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US-Guided Axillary Approach of Brachial Plexus Block for Forearm Fracture

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ABSTRACT

Background: In Emergency Departments (EDs), procedural sedation analgesia, hematoma block, intravenous regional anaesthesia and peripheral nerve blocks are usually used for pain control in forearm fractures. We aimed to review the results of Visual Analog Scale (VAS) scores (during examination and reduction), post reduction neurovascular examinations and complications of forearm fractures which were applied US-guided axillary approach of brachial plexus block (AABPB).

Patients and Methods: We described fourteen patients, who presented to the ED with forearm fractures, and were reduced using US-guided AABPB performed by emergency physicians. The same technique was used for all fourteen nerve blocks. We reviewed the results of VAS scores (during examination and reduction), post reduction neurovascular examinations and complications of forearm fractures who were applied AABPB.

Results: Of the 14 patients admitted to study, the mean age was 59.92 ±12,81 (36.00 – 82.00). Mean VAS score of patients before procedures was 91.57 ± 3.99 (85,00 – 98.00) mm. The US-guided AABPB was performed by emergency physicians and nerve block fracture was reduced. 20 minutes after reduction, mean VAS score of patients was 10.21 ± 5.36 (0 – 19.00) mm. performed (Table 1). All patients were discharged after approximately eight hours' observation period and post-reduction neurovascular examinations were normal. There were no complications during block and reduction.

Conclusion: US-guided axillary approach of brachial plexus block is a technique that can be applied easily in the ED by emergency physicians for forearm fractures. In this technique, the procedural success rate is high, and it was noticed a high level of patient and physician satisfaction.

Keywords: Axillary, forearm, fracture, peripheral nerve block

ÖN KOL KIRIKLARINDA USG EŞLIĞINDE AKSILLER YAKLAŞIMLI BRAKIAL PLEKSUS BLOĞU

ÖZET

Amaç: Acil Servislerde, ön kol kırıklarında ağrı kontrolü için genelde prosedürel sedasyon analjezi, hematom bloğu, intravenöz rejyonel anestezi ve periferal sinir blokları kullanılmaktadır. Ön kol kırıklarında, USG eşliğinde aksiller yaklaşımlı brakial pleksus bloğu (AABPB) uygulanan kişilerde, vizüel ağrı skalasını (muayene sırasında ve redüksiyonda), redüksiyon sonrasındaki nörovasküler muayene ve komplikasyonları gözden geçirmeyi hedefledik.

Hastalar ve Yöntem: Acil Servise ön kol kırığı ile başvuran ve acil hekimleri tarafından USG eşliğinde AABPB uygulanarak redükte edilen 14 hasta tarif edildi. 14 hastaya da aynı teknik uygulandı. Ön kol kırığında AABPB uygulananların, VAS skorlarını (muayene sırasında ve redüksiyon esnasında), redüksiyon sonrası nörovasküler muayenelerini ve komplikasyonlarını gözden geçirdik

Bulgular: Çalışmaya 14 hasta dahil edildi ve hastaların ortalama yaşları 59.92 ±12,81 (36.00 – 82.00) idi. Ortalama VAS skorları prosedür öncesi 91.57 ± 3.99 (85,00 – 98.00) mm. idi. USG eşliğinde AABPB acil servis hekimi tarafından uygulandı ve blok sonrasında kırık redükte edildi. Hastaların 20 dakika sonrasındaki redüksiyon sırasındaki VAS skorları 10.21 ± 5.36 (0 – 19.00) mm. idi. Tüm hastaların yaklaşık sekiz saat gözlem sonrasındaki redüksiyon sonrası nörovasküler muayeneleri normaldi. Redüksiyon ve blok esnasında herhangi bir komplikasyon bildirilmedi.

Sonuç: USG eşliğinde AABPB, ön kol kırıklarında acil servis hekimleri tarafından acil serviste kolayca uygulanabilir bir tekniktir. Bu teknikte, prosedür başarı oranı yüksek ve hasta ve hekim memnuniyetinin yüksek düzeyde olduğunu fark ettik.

