Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2016; 4(5E):1756-1763 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Original Research Article

Study of Induction Times of Various Anaesthetic Techniques

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Abstract: The aims and objectives of our study is to analyse the time taken by the anaesthetist for induction during general, spinal, combined spinal epidural and ultrasound guided brachial plexus block ,comparing these with benchmark values and find reasons for delay. Present prospective case study aims at measurement of anaesthesia induction times during a period of two months. Overall 231 patients had induction of anaesthesia combining surgery and orthopaedics cases. Of these 77 received general anaesthesia, 95 patients were given spinal anaesthesia, 39 patients received ultrasound guided brachial block in procedure room and 20 patients received combined spinal epidural anaesthesia. Mean anaesthesia induction time in cases of general anaesthesia was 14.8 minutes, in spinal anaesthesia was 18.5 minutes, for combined spinal epidural was 24 minutes, and for brachial block in procedure room was 30 minutes. These were within benchmark limits .25% of inductions were delayed. The results show that anaesthesia induction times are fairly within accepted limits. Reasons for delay were due to emergency surgeries, preparation for difficult intubation, fibreoptic intubation, hypotension, arrhythmias after induction, bronchospasm, anaphylactic reaction to anaesthetic agents and, inadequate effect of regional anaesthesia. Benchmark values of anaesthesia induction times are mandatory for optimal functioning of operation theatre schedule, however variations may occur due to complications arising during the process of induction .The anaesthetist should not be pressurized regarding induction time limits, keeping in mind that safety of the patient is the prime goal.
Keywords: anesthesia induction time, delay, techniques

INTRODUCTION:

Setting standards for procedure times is beneficial to measure performance and identify untoward events which may prolong procedure time thereby causing inefficiency. The operation theatre (OT) administration for proper scheduling of OT lists requires a rough estimate of the anesthesia induction time to allow easy calculations of total procedure times. This could avoidover utilized OT time and the number of case cancellations and could lead to more efficient use of limited resources. Anaesthesia induction time has also been named as anaesthesia ready time, anaesthesia preparatory time or anaesthesia release time. Anaesthesia controlled time is the time taken for complete anaesthesia process; it includes induction and emergence in case of general anaesthesia [3]. Anesthesia induction time starts when patient and anesthetist enter the OT and ends surgical preparations starts and remaining anesthesia tasks do not interfere with positioning and further preparations like cleaning and draping.

Aims and objectives of our study is to analyse the time taken by the anaesthetist for induction during general, spinal, epidural and brachial block ,comparing these with benchmark values and find reasons for delay.

METHODOLOGY:

This study was conducted in a 500 bedded tertiary care hospital. It is a Prospective observational study spread over two months from August 2015 to September 2015 on 50 working days for surgery and orthopaedics OT. Patients posted for surgery the day before on the OT list and emergency surgeries during elective working hour's i.e. 9am to 3pm were included. As there is no dedicated emergency OT emergency surgeries are conducted in the respective routine OTs.

Inclusion Criteria:

- All surgeries done during routine hours i.e. between 9 Am to 3PM irrespective of age, gender, and ASA physical status were consideration in our present study as previous work has shown that they do not affect anesthesia induction times [4].

Exclusion Criteria:

- Surgeries done after 3.pm and up to 9am on working days, Sundays and public holidays.
- Cases performed by surgeons using local anaesthesia were also excluded from the analysis.
- Already intubated patients brought to OR.

