Estudo Comparativo entre Ultrassom e Neuroestimulação no Bloqueio do Plexo Braquial pela Via Axilar *

*A Comparative Study between Ultrasound and Neurostimulation Guided Axillary Brachial Plexus Block**

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RESUMO

Conceição DB, Helayel PE, Oliveira Filho GR - Estudo Comparativo entre Ultrassom e Neuroestimulação no Bloqueio do Plexo Braquial pela Via Axilar.

***JUSTIFICATIVA E OBJETIVOS**: O uso do ultrassom em Anestesia Regional vem crescendo. Existem poucos estudos comparando o uso do ultrassom com a neuroestimulação. O objetivo deste estudo foi comparar a execução do bloqueio do plexo braquial pela via axilar guiado por neuroestimulação com dupla injeção e guiado por ultrassonografia em procedimentos cirúrgicos na mão. Para isto, foram comparados o tempo de realização, a taxa de sucesso e complicações.*

***MÉTODO**: Após a aprovação do Comitê de Ética em Pesquisa do Hospital Governador Celso Ramos foram selecionados 40 pacientes escalados para operações eletivas na mão com bloqueio de plexo braquial via axilar. Os pacientes foram distribuídos aleatoriamente eletronicamente em dois grupos de 20 pacientes: Grupo Neuroestimulação (NE) e Grupo Ultrassonografia (US). Foram comparados tempo de realização, taxa de sucesso e taxa de complicações.*

***RESULTADOS**: As taxas de bloqueio completo, falha parcial e falha total não apresentaram diferença estatística significativa entre os grupos US e NE. O tempo médio para realização do procedimento no grupo US (354 segundos) não apresentou diferença estatística significativa quando comparado ao grupo NE (381 segundos). Pacientes do grupo NE apresentaram maior taxa de punção vascular (40%) quando comparados ao grupo US (10%, $p < 0,05$). A taxa de presença de parestesia durante a realização do bloqueio foi igual entre os dois grupos (15%).*

***CONCLUSÕES**: A taxa de sucesso e tempo para a realização foram semelhantes entre o bloqueio de plexo braquial via axilar guiado por ultrassom quando comparado com o guiado por neuroestimulação com dois estímulos em operações sobre a mão. Maior taxa de punção vascular ocorreu no bloqueio guiado por neuroestimulação.*

Unitermos: ANESTESIA, Regional: bloqueio do plexo braquial; EQUIPAMENTOS: neuroestimulador, ultrassom.

SUMMARY

Conceição DB, Helayel PE, Oliveira Filho GR – A Comparative Study between Ultrasound- and Neurostimulation-Guided Axillary Brachial Plexus Block.

***BACKGROUND AND OBJECTIVES:** The use of ultrasound in Regional Blocks is increasingly more frequent. However, very few studies comparing ultrasound and neurostimulation have been conducted. The objective of this study was to compare neurostimulation-guided axillary brachial plexus block with double injection and ultrasound-guided axillary plexus block for hand surgeries. The time to perform the technique, success rate, and complications were compared.*

***METHODS:** After approval by the Ethics on Research Committee of the Hospital Governador Celso Ramos, 40 patients scheduled for elective hand surgeries under axillary plexus block were selected. Patients were randomly divided into two groups with 20 patients each: Neurostimulation (NE) and Ultrasound (US) groups. The time to perform the technique, success rate, and complication rate were compared.*

***RESULTS:** Complete blockade, partial failure, and total failure rates did not show statistically significant differences between the US and NE groups. The mean time to perform the technique in the US group (354 seconds) was not statistically different than that of the NE group (381 seconds). Patients in the NE group had a higher incidence of vascular punctures (40%) when compared with those in the US group (10%, $p < 0.05$). The rate of paresthesia during the blockade was similar in both groups (15%).*

***CONCLUSIONS:** The success rate and time to perform the blockade were similar in ultrasound- and neurostimulation-guided axillary plexus block for hand surgeries. The rate of vascular puncture was higher in neurostimulation-guided axillary plexus block.*

Keywords: ANESTHESIA, Regional: axillary plexus block; EQUIPMENT: neurostimulator, ultrasound.

