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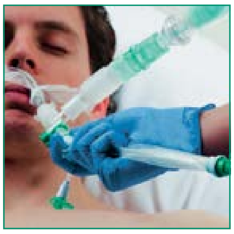

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- Title
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# Editorial

Welcome to our second quarterly edition of the society's scientific journal.

I am pleased to note that the anaesthetic and critical care fraternity have been quite supportive in both critique and writing.

'Primum non nocere' is a phrase familiar to and resonant across the medical fraternity and certainly in anaesthetic practice, it remains a primary guiding philosophy of undertaking. In this edition, an anaesthesiologist pens an article highlighting a practical approach and real interpretation with an insider's view that sets out to define an anaesthesiologist in holistic terms beyond simply the delivery of the anaesthetic. The author underlines the need to be cognisant of various aspects of the fact that the practice of medicine (and Anaesthesia in particular) is not only a science but an art that takes into account the patient's wholesome being hence a need to improve on our soft non-clinical skills.

As the country, indeed the world, strives to effect universal health coverage- a cliché that has gained currency in the medical, social and political fraternity-, it is imperative for all anaesthesia practitioners and managers to participate in the economics of healthcare ranging from resource allocation, futuristic planning and efficient resource utilisation to audit of satisfaction and outcomes: perhaps it is time to make the fundamental basics of healthcare economics an integral part of formal training in anaesthetics and critical care medicine.

Two authors in this publication present papers and recommendations from studies carried out on theatre time utilization and satisfactory general anaesthesia experience as reported and analysed at the main teaching hospital in the country: These studies are intended to change practice across the country in a bid to improve resource allocation, efficiency and improve service delivery.

Establishing an airway is a skill that is key to the practice of safe perioperative and emergency medicine: the difficult airway continues to attract development of various gadgets to ensure safe practice and in this edition, an author highlights a rare local experience with the Treacher Collins syndrome which though is rare in our setting, is something worth noting and preparing for.

As societies make strides in improving healthcare service and delivery, a surge in the numbers of the elderly population and patients with non- communicable lifestyle diseases have been noted. Both these outcomes bring about a dimension of practice that was not prevalent in our setting. A clinical scenario highlighting the pitfalls and challenges faced in initial assessment, fluid resuscitation and treatment of hyponatremic patients with resulting Osmotic Demyelination is presented as a potential negative outcome of a well-intentioned management plan.

# A Case Report On Treacher Collins Syndrome: Anaesthetic Challenges And Literature Review

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## Abstract

Treacher Collins Syndrome is a rare genetically mediated craniofacial malformation with variable expressions. It poses a great challenge of airway management to especially it is unanticipated. We describe a case of unanticipated difficult airway in a 7 year old girl who was posted for lower eyelid reconstruction.


## Introduction

Treacher Collins Syndrome (TSC) is an autosomal disorder characterized by craniofacial malformations. It has a variable degree of phenotypic expression.(1) Prevalence of TCS is estimated to be up to 1:70,000 live births. It has no race or gender predilection.(2)

Features of TCS are maxillary, mandibular and zygomatic dysplasia presenting as down slanting palpebral fissure, lower eyelid coloboma and ear malformations.(1) These features pose a challenge of airway management (difficult intubation) which can be worsened by the presence of cleft lip and or cleft palate. Difficult intubation has been shown to increase with increase in age.(3)

## Case Report

A 7 year old female patient was scheduled for left lower eyelid reconstruction. She presented with a history of partial hearing loss and inability to fully close the eyes while sleeping her pre-anaesthesia review revealed an ASA 1 status with no previous surgeries or anaesthesia experiences, or drug and food allergies. She was reported as an active child, did well in school. There were no milestones delays. Her physical examination was unremarkable. On the day of surgery, she was appropriately fasted. The patient was induced with sevoflurane and 6 liters per minute of 100% oxygen using the Ayer's T-piece. Patient developed obstructed breathing that necessitated the use of oropharyngeal airway. Oropharyngeal airway size 1, which was her appropriate size, was not adequate hence we used a size 2. Breathing was uneventful thereafter. An intravenous cannula was fixed and Fentanyl and rocuronium were administered. Laryngoscopy was attempted after 2 minutes. The view of the vocal cords was Commack Lehane IV. Tracheal intubation was attempted 4 times without success. Laryngeal mask airway size 3 was used successfully to secure the airway and ventilate the patient through the two hours of surgery. Medical air and oxygen at 50% was used to maintain the patient under anaesthesia. Emergence was marked with excessive snoring despite the Guedel airway being insitu. Oxygen saturations were maintained above 95%, the rest of the vital signs remained normal. In retrospect, the clinical features seen in this patient were analyzed in detail. The referring pediatrician was contacted. She acknowledged the child as having TCS.