Pre-anaesthetic check-up is done for every patient one day prior to surgery. Patients posted for surgery are admitted one night before and are transported in the morning of surgery latest by 9.00 am in the pre-operative holding area where, intravenous lines are be set-upexcept in case of difficulty. Patient are preloaded for spinal, combined spinal epidural anesthesia. As the study was part of the quality improvement project ethical clearance was not required. Two faculty members and one resident of department of anaesthesia are posted in each OT .Monthly rotation of anaesthetists is done so an exchange of anaesthetic teams between surgery and orthopaedics OTs was done during the second month. Anaesthesia Induction Time was recorded from the time when the patient and anaesthetist arrived in OT to the time anaesthetist permits surgeon to proceed for surgery. Anaesthetic induction time was noted by the senior faculty member posted in the respective OTs .Compiling benchmark values from various studies [1, 9] as well as our previous experience Anaesthesia induction time for general and spinal anaesthesia the cut-off was taken as 20 minutes for all ASA grade patients, and 30 minutes for combined spinal epidural anaesthesia and ultrasound guided brachial block. Brachial block was conducted in procedure room located by side of OT while the previous surgery is on-going. It was suitably equipped for resuscitation. No separate team of anesthetists ,staff was allocated for procedure room, thereby incurring no extra resources .The next patient to receive USG guided brachial block was shifted one hour prior to start of surgery in the procedure room. Anaesthetists posted in OT where brachial block was needed for next case managed the procedure room . All the other anaesthesia induction techniques i.e. general anaesthesia, (GA), spinal anaesthesia,(SA),combined spinal epidural anaesthesia (CSE) were conducted in the respective OTs because it has been observed in various studies that shifting of anaesthetised patients is associated with potential risk of hypotension and sometimes of cardiac arrest. In patients receiving combined spinal epidural, epidural catheter was inserted for analgesia or for extension of anesthesia if the action of spinal anesthesia gets waived off. As invasive procedures like Central Venous or arterial line insertion takes time therefore up to additional 15 minutes were allotted for these procedures. It was mandatory for anaesthetist to record reasons for delay in induction time whenever anaesthesia induction time exceeded the benchmark time. Various data was collected and analysed using MS Excel 2007.

Table 1: The mean anaesthesia induction time for various techniques

	MEAN TIME(minutes)	S.D
GA	14.8minutes	9.416
SPINAL	18.5 minutes	6.48
CSE	24minutes	7.27
BRACHIAL BLOCK	30 minutes	9.004

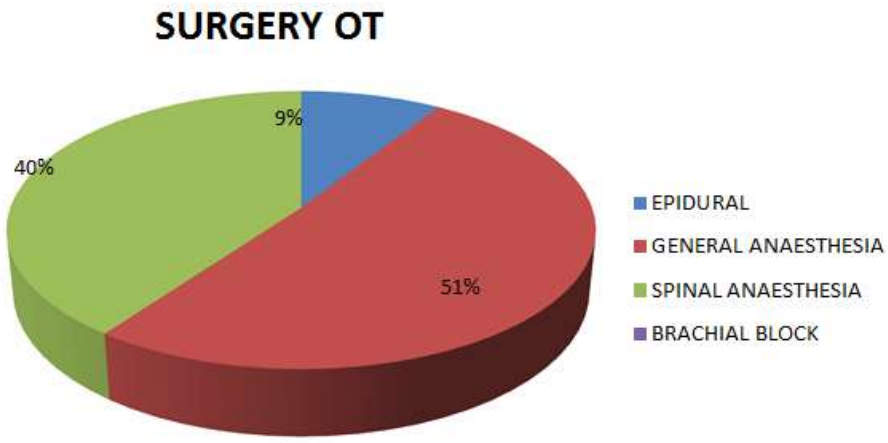

Fig 1: Distribution of various techniques of induction of anaesthesia in Surgery OT

RESULTS

A total of231surgeries were done in both OTs 133 cases were given anesthesia in surgery OT and 98 patients were anaesthetized in orthopedics OT.The distribution of anaesthesia techniques are depicted inPie charts in Figure 1&2.

