

# Is dedicating an ultrasound machine to regional anesthesia an economically viable option?

Vrushali Ponde, Dinesh Borse, Jayashree More, Tulsidas Mange

Department of Anaesthesiology, Holy Spirit Hospital, Mumbai, Maharashtra, India

## Abstract

**Background and Aims:** The cost effectiveness of ultrasound-guided regional anesthesia is an issue which requires discussion. Based on our experience, we hypothesized that this is an economically viable option.

**Material and Methods:** In this retrospective study, we included 90 patients who underwent upper extremity surgeries in our institute solely under ultrasound (USG)-guided brachial plexus blocks in a year. The cost of the block was derived by adding the cost of the material and drugs used for the block. This cost was subtracted from the cost that otherwise would have been incurred for general anesthesia (GA) of similar duration. This cost difference or benefit per case was then used to calculate the duration in years required to recover the cost of the ultrasound machine.

**Statistics:** Data were analyzed using SPSS 15.0. Analysis of variance was applied to compare mean benefits as per surgery, block, and duration. Ninety-five percent confidence interval for mean were calculated. Level of significance was taken as  $P = 0.05$ .

**Results:** There were significant economic benefits using ultrasound guidance as compared to GA. Benefits differed significantly as per the type of surgery, type of block, and duration of the surgery. With the cost benefit that we have obtained, the cost of USG machine can be recovered in about 3 years.

**Conclusion:** USG regional anesthesia is an economically viable concept. The cost benefit increases with the duration of a given surgery and increases with the number of blocks.

**Key words:** Cost, regional anesthesia, ultrasound machine

## Introduction

Although ultrasound guidance has rendered regional anesthesia safe and predictable, often its cost is considered a big bane by the hospital administration. Our experience made us think that this is not so. Hence, we conceptualized this study with the aim to compare the cost of ultrasound-guided brachial plexus blocks for upper extremity surgeries with the cost of general anesthesia (GA) for the same procedure. We hypothesized that the ultrasound-guided blocks would be more cost-effective than GA.

**Address for correspondence:** Dr. Vrushali Ponde, Department of Anaesthesiology, Holy Sprit Hospital, Mahakali Caves Road, Andheri East, Mumbai, Maharashtra, India. E-mail: vrushaliponde@yahoo.co.in

### Access this article online

Quick Response Code:



**Website:**  
www.joacp.org

**DOI:**  
10.4103/0970-9185.194767

## Material and Methods

The approval from the ethical committee of the institute was obtained.

This is a retrospective study. We included patients who underwent upper extremity surgeries in our institute solely under ultrasound-guided brachial plexus blocks during the period from August 2012-August 2013.

Ninety such patients were recruited. The demographics of these ninety patients and their American Society of Anaesthesiologists grading were recorded. The type of

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

**For reprints contact:** reprints@medknow.com

**How to cite this article:** Ponde V, Borse D, More J, Mange T. Is dedicating an ultrasound machine to regional anesthesia an economically viable option?. J Anaesthesiol Clin Pharmacol 2016;32:519-22.

surgeries and the approach to brachial plexus blocks were noted.

The brachial plexus blocks were performed using ultrasound machine (SonoSite Micromax; SonoSite Inc., Bothell, WA, USA) in awake patients. The procedure was explained to them in details and the block was conducted under strict aseptic precautions. The conduct of each block was in accordance with the given reference.<sup>[1]</sup> Eighty-nine patients were sedated with dexmedetomidine 0.5 µg/kg/h and one patient received midazolam 0.05 mg/kg and fentanyl 1 µg/kg. We noted the duration of each surgery.

We estimated the cost of GA per hour in our institute [Table 1]. The cost of sevoflurane nitrous oxide, and ventilator (anesthesia machine) were added upon hourly basis. The cost of one atracurium ampules was added for every additional hour of anesthesia.

We also calculated the cost required for USG-guided regional block and sedation. We excluded the cost of ultrasound machine but included the cost of local anesthetic drugs used, syringes, needles, and drugs used for sedation, such as bupivacaine 0.5% (Rs 37), Lignocaine adrenaline 2% (Rs 34), injection dexamethasone (Rs 9), injection dexmedetomidine (Rs 150), oxygen (30 Rs/h), and syringes (Rs 100).

This cost was subtracted from the cost that would have been incurred if the surgery was done under GA. This benefit, when put up as the charge for the ultrasound machine per case gave us the duration in years, required to recover the cost of ultrasound machine. The cost of USG guided block was also evaluated as per type of surgery, type of block, and duration of surgery.

### Statistics

Data were analyzed on SPSS 15.0 (SonoSite Micromax; SonoSite Inc., Bothell, WA, USA). Analysis of variance (ANOVA) was applied to compare mean benefits as per surgery, block, and duration. Ninety-five percent confidence interval for mean were calculated. Descriptive statistics were given as mean and standard deviation.