Anahtar sözcükler: Aksiller, önkol, kırık, periferal sinir bloğu

Upper extremity fractures are one of the most frequent reasons for admission to an Emergency Department (ED), comprising 15% of ED applications (1, 2). About 44% of these fractures are on radius and ulna (3). Management of these fractures is important, as these bones are directly responsible for wrist and elbow functions (2). In EDs, procedural sedation analgesia (PSA), hematoma block, intravenous regional anaesthesia (Bier's block), brachial plexus and peripheral nerve blocks (PNBs) are usually used for pain control in the reduction of upper extremity fractures and dislocations (4, 5). The brachial plexus may be blocked using supraclavicular, interscalene, infraclavicular and axillary approaches. Axillary approach of brachial plexus block (AABPB) with bedside ultrasound is a useful technique with promising results in this area in ED. We describe fourteen patients who presented to the ED with forearm fractures, and were successfully reduced using US-guided AABPB performed by emergency physician. Despite common usage of AABPB by anaesthesiologists, this is the first implementation by emergency physician for -in pain management.

Material and methods

Patients and methods

we describe fourteen patients, who presented to the ED with forearm fractures, and were reduced using US-guided AABPB performed by emergency physicians. In the current study, we reviewed the results of Visual Analog Scale (VAS) scores (during examination and reduction), post reduction neurovascular examinations (PRNVE) and complications of forearm fractures who were applied AABPB. The same technique was used for all fourteen nerve blocks. The exclusion criteria were: age < 18 years and presence of allergic reaction to local anaesthetic agents.

US-guided axillary approach of brachial plexus block procedure

aABPB was applied to the patients using 22 G needle and 20 cc prilocaine in ED. The patients were placed in the supine position before the procedure, to avoid complications like vasovagal syncope that may develop due to local anaesthetic agents (LA). The patients were positioned and the arm to receive the block procedure was abducted to 90 degrees with the palms facing up. The site where the needle was to be placed was cleaned with povidone iodine and the area marked with sterile swabs. Dermal anaesthesia was administered.

The probe was prepared with an application of sterile USG gel. Ultrasound machine (Fuji Film Sonosite, Ultrasound System, 03/2014, USA) with linear transducer (8-14 MHz), was placed on the marked site over the superior axillary fold. Sliding the transducer across the axilla brought the axillary artery (reference structure in the neurovascular bundle) and brachial plexus into view. The axillary artery was the prime point of reference. The axillary artery and vein were determined using a Doppler USG. The terminal branches of the brachial plexus in the axillary sheath were observed as hyperechoic nodules around the anechoic (dark), circular axillary artery (Figure 1a). The median nerve (superior and lateral to the artery, most commonly seen at the 11-12 o'clock position), the ulnar (superior and medial to the artery, 2-3 o'clock position), and the radial (posterolateral or medial to the artery, 4-6 o'clock) nerves were positioned in the axillary sheath. The musculocutaneous nerve (MCN) (commonly located at the 8 to 9 o'clock position) was blocked separately, out of the neurovascular band.

The needle was placed superior to the US probe and advanced slowly through US-guidance (in-plane approach) (Figure 1b). The in-plane approach was the method recommended for needle insertion during AABPB. Guided between the axillary artery and vein, the needle was completely in view while it was advanced.

According to the divisions of plexus sheath, about 25 cc local anaesthetic was given around the radial, median, ulnar and MCN nerves, respectively. Ideally, the radial nerve was targeted first. Use of at least 4-5 mL of LA for each nerve was employed for AABPB effectiveness. One to two mL of the LA were injected as a test dose. If satisfactory, the remaining LA were injected, looking for the 'donut sign'. If the test dose was not satisfactory, the needle was located again, and another test dose was injected.

Statistical analysis

descriptive statistical analyses were performed and quantitative VAS score, PRNVE and complication parameters were reported. Data were presented as mean ± sd and minimum-maximum for normally distributed data. Statistical analyses were performed with SPSS 15.0 (SPSS Inc. Chicago, IL).

