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Comparative Study of General Anesthesia and Regional Anesthesia in Upper Extremity Surgery: Anesthesia Time and Postoperative Hospital Day – A Retrospective Observation Study

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Abstract **Original Research Report**

Introduction: This study aims to investigate the differences in anesthetic time and hospital stay after surgery based on the anesthesia techniques used in upper extremity surgeries. ***Methods:*** A retrospective analysis was conducted on the medical records of 453 patients who underwent upper extremity surgery from January 1, 2020 to March 31, 2022. The patients were divided into two groups: axillary brachial plexus block (BPB) and General Anesthesia (GA). ***Results:*** The induction time before starting the operation for axillary BPB was significantly longer than GA. However, the time required to awaken patients from GA was significantly longer than that for patients receiving axillary BPB. Patients who received axillary BPB exhibited significantly shorter stays in the post-anesthesia care unit (PACU) and a reduced time until discharge after surgery ($P < 0.05$). ***Conclusion:*** In upper extremity surgery, axillary BPB requires more induction time than GA. However, axillary BPB demonstrated advantages such as quicker awakening, shorter PACU stays, and reduced hospitalization days after surgery.

Keywords: Upper extremity surgery, axillary Brachial plexus block, General anesthesia, Induction time, Awake time, Recovery time, Postoperative hospital day.

INTRODUCTION

Upper extremity surgery under axillary brachial plexus block (BPB) allows for a shorter postoperative recovery period and faster discharge, ultimately reducing hospital stay time. However, regional anesthesia has the disadvantage of longer anesthesia induction time. If regional anesthesia fails, it may necessitate a change to General Anesthesia (GA), potentially increasing anesthesia induction time and operating room usage time [1]. Recently, regional anesthesia has witnessed significant advancements with the development of ultrasound technology, enabling accurate targeting of the nerve and injecting a small amount of drug, thereby reducing the failure rate of regional anesthesia [2-4]. Additionally, advancements in GA drugs have contributed to faster patient awakening from anesthesia compared to the past [5]. In light of these advancements in ultrasound technology and anesthesia drugs, this study aims to compare the anesthesia time and hospitalization period after upper extremity surgery based on the anesthesia technique (GA or axillary BPB) through a retrospective study involving patients who underwent such surgeries.

METHODS

This study was conducted after obtaining approval from the Institutional Review Board (IRB 2022-04-032) of Presbyterian medical center. The study involved 453 patients who underwent upper limb surgery from January 1, 2020 to March 31, 2022. Patients under the age of 18, patients whose anesthesia technique was changed to GA due to regional anesthesia failure, patients who underwent bilateral hand surgery, and patients who underwent surgery on parts other than the hand were excluded from this study (Fig 1).