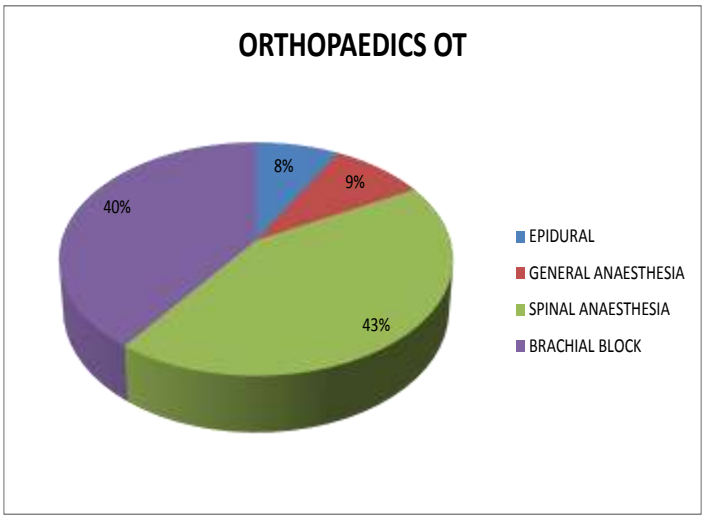

Fig 2: Distributions of anesthesia induction techniques for Orthopedics OT

As the anaesthesia department has rotation of anaesthesia posting every month, the anesthetists of surgery and orthopaedics OT interchanged OTs next month therefore cases performed in both OTs were added up. Total of 95 cases were done under spinal anaesthesia, 77 under general anesthesia, 20 patients received CSE anesthesia and 39 patients received brachial block Distribution of anaesthetic techniques in both OTs is shown in Table-1. Mean anaesthesia induction time in cases of general anaesthesia was 14.8 minutes., in spinal anaesthesia was 18.5 minutes, for combined spinal epidural was 24 minutes and for brachial block in procedure room was 30 minutes. These were within benchmark time of 20 minutes for general and spinal anaesthesia and 30 minutes for combined spinal epidural and brachial block. 68% (52 cases)of GA inductions were completed by 20 minutes, whereas in spinal anaesthesia 87%(80 cases)of the time patient was handed over from anaesthesia side for positioning and surgical preparation within 20 minutes. In case of CSE and brachial block85 %(17 cases) and 60 %(22 cases) of inductions respectively were completed within the benchmark time of 30 minutes. Thus overall in 75% cases the anaesthesia induction completed within our accepted benchmark limits .In 25% of cases anaesthetic induction time was delayed. The mean induction time for anaesthesia was 25.45 minutes in our study. The mean anaesthesia induction time for various techniques is shown in Table-2

Table 2: Distribution of anaesthetic techniques in surgery and orthopaedics OT

	SURGERY OT 133 cases	ORTHOPAEDICS OT 98 cases	TOTAL231 cases
GENERAL ANAESTHESIA	68(51%)	9(10%)	77(34%)
SPINAL ANAESTHESIA	53(40%)	42(42%)	95(41%)
COMBINED SPINAL EPIDURAL	12(9%)	8(8%)	20(8%)
BRACHIAL BLOCK	0	39(40%)	39(17%)