Results

The 14 patients admitted to study had a mean age of 59.92 ±12,81 (36.00 – 82.00) year. Mean VAS score of patients before procedures was 91.57 ± 3.99 (85,00 – 98.00) mm. The US-guided AABPB performed by emergency physician and after nerve block fracture was reduced. 20 minutes

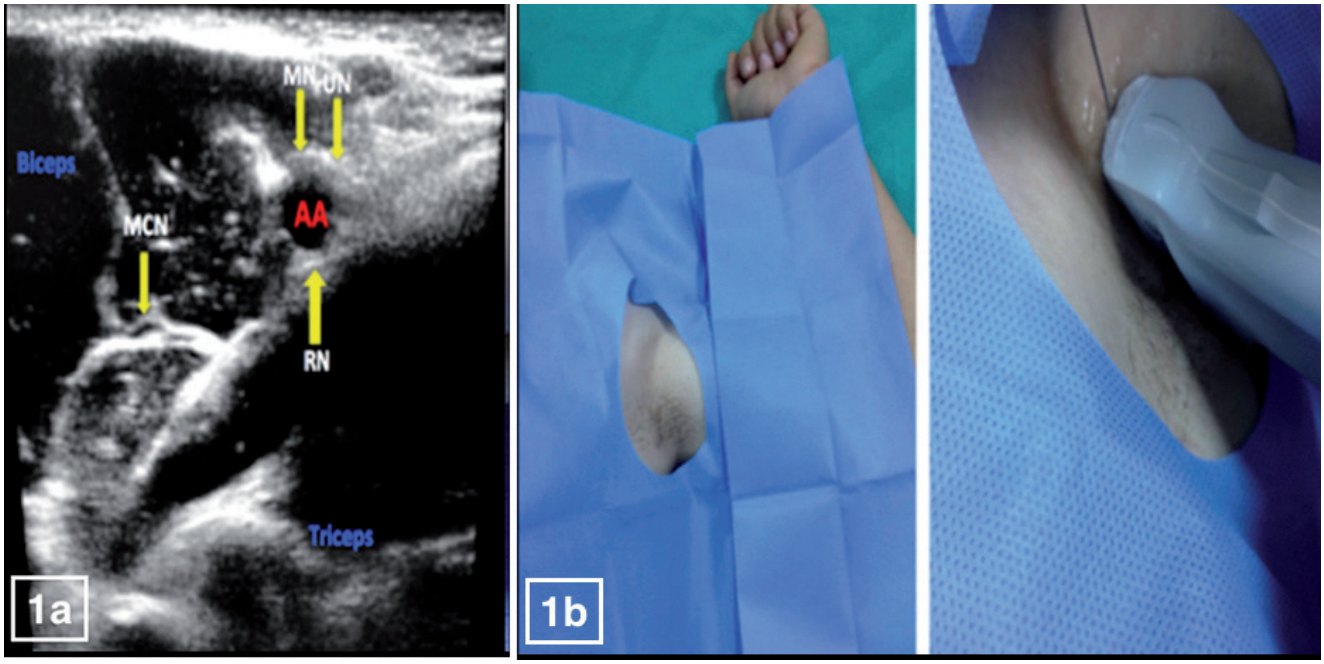

Figure 1A. USG view of anatomic structures during procedure
(**AA:** Axillary Artery, **MN:** Medial Nerve, **UN:** Ulnar Nerve, **RN:** Radial Nerve, **MCN:** Musculocutaneus Nerve) **B:** Location of the axillary puncture side

Table 1. Characteristics of cases

Cases	*Age*	*Direct Radiography Findings*	*VAS (mm) (DE)*	*VAS (mm) (DR)*	*PRNVE*	*Complications*
1	78	Radius and ulna distal fracture	92	11	Normal	None
2	42	Radius and ulna distal fracture	94	0	Normal	None
3	57	Radius and ulna distal fracture	98	13	Normal	None
4	55	Radius distal fracture	88	5	Normal	None
5	61	Radius distal fracture	85	0	Normal	None
6	66	Radius and ulna fracture	96	9	Normal	None
7	76	Radius and ulna distal fracture	94	19	Normal	None
8	82	Radius and ulna distal fracture	92	12	Normal	None
9	36	Radius distal fracture	85	10	Normal	None
10	52	Radius distal fracture	89	13	Normal	None
11	56	Radius and ulna distal fracture	96	12	Normal	None
12	62	Radius and ulna distal fracture	93	10	Normal	None
13	60	Radius and ulna distal fracture	91	14	Normal	None
14	56	Radius and ulna distal fracture	89	15	Normal	None

DE: During Examination, **DR:** During Reduction, **mm:** Millimeter, **PRNVE:** Post Reduction Neurovascular Examinations

after reduction, mean VAS score of patients was 10.21 ± 5.36 (0 – 19.00) mm (Table 1). All patients were discharged after approximately eight hours' observation period and post-reduction neurovascular examinations were normal. There were no complications during block and reduction.