### Results

None of the ninety patients required conversion to GA for completion of surgery.

The mean and standard deviation of ages were 52.7 ± 14.3 years. 32 of 90 were female patients and 58 were male. Of the 90 patients, 31 were American Society of Anaesthesiologists (ASA) I, 48 were ASA II, 10 were ASA III, and 1 patient

was ASA IV. Table 2 enumerates the type of surgeries undertaken and their respective benefits.

The benefit (amount saved due to regional block or the cost difference between amount for GA regional anesthesia) was statistically significant as the *P* = 0.004. There were significant differences as per the types of surgery. Table 3 shows numbers and types of ultrasound-guided brachial plexus blocks and benefit as per block. Table 4 shows the duration of surgeries and the respective benefits.

- Total benefit of ultrasound-guided blocks as compared to GA per years = 323270.
- Rough cost of USG machine = 10 lakhs (approximately).
- Recover cost of USG machine in about 3 years.

There were significant economic benefits using ultrasound guidance as compared to GA.

**Table 1: Cost of general anesthesia for an hour (in our institute)**

Material used general anesthesia	Cost in rupees
Glycopyrrolate	13
Ondansetron	60
Pantoprazole	80
Midazolam	30
Fentanyl	90
Propofol	96
Atracurium	113
Sevoflurane	1000
Myo-pyrrolate	47
Oxygen and nitrous oxide	200
ETT + ventilator	378
Suction catheter	21
Dynapar	34
Tramadol	33
Paracetamol	335

ETT = Endotracheal tube

**Table 2: Type of surgeries undertaken, their respective numbers, and benefit (mean ± standard deviation) per type of surgery are shown**

Surgery	Mean ± SD	95% CI for mean	
		Lower limit	Upper limit
Shoulder arthroscopy (n=28)	4691.86±35.58	4678.06	4705.65
Shoulder replacement (n=7)	4711.86±48.89	4666.64	4757.08
Humerus <sup>#</sup> (n=15)	3389±334.05	3204.01	3573.99
Elbow joint (n=10)	3004±0.00	3004.00	3004.00
Radius <sup>#</sup> (n=21)	2526.14±17.93	2517.98	2534.30
Wrist joint (n=7)	2519±28.87	2492.30	2545.70
Clavicle <sup>#</sup> (n=2)	3679±0.00	3679.00	3679.00
Total (n=90)	3591.89±949.74	3392.97	3790.81

n = Number of surgeries. Significant, *P* = 0.004: Conclusion: There were significant differences as per type of surgery, SD = Standard deviation, CI = Confidence interval

**Table 3: Numbers and types of ultrasound-guided brachial plexus blocks and benefits as per block**

Block	Mean $\pm$ SD	95% CI for mean	
		Lower limit	Upper limit
Interscalene block (n=52)	4279.77 $\pm$ 630.85	4104.14	4455.40
Subclavian perivascular + infraclavicular blocks (n=8)	2761.5 $\pm$ 259.24	2544.77	2978.23
Subclavian perivascular + axillary block (n=23)	2652.04 $\pm$ 214.45	2559.31	2744.78
Axillary block (n=7)	2519 $\pm$ 28.87	2492.30	2545.70
Total (n=90)	3591.89 $\pm$ 949.74	3392.97	3790.81

Significant,  $P < 0.001$ . There were significant differences as per block, SD = Standard deviation, CI = Confidence interval

**Table 4: Duration of surgery and benefits as per duration**

Duration	Mean $\pm$ SD	95% CI for mean	
		Lower limit	Upper limit
1.0 h (n=28)	2524.36 $\pm$ 20.81	2516.29	2532.43
1.50 h (n=16)	3004 $\pm$ 0.00	3004.00	3004.00
2.0 h (n=11)	3651.72 $\pm$ 90.45	3590.96	3712.49
3.0 h (n=32)	4685.25 $\pm$ 16.80	4679.19	4691.31
3.5 h (n=3)	4809 $\pm$ 0.00	4809.00	4809.00
Total	3591.89 $\pm$ 949.74	3392.97	3790.81

Significant,  $P < 0.001$ , SD = Standard deviation, CI = Confidence interval

Benefits differed significantly as per the type of surgery, type of block, and duration of the surgery. With the cost benefit that we have obtained, the cost of USG machine can be recovered in about 3 years.

## Discussion

For any concept to be viable in everyday practice, its economical aspect has to be considered. As per our study, ultrasound-guided regional anesthesia showed more economic benefits.