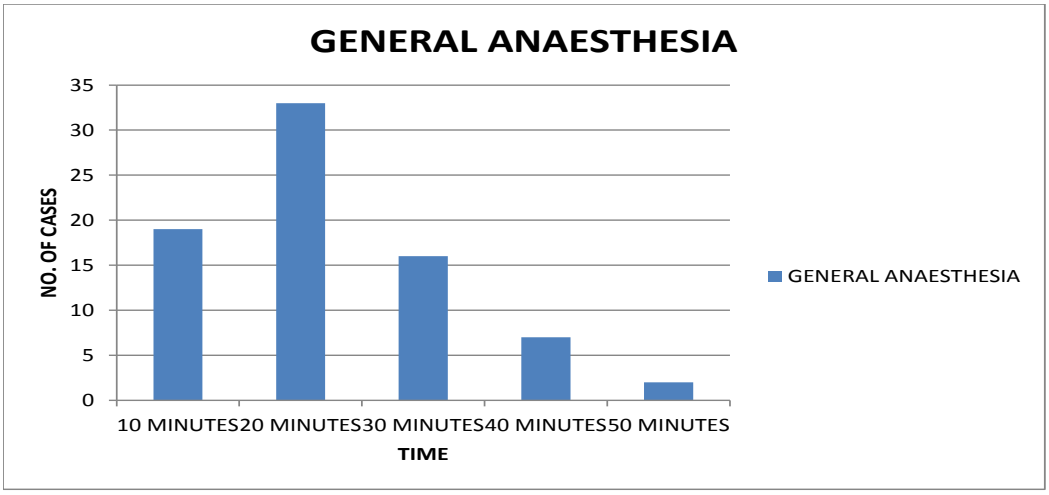

Fig-3: Range of anaesthesia induction time for General Anaesthesia

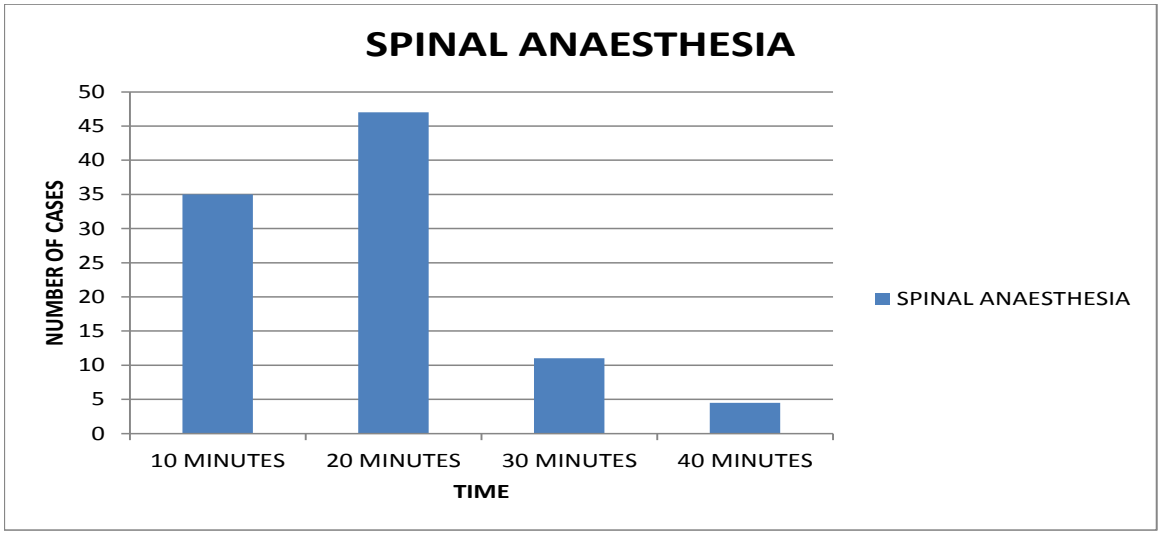

Fig 4 Range of anaesthesia induction time for Spinal Anesthesia

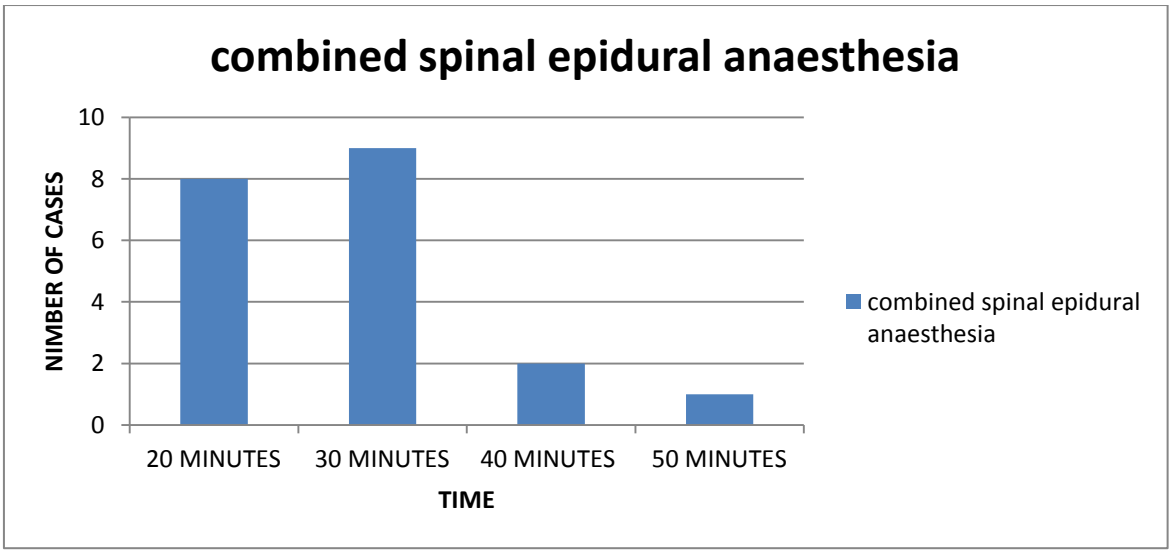

Fig 5: Range of anaesthesia induction time for combined spinal epidural anaesthesia