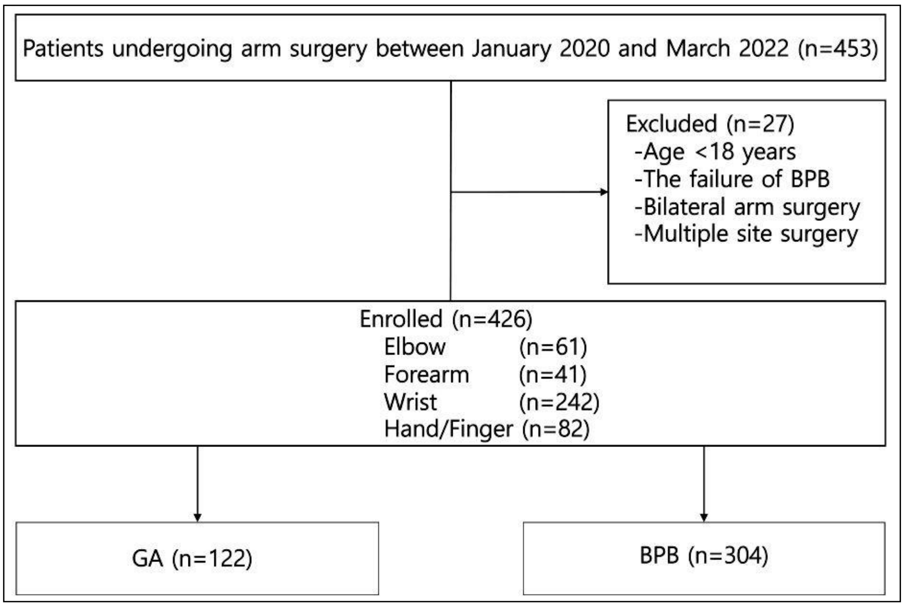

Figure 1: Flow chart of the study

GA=General Anesthesia, BPB=Brachial plexus block

The anesthesia techniques used for the surgery were GA and axillary BPB. GA was induced using propofol or pentobarbital sodium and remifentanil, and after the administration of neuromuscular blocking agent (rocuronium) endotracheal intubation or i-gel supraglottic airway device (Intersurgical, Wokingham, Berkshire, UK) was placed. Anesthesia was maintained using an inhalational anesthetic, desflurane and remifentanil. For neuromuscular blocking reversal, pyridostigmine or sugammadex were used. Regional anesthesia was performed by blocking the axillary plexus using a 20-30 mL mixture of 0.375% ropivacaine and 1% lidocaine under ultrasound guidance. After confirming the degree of anesthesia, if the patient requested sedation, a continuous intravenous infusion of propofol was administered. Regional anesthesia was performed in the operating room, the same as GA. After surgery, the patient was observed in the PACU for a minimum of 30 minutes and then transferred to the ward. The type of the surgery, type of anesthesia, anesthesia induction time, operation time, total anesthesia time, PACU stay time, and length of stay in the hospital after surgery were retrospectively investigated through the patient's chart.

Data were analyzed with SPSS version 23 software (SPSS Inc., Chicago, USA). Non-parametric data were analyzed by one-way nonparametric analysis of variance and multiple comparisons with the Mann-Whitney U-test. Categorical data were analyzed appropriately using $\chi 2$ or Fisher's exact test. Values were considered statistically significant when P was less than 0.05.

RESULTS

Of the 453 patients recruited, 27 had to be excluded described above (Fig. 1). Patients' demographics of the included 426 cases are displayed in Table 1. There was no statistically significant difference between the two groups in patient demographics.

Table 2 summarizes anesthesia-related time. The induction time is defined as the time from entering the operating room to the start of surgery. Induction time was 33.7 ± 7.2 minutes in the BPB group compared with 25.2 ± 8.7 minutes in the GA group ($P<0.001$). Induction time for axillary BPB group was significantly longer than GA group. The awake time was defined as the time from the end of surgery to the time of admission to the PACU. The awake time in GA was 10.90 ± 4.98 minutes compared with 5.33 ± 1.59 minutes in the BPB group ($P<0.001$). Awake time for axillary BPB group was significantly shorter than GA group. The surgery time was defined as the time from the start to the end of surgery. Total anesthesia time was defined as the sum of induction time, surgery time, and awake time. There was no statistically significant difference between the two groups in surgery time and total anesthesia time (respectively, $P=0.168$, $P=0.592$).

PACU recovery time was defined as the time from the time of admission to PACU to the time of departure. PACU recovery time was 31.4 ± 3.1 minutes in the BPB group compared with 32.5 ± 4.1 minutes in the GA group ($P<0.01$). PACU recovery time for axillary BPB group was significantly shorter than GA group. Postoperative Hospital day was counted by defining the day following surgery as day 1. Postoperative Hospital day was 4.5 ± 1.7 days in the BPB group compared with 4.9 ± 1.4 days in the GA group ($P < 0.05$). Postoperative hospital day for axillary BPB group was significantly shorter than GA group.