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A Comparative Study between Ultrasound and Neurostimulation Guided Axillary Brachial Plexus Block

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INTRODUCTION

Axillary plexus block is one of the most popular techniques in upper limb surgeries. Different methods can be used to identify the branches of the brachial plexus: loss of resistance, transarterial injection, presence of paresthesia, neurostimulation, and ultrasound[1,2]. Neurostimulation is the technique used more often in peripheral nerve blocks. Surgeries in areas of the forearms and hands that are not innervated by the musculocutaneous nerve can be successfully done under axillary brachial plexus block with double stimuli and double injection[3].

The use of the ultrasound to guide regional blocks is becoming increasingly popular[4,5]. It allows the anatomical evaluation of the region before the blockade to correctly identify the structures of the brachial plexus[6,7]. This can avoid lesions of the blood vessels and pleura, and the local anesthetic can be deposited around the nerves under real time direct visualization[4,8].

A systematic review compared the use of the ultrasound with neurostimulation in peripheral nerve blocks and it concluded that the ultrasound was associated with a lower risk of failure of the blockade, reduced the time to perform the technique and the latency, and it increased the duration of the blockade. Besides, the use of the ultrasound also decreased the risk of vascular puncture[9].

A systematic qualitative review concluded that there is not enough evidence that the use of the ultrasound increases the success rate of regional blocks when compared to other techniques because of the limited number of studies in the literature[10]. The same authors concluded that randomized controlled studies and series of cases should be encouraged to allow future comparison[10].

Three variables have been identified as relevant when comparing ultrasound and neurostimulation in peripheral nerve blocks: time to perform the procedure, success rate, and complications[13]. The objective of the present study was to compare those three variables in neurostimulation with double injection and ultrasound-guided axillary brachial plexus block for hand surgeries.

METHODS

After approval by the Ethics on Research Committee of the Hospital Governador Celso Ramos, 40 patients scheduled for elective hand surgeries under axillary brachial plexus block were selected. To participate in the study, patients agreed to sign an informed consent.

Inclusion criteria were as follows: ages between 18 and 65 years, physical status (ASA) I or II, and body mass index (BMI) ≤ 40. Exclusion criteria included: absolute contraindication of regional block, diabetes mellitus, or any other neurological disorder of the upper extremity.

Chan et al. [12] reported a success rate of 62.5% in neurostimulation-guided axillary plexus block. Success rates of ultrasound-guided peripheral nerve blocks range from 95 to 100%. To calculate the size of the study population, the hypothesis of the present study was that ultrasound increased to at least 95% the success rate of axillary brachial plexus block.

Assuming a probability of a type I error of 5% and type II error of 20%, 18 patients in each group would be necessary for one-tailed comparisons and 23 for two-tailed comparisons.

Patients were divided into two groups according to randomly numbers generated electronically: in the NE group (n = 20) neurostimulation was used to identify the terminal branches of the brachial plexus, and in the US group (n = 20) the ultrasound was used. All patients were monitored with pulse oximeter, non-invasive blood pressure, and electrocardioscope. A 20G Teflon catheter was used for venipuncture, NS was infused, and Midazolam (1 to 3 mg) was administered 3 to 5 minutes before the blockade.

In the NE group, a 5 cm long 22G electrically isolated needle (Stimuplex®, B-Braun, Germany) guided by a neurostimulator (Stimuplex Dig®, B-Braun, Germany) was used for the axillary brachial plexus block. The arm was abducted 90° in relation to the trunk, and the forearm was flexed 90° in relation to the arm. The motor response of the hand corresponding to the territories of the motor innervation of two terminal nerves of the brachial plexus (median + ulnar, median + radial, or ulnar + radial) to a current lower than 0.5 mA and greater than 0.2 mA was considered an adequate response. Extension of the fingers or wrist was considered an adequate response for the radial nerve; flexion of the wrist or of the second and third fingers was considered an adequate response for the median nerve; and for the ulnar nerve, flexion of the fourth and fifth fingers or adduction of the thumb was considered an adequate response.