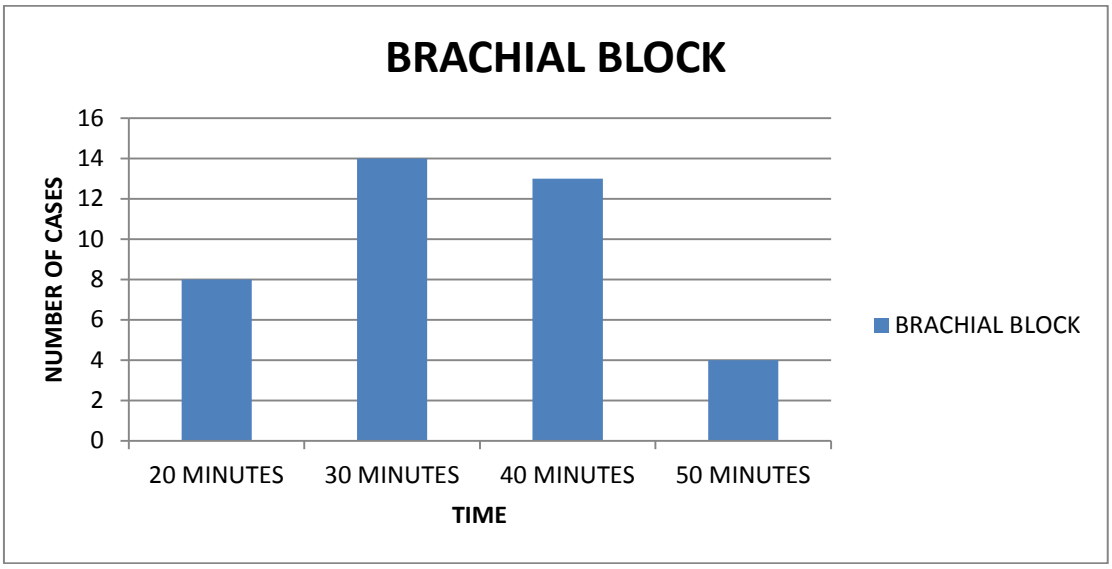

Fig 6 Range of anaesthesia induction time foe USG guided brachial block

Table-3 Range of Anaesthesia induction time for various techniques

	GA(no. of cases)	SPINAL(no. of cases)	CSE(no. of cases)	BRACHIAL BLOCK(no. of cases)
<20MINUTES	52	80		
20-30MINUTES	16	11	17	22
30-40 MINUTES	7	4	2	13
40-50 MINUTES	2		1	4

DISCUSSION:

