initiated so that end-tidal CO_2 was 33–35 mmHg, was ensured with sevoflurane (Sevorane, AbbVie) with a MAC (minimum alveolar concentration) of 1.5 and 0.2 mcg/kg/min IV remifentanil (Rentanil, Vem İlaç) infusion in an air/oxygen mixture.

The patient's head was turned to the right, the arm to be blocked was adducted, and the forearm was flexed. The 8–12 MHz high-frequency linear probe of the ultrasound device (GE Healthcare LOGIQ Vision Series) was guided at the cricoid cartilage level from the midline to the lateral at the transverse oblique plane, and the brachial plexus was revealed at the interscalene groove level. A 50 mm 22G stimulator needle (Stimuplex A, Braun) was advanced to the left interscalene area by in-plane technique, and a solution containing 10 ml 0.5% bupivacaine (Buvicaine, Pollifarma) and 5 ml isotonic was injected by performing intermittent negative aspiration to surround the brachial plexus. During the operation, sevoflurane was gradually reduced down to a MAC of 0.5 and remifentanil to 0.05 mcg/kg/min so that the heart rate and blood pressure remained at normal values. The patient, whose vital signs remained within normal limits during the operation that lasted for two hours, was extubated by administering 150 mg sugammadex (Bridion, Merck) at the end of the operation.

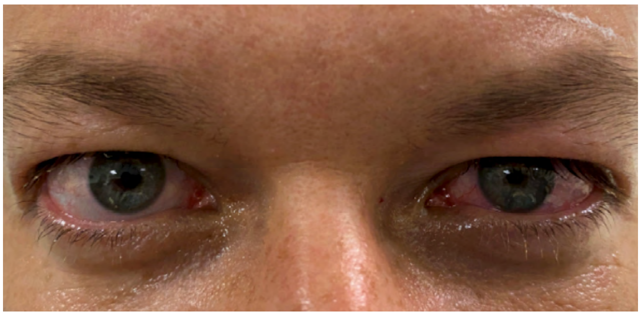

Figure 1. Increase in conjunctival congestion, ptosis, miosis.

The congestion in the conjunctiva of the operated side of the patient, who was taken to the postoperative recovery room, was remarkable (Fig. 1), and the patient stated that he had difficulty breathing. In his vitals measured simultaneously, blood pressure and heart rate were normal, but SpO_2 was 88%. There was no crepitation or edema under the skin.

When we evaluated the plexus block, the VAS (Visual Analogue Scale) score was 0 (no pain), and the Modified Bromage Scale score was 2 (neither shoulder abduction nor elbow flexion) in the motor function evaluation. The SpO_2 value of the patient, who received oxygen support with a 5 lt/min mask, was observed to increase to 90%. In the bedside lung ultrasound evaluation, when we placed the 2–8 MHz convex ultrasound probe at the anterior axillary line, there was no left diaphragm movement in the B-mode and no displacement in the M-mode (Fig. 2) on the same side with deep inspiration. In the portable chest radiography taken bedside, the

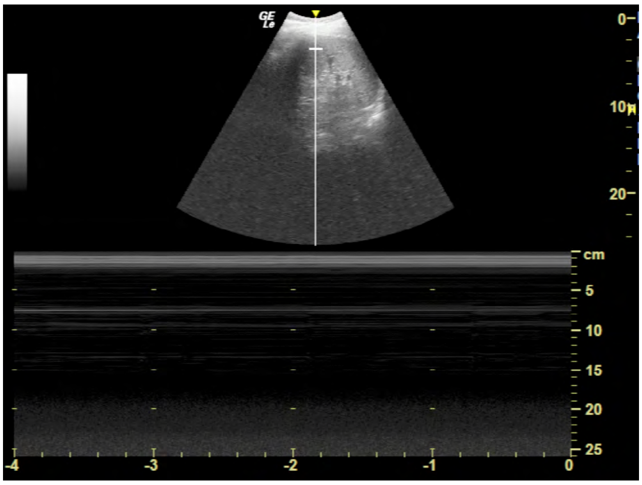

Figure 2. M-mode diaphragm ultrasound image.