In the US group, patients underwent ultrasound-guided axillary nerve block with a 4 cm linear transducer with a frequency of 5 to 10 MHz (SonoAce 8000 SE®, Medison, South Korea) and a 5 cm, 22G electrically isolated needle (Stimuplex®, B-Braun, Germany). For the blockade, the arm was placed in 90° abduction in relation to the trunk, and the forearm was flexed 90° in relation to the arm. After the identification of the median, ulnar, and radial nerves, along with the biceps and triceps muscles, and axillary artery and vein, the needle was introduced longitudinally to the transducer and the local anesthetic solution was injected around each of the terminal branches of the brachial plexus (median, ulnar, and radial).

In all patients, 0.5% ropivacaine was the local anesthetic used. It has been demonstrated that 40 mL is the volume of local anesthetic associated with greater dispersion in the axillary sheath and greater success rate in axillary brachial plexus block[14], and, therefore, this was the volume used in the present study. In the NE group, 20 mL of the solution were injected on the first nerve and 20 mL on the second, for a total of 40 mL. In the US group, 20 mL of the anesthetic solution were injected in the region of the radial nerve, 10 mL in the region of the ulnar nerve, and 10 mL in the region of the median nerve, for a total of 40 mL.

The time necessary to perform the blockade was recorded. In the NE group, the time was counted from the palpation of the axillary artery on, and in the US group from the time the transducer was placed on the skin. Complications, such as vascular puncture, pain with the injection, and paresthesia were recorded.

The surgery started 30 minutes after the blockade, just after the lack of sensitivity to pin prick at the site of the incision was confirmed. Afterwards, all patients were sedated with target-controlled infusion of propofol (Diprifusor, AstraZeneca, Sweden) with an initial target-controlled concentration in the effector compartment of 1 to 1.5 ng.mL^{-1}. Patients remained somnolent, but easily aroused during the procedure. Changes were made in the target-concentration of propofol to guarantee this level of sedation[15]. The blockade was considered complete when opioid supplementation was not necessary to complete the surgery, partial failure when 50 to 100 µg of fentanyl were necessary to guarantee analgesia, and total failure when general anesthesia was necessary[9].

The Kolmogorov-Smirnov test was used to evaluate the normal distribution of the data. The Student *t* test for independent samples was used to compare continuous parameters between both groups. The Chi-square test was used to compare categorical parameters between both groups. A $p < 0.05$ was considered significant.

RESULTS

The demographic data was similar in both groups (Table I). The rate of complete and partial blockades and total failure (Table II), as well as the time to perform the blockade (Table III), did not show statistically significant differences between the groups.

The frequency of vascular puncture was greater in the NE group (40%) than in the US group (10%) ($p < 0.05$). The incidence of paresthesias did not differ (Table III).

Table I – Demographic Data

	NE	US	p
Weight (kg)	72.9 ± 14.62	78.1 ± 20.5	0.14
Height (m)	1.64 ± 9.51	1.69 ± 7.96	0.44
Age (years)	45.15 ± 13.35	39.75 ± 13.02	0.91
Gender (M/F)	8 / 12	13 / 7	0.11

NE – neurostimulation group; US – ultrasound group

Table II – Success Rate

	NE	US	p
Total failure	1 (5%)	1 (5%)	= 1
Partial failure	4 (20%)	2 (10%)	= 0.37
Complete block	15 (75%)	17 (85%)	= 0.42

NE – neurostimulation group; US – ultrasound group

Table III – Time to Perform the Technique and Complications

	NE	US	p
Time (seconds)	381	354	> 0.05
Paresthesia	3 (15%)	3 (15%)	= 1
Vascular puncture	8 (40%)	2 (10%)	< 0.05

NE – neurostimulation group; US – ultrasound group

DISCUSSION

The use of ultrasound to guide regional blocks has been increasing over the past few years[4]. Besides the evaluation of the anatomy before the blockade, its use allows depositing the local anesthetic around the nerves and avoiding damaging blood vessels, pleura, and muscles[4,5].