This audit also attempted to identify the reasons for delay in anesthesia induction time, time taken for different techniques and identify factors leading to undue delay .Obviously, some delays are unavoidable. But if the avoidable delays can be easily fixed and attended to, valuable time can be saved, which will ultimately keep the surgeries on schedule throughout the day. Opportunities to improve theatre efficiency were identified. The anaesthesia induction time varies with the type of anaesthesia. Time taken by different anesthetists for same and different procedures may vary. Delay of anaesthetic induction not only affects the surgeons by prolonging their idle time but also increases expenditure for the patient [2]. However increasing efficiency by decreasing anaesthesia induction time is not always possible as surgery duration has a major impact [5]. Schuster *et al.;* reported that patient characteristics such as ASA grading, obesity, elective or emergencies do not affect AIT [4]. Other disagrees with this.practice [6, 7]. The demographic characteristics of the patients and ASA status were not considered in our study. Anaesthesia induction time involves a complex interaction between procedure, provider and patient. As the members of anesthesia department had rotation among the two operation theatres for one month each the provider for the anesthetic technique remained constant. Even experienced anaesthetists, cannot accurately predict how much time a particular technique will need [8]. Studies have suggested benchmark values for induction of different techniques over dyk *et al.;* [1] fixed anaesthesia induction time at 15 minutes in their study. In study by Zafar *et al.;* [9] the anaesthesia induction time varied with ASA status for GA patients i e 15 minutes for ASAI& II and twice as much for ASAIII&IV. In spinal anaesthesia their benchmark was 15 minutes whereas for epidural it was 30 minutes. Another 15 minutes was set for each invasive monitoring. In our study benchmark time for GA, spinal, induction was arbitrarily taken as 20 minutes and 30 minutes for CSE and brachial block as the ASA grading of the patient is not taken into consideration due to many contradicting studies [4, 6].

Performing anaesthetic induction in parallel while the previous surgery is ongoing can go a long way in increasing operating room efficiency [10]. Use of a block room, a space reserved for regional anesthesia(RA) procedure preoperatively may reduce or even eliminate the time normally required for anesthesia induction [11, 13, 17]. It also permits adequate time for teaching residents and for distal supplementation in the case of incomplete anesthesia prior to surgery [12]. Dexter *et al.;* showed through computer modelling that even eliminating anesthesia-

controlled time fails to facilitate the addition of surgical cases [5].

In our study the mean induction time was 25.45 minutes combining all techniques. Our study shows reasons for delay in .25 cases receiving general anaesthesia. These patients had an anaesthesia induction time beyond 20 minutes .Maximum time needed for of induction was for fibreoptic intubation(2 cases),other causes being hemodynamic instability after induction ,hypotension, hypertension, arrhythmias, ECG changes needing stabilization(6 cases), bronchospasm(2 cases), reaction to anaesthetic agent(2 cases), faulty anaesthetic equipment(2 cases),difficulty in iv access(3 cases),emergency case(1case) improper size of endotracheal tube requiring change of tube(2 cases),and even pre-induction problems such as hypertension, ECG changes requiring medical specialist opinion (2 cases).

In (13%)13 cases spinal anaesthesia took longer time compared to benchmark values .The causes were resident training in 2 cases , effect inadequate took time to achieve adequate motor block(3 cases), no effect so repeat spinal given(2 cases), patient apprehension(1 case), severe hypotension after spinal needing stabilization(3 cases), difficult back in old patient, obese patient(2 cases). Difficulty in passing the epidural catheter was among the main causes for delay in 15 %(3) of cases receiving combined spinal epidural anaesthesia

In Patients receiving USG guided brachial block in 40 % [17] cases there was delay beyond 30 minutes. The level of experience of anaesthetist was among the prime reason for delay(5 cases),others being inadequate block (6 cases) requiring additional dose by other technique, subclavian artery puncture mandating change of technique(2 cases) and technician unavailability(4 cases).

In 231 cases there was delay in (60) 25% cases where anesthesia induction time exceeded benchmark timings this delay could be avoided in some cases whereas in others the exceeded time limit was explainable. The problems which could be dealt with before hand thus curtailing on anesthesia induction time are faulty equipment, keeping spare equipment ready, insertion of IV lines by anaesthetist in preoperative room, anaesthetic preparation for next case during turnover time, patient apprehension to be handled in preoperative room, correct size endotracheal tube to be used, resident training under supervision of senior and more experience in performance of blocks. And hiring extra technical staff for procedure room. Problems arising due to performance of different anaesthesia procedures such as hemodynamic instability, bronchospasm, could not be avoided .Besides pre-induction hypertension, ECG changes, severe hypotension after spinal anaesthesia, inadequate or no effect, difficulty in performing in old, obese patient, were also unavoidable.