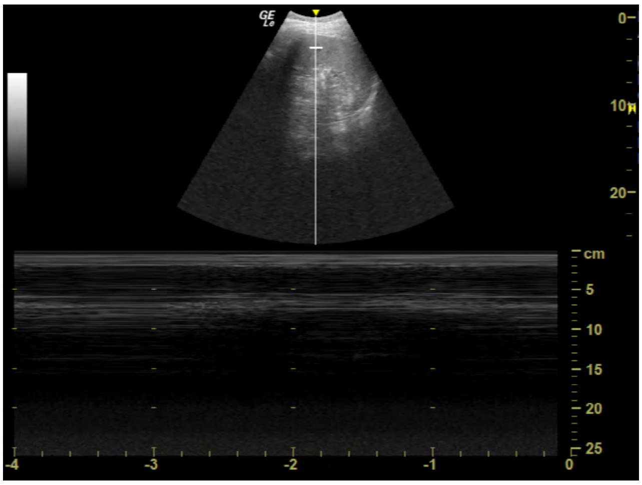

Figure 4. M-mode diaphragm ultrasound image.

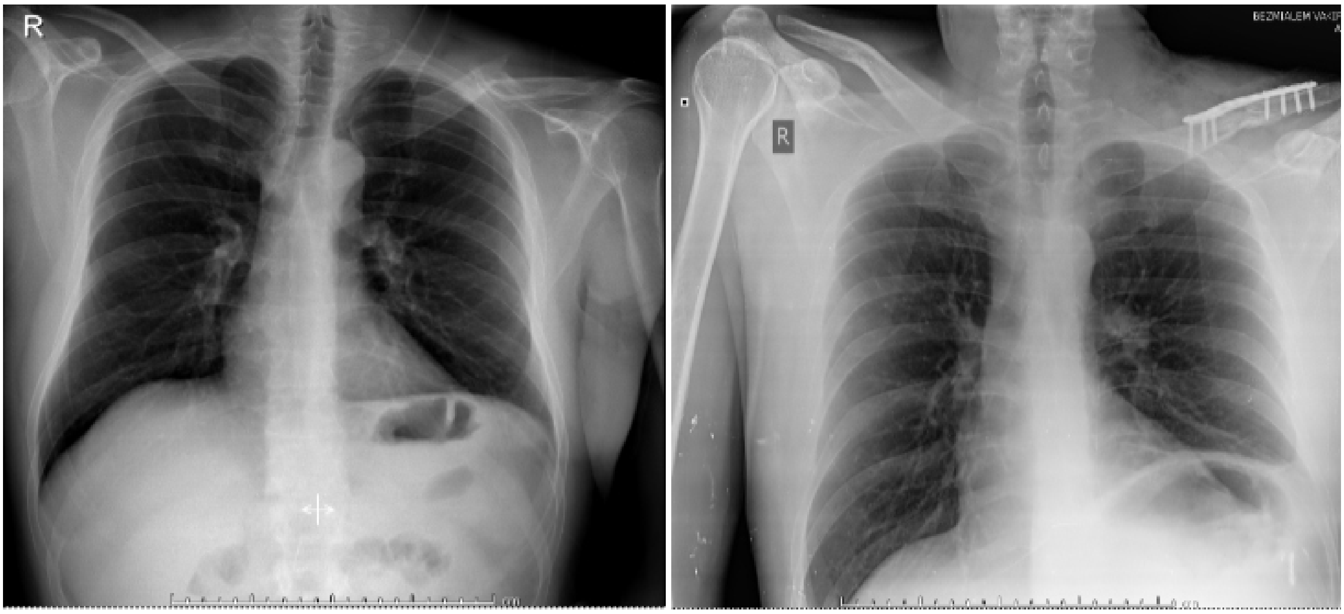

Figure 3. Preoperative and postoperative PA chest radiography.

left diaphragm was displaced 2 cm towards the cephalad compared to the preoperative chest radiography (Fig. 3). As the patient's respiratory distress could not be relieved with low-flow oxygen support, it was switched to a high-flow nasal cannula (Precision Flow Hi-VNI, Vapotherm). After the SpO_2 value of the patient, who was followed up for one and a half hours under 40% oxygen support at 15 lt/min, increased above 94%, a movement of 1 cm in the diaphragm in the M-mode was detected in the ultrasound imaging performed again (Fig. 4).

The respiration of the patient, for whom high-flow oxygen support was switched to low-flow 2 lt/min oxygen support, was observed to improve after 2 hours of PACU (Post-Anesthetic Care Unit) monitoring. Oxygen therapy was terminated when the left diaphragm movement was seen to return to normal in the lung ultrasound repeated one hour later. The patient, whose SpO_2 value was 98% at room air, was transferred to the service with a VAS score of 0 and a Modified Bromage Score of 1.