Despite those advantages, very few studies comparing this technique with neurostimulation-guided peripheral nerve blocks, currently the standard technique to locate nerves in regional peripheral blocks, are found in the literature[9,10].

Three nerves are involved in the innervation of the hands: the median, ulnar, and radial nerves. The success rate of the axillary brachial plexus block with double stimuli is similar to that of three or four stimuli in hand surgeries[3], which is associated with a lower complication rate.

In the present study, we compared neurostimulation-guided axillary brachial plexus block with double stimuli with the ultrasound-guided technique for hand surgeries. This approach did not allow to evaluate the rate of musculocutaneous nerve block, which has a high failure rate in neurostimulation-guided axillary brachial plexus block with double stimuli[3].

Chan et al. [12], using 42 mL of a standard solution, compared the ultrasound-guided to the neurostimulation-guided axillary brachial plexus block with three stimuli for hand surgeries and found a higher success rate and smaller time to perform the technique in the ultrasound group.

The results of the present study were different. The success rate and the time to perform the technique did not differ between the study groups. However, different methods were used to evaluate the success rate in both studies. In the present study, surgical anesthesia was the parameter for a successful block while in the study of Chan et al. the lack of skin sensitivity to pin prick and loss of muscle strength in the territory of the three terminal branches of the brachial plexus were the criteria used. Besides, Chan et al. used the three-stimulus technique, which might explain the longer time necessary to perform the technique.

In the study of Chan et al., intravascular injection, evaluated by the presence or absence of systemic complications, was not seen in the study groups. In the present study, we evaluated the rate of vascular puncture during the procedure, which was greater in the NE group.

Casati et al. [11] compared ultrasound-guided with neurostimulation-guided axillary brachial plexus block with multiple stimuli in upper limb surgeries and found similar success rates for both techniques, similar to the results of the present study. However, the authors did not evaluate the time of the blockade or the rate of vascular puncture and paresthesia.

We concluded that the success rate and time to perform the procedure are similar in ultrasound-guided and neurostimulation-guided axillary plexus block with double stimuli for hand surgeries. However, ultrasound-guided nerve blocks were associated with a lower incidence of vascular punctures.