Table 1: Patients' demographics

	BPB(n=304)	GA(n=122)	P value
Sex (M/F)	125/179	58/64	0.226
Age (yr)	63.6 ± 15.1	61.5 ± 15.7	0.198
Height (cm)	159.8 ± 8.3	161.30 ± 8.9	0.095
Weight (kg)	62.9 ± 10.5	64.5 ± 10.0	0.134
ASA physical status (I/II/III/IV)	36/170/97/1	21/65/36/0	0.121

Values are mean ± SD. There was no statistically significant difference between the two groups in sex, age, height, weight, and ASA physical status. BPB=brachial plexus block, GA=general anesthesia, ASA=American society of anesthesiologists

Table 2: Anesthesia-related time for the axillary BPB and GA

	BPB(n=304)	GA(n=122)	P value
Induction time (min)	33.7 ± 7.2	25.2 ± 8.7	<0.001*
Surgery time (min)	70.4 ± 32.3	75.2 ± 33.6	0.168
Awake time (min)	5.3 ± 1.6	10.90 ± 5.0	<0.001*
Total anesthesia time (min)	109.4 ± 32.7	111.4 ± 34.4	0.592
PACU recovery time (min)	31.4 ± 3.1	32.5 ± 4.1	<0.01*
Postoperative Hospital day (days)	4.5 ± 1.7	4.9 ± 1.4	<0.05*

Values are mean ± SD. * Statistically significant difference ($P < 0.05$). PACU=Post-anesthesia care unit

DISCUSSION

The results of this study showed that BPB had a significantly longer induction time than GA. However, the time required to wake up after surgery, the time taken to leave the room from the PACU, and the discharge time after surgery were significantly shorter in axillary BPB than in GA.

In a comparative study of GA and BPB for hand surgery, Chan Vincent et al. found that BPB took significantly longer induction time and total anesthesia time, but they found no difference in PACU stay time [6]. The study by Chan Vincent *et al.*, used isoflurane, a volatile inhalational anesthetic, in GA, and blindly blocked nerves without ultrasound in a block room, not an operating room, before moving the patient to the operating room.

Gonano C. and colleagues compared patients undergoing arthroscopic shoulder surgery with GA and those who received BPB under ultrasound guidance, and there was no difference in total anesthesia time. The length of stay in the PACU was significantly shorter for those who underwent regional anesthesia [7]. A block room was used for BPB, and sevoflurane was used as the inhalation anesthetic during GA.

When comparing the results with previous studies, it is observed that despite the advancement of ultrasound technology, BPB still requires a longer induction time compared to GA. This prolonged induction time in regional anesthesia can be attributed to the nature of the procedure, as it takes time for the administered local anesthetics to spread to the target area. Furthermore, another factor that could account for the longer induction time in our study is the hospital's specific practice of performing the block in the operating room, as opposed to other studies that might have utilized separated block rooms for this purpose. This difference in practice could potentially impact the overall induction time and outcomes in regional anesthesia.

Moreover, unlike other studies, our research revealed that even when using inhalational anesthetics such as desflurane and the recently developed muscle relaxation reversal agent, sugammadex, in GA, the awakening time for patients was significantly shorter in BPB. BPB is thought to take less time than GA with endotracheal intubation because only sedation is performed. Regarding the length of stay in the PACU, patients with BPB experience less pain and less discomfort from endotracheal intubation, so they are thought to be able to leave the PACU more quickly [8]. It is thought that this will affect the period from hospital discharge after surgery.

BPB is widely used because of its many advantages in upper extremity surgery, but it requires ultrasound equipment, proficiency, block space [9]. If the block fails, it can switch to general anesthesia, which can increase the anesthesia induction time [10]. Therefore, it is necessary to compare anesthesia time and postoperative recovery time through a prospective study and to identify the cause. In addition to time, research on the differences in patient satisfaction, pain score, and anesthetic complications is also needed.

CONCLUSION

For upper extremity surgery, axillary BPB requires more induction time than GA. However, axillary BPB offers advantages such as quicker awakening, shorter PACU stays, and reduced hospitalization periods after surgery. The BPB induction will be shortened by using a system that blocks in a different block room and moves to the operating room before surgery. If such a system is equipped, BPB would be a good anesthetic option for upper extremity surgery.

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