Discussion

Our patient, who reported that he could not breathe comfortably in the recovery room, had no smoking history, and his preoperative physiological health score was normal. First of all, we aimed to eliminate pneumothorax and/or phrenic nerve palsy in the differential diagnosis, as no airway-related complication developed during awakening. In the first 5 minutes, we detected 100% diaphragmatic paralysis with ultrasound performed at the bedside.

Infection, hematoma, vascular injury, local anesthetic toxicity, nerve damage, total spinal anesthesia, diaphragm paralysis, and Horner syndrome may occur after interscalene block.[7] The incidence of diaphragmatic paralysis is reported as 1–60% in various sources.[8,9] When the interscalene block is performed using the landmark technique and high volume is used, phrenic nerve damage occurs as a mild to moderate complication in almost all cases.[2] However, as permanent phrenic nerve injury cases have been reported, albeit rarely, in the literatüre,[10] and as this damage might cause mortality due to acute respiratory distress, this issue must be addressed more elaborately.

Three principal causes in the etiology of phrenic nerve damage are stated to be the volume of the local anesthetic, anatomical proximity to the phrenic nerve, and nerve injury.[10] Reducing the volume of the local anesthetic can reduce the incidence from 92% to 2%.[11] Another reason is anatomical proximity. At the level of the cricoid cartilage, the phrenic nerve is located 2 mm from the brachial plexus and then moves 3 mm further away with every 1 cm.[12] Therefore, blocks made at the cricoid level have a higher incidence of nerve damage than those made at lower levels. In their studies, Weismann et al.[12] reported the rate of phrenic nerve palsy as 43% in the interscalene group and 21% in the suprascapular group.

We applied the interscalene block to our patient with ultrasound, which has become a part of our routine practice. We used low volume and low concentration local anesthetics to reduce the risk of block-related complications. However, probably because we applied the block from the upper trunk, the spread to the adjacent tissue could not be prevented. Redness in the eyes, drooping of the eyelid (Horner syndrome), and diaphragm paralysis developed.

The most frequent symptom after diaphragmatic paralysis is dyspnea.[8] In emergencies characterized by dyspnea, respiratory causes such as pneumothorax and pulmonary embolism, cardiac causes such as acute coronary syndrome, and circulatory causes such as anaphylaxis should be evaluated in the differential diagnosis. With bedside ultrasound, we can diagnose possible complications and also make the differential diagnosis of other etiologic causes quickly. In our case, the diagnosis was made within the first 5 minutes in the recovery room with the help of lung ultrasound, and treatment was started immediately.

The sensitivity and specificity of lung ultrasound in diagnosing diaphragm dysfunction are close to 100%.[9] The assessment of phrenic nerve palsy using ultrasound relies on visualizing the diaphragm and quantifying the magnitude and direction of its movement with respiration. The most common method involves placing a 3- to 5-MHz curved array transducer inferior to the costal margin and in a longitudinal parasagittal orientation in the anterior axillary line on the left or in the midclavicular line on the right. The ultrasound beam is directed medially and cephalad to visualize the posterior third of the hemidiaphragm by using either the spleen or the liver as an acoustic window in a two-dimensional B-mode, where the diaphragm appears hyperechoic (white) and linear. M-mode can then be used to quantify the amount of displacement or lack thereof during a normal respiratory cycle.[10] While a decrease of 25–75% is observed in caudal movement during the sniff test in partial paralysis, a decrease of 75% in caudal movement or paradoxical movement of the diaphragm toward the cephalad can be seen in complete paralysis.[13] In our patient, there was no diaphragm movement in M-mode. His breathing was relieved with the high-flow nasal cannula. When we reevaluated our patient, whose respiratory distress regressed and oxygen need decreased after his 1.5 hours of follow-up, with ultrasound in M-mode, we saw a displacement movement of 1 cm in the diaphragm.

As a result, bedside ultrasonography provided noninvasive diaphragm imaging with high sensitivity and specificity, while also providing the opportunity to use a high-flow nasal cannula.

Authorship Contributions: ***Concept – ZÇ, DK, AT; Design – ZÇ, DK, AT; Supervision – ZÇ, DK, AT; Resource – ZÇ, DK; Materials – ZÇ, DK; Data collection and/or processing – ZÇ, DK; Analysis and/or interpretation – AT; Literature review – ZÇ, DK; Writing – ZÇ, DK; Critical review – AT.***

Conflict-of-interest issues regarding the authorship or article: None declared.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Use of AI for Writing Assistance: Not declared.

Peer-rewiew: Externally peer-reviewed.

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