Discussion

Pain control is an important issue for painful interventional procedures, such as the reduction of upper extremity fractures. PSA is the accepted approach for all painful procedures in EDs (4). Recently, the availability of

combined propofol and ketamine (Ketofol) for PSA in EDs have been shown with class 1 studies (4). However, medications used in PSA may result in serious adverse effects, such as respiratory depression and hemodynamic impairment. An important disadvantage of PSA in crowded EDs is the necessity for close monitorization and observation. On the other hand, PNB offers many advantages, such as ease of application, safety, efficacy and a shorter hospitalization period (5, 6).

PNB is also described as peripheral nerve infiltration with local anesthetics for the reduction of motor output and sensorial input. Therefore, PNB is now being used for pain control in emergency procedures. This technique may also be used for the reduction of fractures and dislocations, the removal of foreign bodies, abscess drainage, wound exploration and care. The brachial plexus may be blocked using supraclavicular, interscalene, infraclavicular and axillary approaches. For the reduction of fractures and dislocations of the radius and ulna, the axillary approach to the brachial plexus is the most commonly used and preferred technique.

The following are among the indications for ABPB application: reduction of fractures and luxations, the extraction of foreign bodies, abscess drainage, pain control, wide wound exploration, and wound care. Anamnesis of a bleeding disorder or coagulopathy, and an infection in the injection site are the absolute contraindications of ABPB. Anamnesis of an allergic reaction is the primary and the most frequent contraindication of the local anaesthetic agent used in ABPB (7).

In a study by Ali Mohammadi at al. (8) that included 60 patients and compared PSA and AABPB for upper extremity fractures, it was found that there was no significant difference between intra-procedural and post-procedural pain scores in either PSA or AABPB groups. Statistically, recovery time was significantly shorter in the AABPB group than the PSA group. In our study, pain scores, procedural success and satisfaction were rated as very good in all our patients.

There is no known major complication with this procedure and it can also be easily applied to obese patients. Major signs of toxicity from local anaesthesia exist most frequently in the central nervous system (CNS), and cardiovascular system (CVS) (9). The first signs and symptoms include those of CNS excitation. These signs and symptoms are vertigo, nystagmus, sensory disorders, disorientation, epileptic episode, and psychosis. Intravenous benzodiazepines are administered for treatment.

Phenytoin may potentiate the arrhythmogenic properties of local anaesthetics, and is therefore not used. Short-acting neuromuscular agents, like Succinylcholine or vecuronium, are used in episodes where there is no response to benzodiazepines (10). Compared with the CNS, the cardiovascular system is slightly more resistant to the toxicity of local anaesthetics. Arterial dilation, progressive hypotension, bradycardia and cardiac arrest may develop. Therefore, before the application of regional anaesthesia, the vital signs of the patient should be checked, a systemic examination should be completed, a neurological examination of the area to be anesthetized should be conducted, and the results should be recorded.

Ecoffey et al (11), conducted with 27,031 patients who underwent AABPB, incidences of immediate systemic toxicity of local anaesthetic were 1.5 per 10 000, and the overall incidences of postoperative neurological symptoms was 0.37 per 10 000. There were no reports of serious neurological complications with USG application and it was reported to increase the success of the block, shorten the duration of the procedure, decrease the quantity of local anaesthetic used, decrease the risk of vascular puncture, and reduce the complications (11).

USG also plays an important role in the early diagnosis of complications; for instance, the view of a non-distributed local anaesthetic solution indicates an intravascular or intraneural injection. Moreover, before the application of the block procedure, anatomical structures should be carefully defined, aspiration has to be performed frequently, the advancing needle has to be entirely in view, and a test dose of 1 to 2 mL of local anaesthetic solution has to be injected to check its distribution. We have not observed any major or minor complications in our patients. The follow-up period in ER was short.

Consequently, ABPB is a technique that can be applied easily in ED for reduction of upper extremity fractures and dislocations. In this technique, the procedural success rate is high and without any complications. Furthermore, we noticed a high level of patient and physician satisfaction when using the ABPB technique. It should be kept in mind as well considering the application of median, ulnar and radial nerve block separately instead of AABPB in forearm, might end up with compartment syndrome, due to higher amount of LA.

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