In our scenario, the economic benefit obtained from the ultrasound-guided block is in the range of Rs 323,270/year. The cost benefits would increase if the number of surgery done with ultrasound-guided blocks increases and vice versa. The mean benefit shown for each type of surgery can be put up as the charge of ultrasound machine to recover the cost of ultrasound machine. With our results, it can be assumed that we can recover the cost of ultrasound machine in about 3 years if 90 upper extremity surgeries are performed successfully solely with ultrasound-guided blocks. Here, we have assumed that the cost of GA in other institutes could be somewhat similar to that of ours.

We analyzed benefits in terms of types and duration of surgeries and types of blocks separately. In our study, they all seem to be interrelated. The interscalene blocks ( $n = 52$ ) were given mainly for shoulder arthroscopic repairs ( $n = 23$ ) and shoulder replacements ( $n = 7$ ), which also coincided with the longest duration of procedures. Humerus fracture had a combination of interscalene (main block) and

subclavian perivascular (around 5 ml local anesthetic given). These surgeries took almost 3-3.5 h. Fracture clavicle surgeries ( $n = 2$ ) also received interscalene but were of a relatively shorter duration. The combination of subclavian perivascular and infraclavicular blocks was mostly given for elbow surgeries that were of a relatively longer duration; hence, Table 2 depicts the cost of these blocks accordingly. The radius fracture and the wrist fractures were done under axillary or a combination of subclavian perivascular and axillary block. These surgeries were relatively shorter hence of lesser cost. In general, it is not the type of the brachial plexus block that mattered but the duration of surgery undertaken with the block determined the cost benefit.

In this study, we did not consider the cost of operation theater and the staff at all. These were standard and did not differ with the modalities.

Gonano *et al.*<sup>[2]</sup> also investigated the cost effectiveness of ultrasonographic-guided brachial plexus blocks. It differed from our study in number of ways. This study compared the cost-effectiveness of interscalene ultrasound-guided blocks given for shoulder arthroscopies with GA. Forty patients were studied. They either received block or GA. In our study, we had derived the cost of GA depending on the duration of the surgery. This was in accordance with the charges specified by our institute. This was done after calculating the cost of GA for each hour in our institute.

They investigated the following anesthesia-related times: ready for surgical preparation (from arrival in the OR until end of anesthesia induction), OR emergence time (from end of dressing until leaving the OR), anesthesia control time (from patient's arrival in the OR until readiness for positioning plus time from the end of surgery to patient's discharge from the OR), and postanesthesia care unit (PACU) time (from patient's arrival in the PACU to the eligibility for discharge to normal ward). Our study concentrated on the economic aspects of the two modalities. We did take into consideration the analgesia time rendered by the block in the postoperative period. In this study, they too had excluded the personnel costs from statistical analysis which is similar to us.

The main difference is we estimated the period of amortization of the ultrasound machine which turns out to be approximately 3 years with our assumptions. Of course, the period can be shorter if the number of surgeries increases and would be longer if the machine is more expensive than the cost we have considered.

The retrospective nature of our study is one of the main limitations of this study. We have tried our best to collect all the required information. There is a possibility that we may have skipped certain items such as syringes. It may not be always possible to keep track of them as they comparatively inexpensive and most casually used. In case, we have missed on them surely the difference is innocuous.

Perhaps comparison between similar cases would have strengthened this study. We have compared the cost of regional anesthesia with an equivalent GA time. It is important to know that the cost of GA almost repeats itself every hour, unlike regional anesthesia.

From this study, we believe that ultrasound-guided regional anesthesia is cost-effective. This is besides the fact that ultrasound equipment can be used for several purposes such as venous cannulation and shared with other users too. The safety and predictability it renders to regional blocks cannot be compared in cost.<sup>[3]</sup>

## Conclusion

1. There were significant cost benefits using ultrasound

guidance as compared to GA

2. Benefits differed significantly as per type of surgery, blocks, and duration
3. The cost of USG machine can be recovered in about 3 years.

Investment in an ultrasound machine solely for regional anesthesia need not be considered as a big bane.

## Acknowledgment

We wish to acknowledge Dr. Nicholas Antao and Dr. Mukesh Shroff for their unconditional support for this work.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

1. Ponde V. Illustrative Manual of Ultrasound Guided Regional Anaesthesia in Children and Adults. 2<sup>nd</sup> ed. Mumbai: Bhalani Publishers; 2013.
2. Gonano C, Kettner SC, Ernstbrunner M, Schebesta K, Chiari A, Marhofer P. Comparison of economical aspects of interscalene brachial plexus blockade and general anaesthesia for arthroscopic shoulder surgery. *Br J Anaesth* 2009;103:428-33.
3. Jochum D, Iohom G, Bouaziz H. Ultrasound guidance, a win-win approach to peripheral nerve blockade. *Curr Opin Anaesthesiol* 2013;26:600-4.