REFERÊNCIAS – *REFERENCES*

01. Brull R, Perlas A, Chan VW - Ultrasound-guided peripheral nerve blockade. Curr Pain Headache Rep, 2007;11:25-32.
02. Neal JM, Gerancher JC, Hebl JR et al. - Upper extremity regional anesthesia: essentials of our current understanding, 2008. Reg Anesth Pain Med, 2009;34:134-170.
03. Sia S, Lepri A, Ponzecchi P - Axillary brachial plexus block using peripheral nerve stimulator: a comparison between double- and triple-injection techniques. Reg Anesth Pain Med, 2001;26:499-503
04. Marhofer P, Chan VW - Ultrasound-guided regional anesthesia: current concepts and future trends. Anesth Analg, 2007;104: 1265-1269.
05. Sites BD, Brull R - Ultrasound guidance in peripheral regional anesthesia: philosophy, evidence-based medicine, and techniques. Curr Opin Anaesthesiol, 2006;19:630-639.
06. Conceição DB, Helayel PE, Carvalho FAE et al. - Imagens ultrasonográficas do plexo braquial na região axilar. Rev Bras Anestesiol, 2007;57:684-689.
07. Helayel PE, Conceição DB, Nascimento BS et al. - Curva de aprendizado da sonoanatomia do plexo braquial na região axilar. Rev Bras Anestesiol, 2009;59:187-193.
08. Helayel PE, Conceição DB, Oliveira Filho GR - Bloqueios nervosos guiados por ultra-som. Rev Bras Anestesiol, 2007;57:106-123.
09. Abrahams MS, Aziz MF, Fu RF et al. - Ultrasound guidance compared with electrical neurostimulation for peripheral nerve block: a systematic review and meta-analysis of randomized controlled trials. Br J Anaesth, 2009;102:408-417
10. Liu SS, Ngeow JE, Yadeau JT - Ultrasound-guided regional anesthesia and analgesia: a qualitative systematic review. Reg Anesth Pain Med, 2009;34:47-59
11. Casati A, Danelli G, Baciarello M et al. - A prospective, randomized comparison between ultrasound and nerve stimulation guidance for multiple injection axillary brachial plexus block. Anesthesiology, 2007;106:992-996.
12. Chan VW, Perlas A, McCartney CJ et al. - Ultrasound guidance improves success rate of axillary brachial plexus block. Can J Anaesth, 2007;54:176-182.
13. Sites BD, Beach ML, Spence BC et al. - Ultrasound guidance improves the success rate of a perivascular axillary plexus block. Acta Anaesthesiol Scand, 2006;50:678-684.
14. Rucci FS, Barbagli R, Pippa P et al. - The optimal dose of local anaesthetic in the orthogonal two-needle technique. Extent of sensory block after the injection of 20, 30 and 40 mL of anaesthetic solution. Eur J Anaesthesiol, 1997;14:281-286
15. Nakagawa M, Mammoto T, Hazama A et al. - Midazolam premedication reduces propofol requirements for sedation during regional anesthesia. Can J Anaesth, 2000;47:47-49.

RESUMEN

Conceição DB, Helayel PE, Oliveira Filho GR - Estudio Comparativo entre Ultrasonido y Neuroestimulación en el Bloqueo del Plexo Braquial por la vía Axilar.

***JUSTIFICATIVA Y OBJETIVOS**: El uso del ultrasonido en Anestesia Regional ha venido creciendo. Existen pocos estudios comparando el uso del ultrasonido con la neuroestimulación. El objetivo de este estudio, fue comparar la ejecución del bloqueo del plexo braquial por la vía axilar, guiado por neuroestimulación con doble inyección y guiado por ultrasonido en procedimientos quirúrgicos en la mano. Para eso, se compararon el tiempo de realización, la tasa de éxito y las complicaciones.*

***MÉTODO**: Después de la aprobación por parte del Comité de Ética en Investigación del Hospital Governador Celso Ramos, se seleccionaron 40 pacientes para operaciones por elección en la mano, con bloqueo de plexo braquial vía axilar. Los pacientes se distribuyeron aleatoriamente y electrónicamente en dos grupos de 20 pacientes: Grupo Neuroestimulación (NE) y Grupo Ultrasonido (US). Se compararon el tiempo de realización, la tasa de éxito y las complicaciones.*

***RESULTADOS**: Las tasas de bloqueo completo, falla parcial y falla total, no presentaron diferencias estadísticas significativa entre los grupos US y NE. El tiempo promedio para la realización del procedimiento en el grupo US (354 segundos) no presentó diferencia estadística significativa cuando se le comparó al grupo NE (381 segundos). Los pacientes del grupo NE presentaron una tasa más elevada de punción vascular (40%), cuando se les comparó con el grupo US (10%, $p < 0,05$). La tasa de presencia de parestesia durante la realización del bloqueo fue igual entre los dos grupos (15%).*

***CONCLUSIONES:** La tasa de éxito y el tiempo para la realización, fueron similares entre el bloqueo de plexo braquial vía axilar guiado por ultrasonido, cuando se le comparó con el guiado por neuroestimulación con los de los estímulos en operaciones sobre la mano. Un tasa más elevada de punción vascular se dio en el bloqueo guiado por neuroestimulación.*