A study by Shin YD *et al.;* [14] on Spinal and Epidural anesthesia reported anesthesia to surgery start time was 20.41 ± 3.77 minutes for spinal anesthesia and 27.5 ± 5.67 minutes for epidural anesthesia they found that the entire anesthetic time were longer with epidural anesthesia than with spinal anesthesia. In our study mean induction time for spinal anesthesia was 18.5 minutes and for CSE was 24 minutes.

In a study of developing country Oluwadiya KS *et al.;* [15] the mean induction time for GA was 19 minutes, in comparison to 14.8 minutes in our study. The mean induction time for spinal anaesthesia was 26 minutes in comparison to our study where it was 18.5 minutes In our study the mean induction time was 25.45 minutes combining all techniques. Nandanwar A.S *et al.;* repoted longer duration for epidural anaesthesia induction (15.45±2.8 min) compared to spinal anaesthesia (8.52±2.62 min) [16]. Mehta S.S *et al.;* [18] observed. That the time of block performance in nerve stimulator group was 10.5 ±2.5 min. and in ultrasound guided group was 6± 1.5 min. Mean time for performance of block, onset of sensory and motor block and volume of drug are less with ultrasound guided method. USG guided block technique is safe as compared to nerve stimulator regarding peri-operative complications.

Strum *et al.;* compared anesthesia induction time for different surgeries [7]. Another study reported presence of surgeon at induction reduced anaesthesia induction time [6]. Several studies observed that anesthesia residents in OR may extend anaesthesia induction time [4, 19, 20]. Educational level of the anesthetist and age of the patients had small, but significant effects [7]. 2 cases out of 231 inductions in our study were delayed due to training of residents.

Emergency cases, may contribute to delays due to unexpected events and a shorter preparation time with acute patient, in our study GA was delayed in one case as it was an emergency.

Mariano E.R. *et al.;* [21] found anesthesia-controlled time (median [interquartile range]) for the nerve block group utilizing a block room for preoperative regional anaesthesia procedures (median 28 min) was significantly shorter than for GA (median 32 min, P=0.0392) .In our study USG guided brachial plexus block needed on an average 30 minutes to be effective, so indirectly we saved 30 minutes of precious OT time for each case of brachial block. Singh *et al.;* [22] noted that block execution time was significantly

shorter in USG guided block than in nerve stimulator group (8.14 vs. 10.63-min) however a good block ensued in both the groups by approximately 20 min Thus the time required to execute USG guided brachial block and for its effect took 28 minutes, and in our study it took 30 minutes.

Escobar *et al.;* [23] found significant variation in anesthesia release time and concluded that assigning a constant fired time for anesthetic induction is inappropriate for OR scheduling purposes .A Dutch study [24] advised grossing up the surgeon controlled time by 33% to account for anesthesia controlled time. This recommendation will improve OR scheduling, which could result in reducing over utilized OR time and the number of case cancellations and could lead to more efficient use of limited OR resources.

There are limitations in our study. Separation of anesthetic techniques led to small group in some cases for e.g. we had only 20 cases of combined spinal epidural anaesthesia. As anesthetists were recording anaesthesia induction times, element of Hawthrone effect cannot be ruled out. Moreover Overdyk [1] observations needs to be taken into consideration that it might even be impossible to exclude bias when data collection depends on human individuals instead of automatic electronic time recording systems.

CONCLUSION

In our study 75%of the time anaesthetic induction was completed within benchmark limits. Avoidable causes of delay should be rectified. Anaesthetic induction time delays have considerable impact on surgeons they feel satisfied if their waiting time before surgery is less. A "procedure room," to perform regional blocks can preoperatively reduce or even eliminate the time normally required for anesthesia induction. efficiency and provide direct feedback in regards to individual performances .Efficient OT management demands the accurate prediction of the procedure times including anaesthesia induction times for each surgical procedure. This could lead to a reduction in over utilized OT time and fewer case cancellations.Unforeseen complications during induction of anesthesia as in our study can be reason for delay ,but the anesthetist hurrying up to be within benchmark values can jeopardize the safety of the patient.So variations may occur in anaesthesia induction times due to complications during induction process. The anaesthetist should not be pressurized regarding induction time limits, keeping in mind that safety of the patient is the prime goal.

Conflict of Interest: Nil

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