## Discussion

Treacher Collins syndrome also known as Franceschetti syndrome or mandibulofacial dysostasis is a rare craniofacial developmental disorder. It is caused by changes in embryological development of first and second branchial arches. There is incorrect coding of protein treacle, which is essential for the survival of cephalic neural crest cells. This is due abnormal expression of TCOF 1 gene. (4) It is characterized by craniofacial deformities that necessitate a number of both aesthetic and functional corrections. This means that the child will have several surgeries hence anaesthesia in his/her lifetime.(2, 3)

Major issues that these deformities are associated with include airway management challenge both at the perioperative and postoperative period. TCS pose a difficult intubation challenge and obstructive sleep apnea complications to anaesthetists. (5, 6) Difficult airway has been shown to increase with age. (3) Recognizing the condition and anticipating these challenges help in devising a comprehensive anaesthesia plan and management. The causes of difficult airway in these patients are the craniofacial and bony configuration abnormalities presenting as retrognathia, microstomia and macroglossia. (2, 5) While endotracheal intubation remains the commonest technique of airway management in general population, its use is discouraged in TCS cases, especially in the older children and in the absence of a highly skilled anaesthesiologist. Alternative techniques for airway management include intubating or non-intubating laryngeal mask airway (LMA), fibreoptic intubation and tracheostomy.(2) In our case, the difficult intubation was unanticipated, tracheal intubation was unsuccessful even in the presence of a consultant anaesthesiologist. An LMA was therefore used. These alternative airway management techniques have their limitations: LMA can be dislodged by the large tongue and has lack of airway protection in the event of aspiration. Fibreoptic intubation is made difficult by lack of co-operation from the child, macroglossia and limited mouth opening.(2) During the postoperative period, cases of obstructive sleep apnea and pharyngeal edema that have resulted in breathing problems have been reported.(7) In our case, the patient had excessive snoring that occasionally obstructed her breathing. However, this was relieved by appropriate positioning.

## Conclusion

TCS is a rare condition with variable expression. Understanding the unique features and characteristics of the syndrome which may present with life threatening complications can lead to a better anaesthetic outcome for patients.

**Figure 1:** A child with Treacher Collins Syndrome: front view. Goel L et al.

**Figure 2:** Same child with Treacher Collins Syndrome: side view. Goel L et al.

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# Incidence Of Awareness With Explicit Recall In Patients Undergoing General Anaesthesia At Kenyatta National Hospital

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## Background

Awareness with explicit recall during anaesthesia (AWR), also known as intraoperative awareness, is a rare but debilitating complication of general anaesthesia. It can be anaesthesia related, surgical related, patient related or multifactorial. It has short term and long term consequences.

These may include but are not limited to insomnia, panic attacks, sensation of pain and post traumatic stress disorder. It is mostly detected using a structured interview done over time. This is because memory tends to evolve over time. The most commonly used tool is a modified Brice questionnaire (1).

## Methodology

This was a prospective observational study on all patients over 18 years undergoing general anaesthesia at Kenyatta national hospital theatres.

Evaluation of awareness was based upon three consecutive interviews. The patients were interviewed on the day of surgery (in PACU when fully awake) and then on the 3rd and 7th day post operatively. The interview was conducted using a modified Brice questionnaire.

The interviewers were blinded to both the anaesthetic procedure and the medication used. Suspicion of an episode of AWR was registered together with its characteristics.

Patient, anaesthetic and surgical characteristics and the drugs used perioperatively were recorded on a separate form by the person administering the anaesthesia.

## Results

Data was obtained from a total of 369 patients undergoing general anaesthesia in KNH. The mean age of the patients was 38.8 (3 14.5) years with an age range between 18 and 82 years.

Males were 186 (50.4%) and females 183 (49.6%) giving a male to female ratio of 1:1.

Majority of patients were ASA I 230(63.5%). General anesthesia (GA) was administered by four anaesthesia provider cadres including consultants 108 (30.7%), graduate anaesthesia trainees 163 (46.3%), diploma anaesthesia trainees 32 (9.1%) and specialist anaesthesia registered clinical officers 49 (13.9%). Propofol 353(95.7%) and Fentanyl 319 (86.4%) were the most commonly used induction agents while maintenance was mostly done using Isoflurane 345 (93.5%) and nitrous oxide 272 (73.7%). The mean total gas flow 3.3 (SD 3 1.1) l/ min with a range between 1 and 7 l/ min. There were 6 (1.7%) patients with minimal total gas flow rates ($\leq$ 1 L/min). The mean duration of anaesthesia and surgery were 2.7 (3 1.3) hrs and 2.4 (3 1.3) hours, respectively. Out of the 369 patients under GA, 2 had awareness with recall (AWR) giving a prevalence of 0.54%. The two patients with AWR were aged 23 years and 34 years, and both patients were male. There was no evidence of an association between patients' age ($p = 0.842$) or sex ($p = 0.16$) and occurrence of AWR.

## Conclusion

We were able to meet our primary objective which was incidence of AWR in patients undergoing GA at KNH. We got an incidence of 0.54% which is within the range (2). The two patients we got were both males and age range of 18-35 years. The statistical test done showed there was no association of gender and age with incidence of AWR. We were therefore unable to draw a conclusion on the risk factors and groups at risk of AWR. The study was not significantly powered to identify groups at risk and factors associated with AWR.

## Introduction

Awareness with recall during general anaesthesia is a rare but extremely feared complication of general anaesthesia. Its incidence varies between 0.1%-0.2% with certain specialities surgical procedures being more prone to awareness(2). AWR has been noted to be a problem preoperatively with several consequences ranging from insomnia, anxiety to post traumatic stress disorder(3)(4).

This can and has led to fear of future surgery by affected patients and an increase in litigation for anaesthesia providers(5).

The risk factors for awareness include patient related, anaesthesia related, surgical related and multifactorial. Patient factors include genetic variation in pharmacokinetics based on gender.

Women tend to wake up faster from anaesthesia compared to men (6). Younger people also emerge earlier compared to the elderly population. Patients with a previous history of drug abuse e.g. amphetamine, alcohol etc have a higher risk of awareness since they will need higher drug dosages to achieve an acceptable depth of anaesthesia. Patients who have a history of awareness have an increased risk of the same. Significant also is the ASA classification of the patient. The sicker the patient the higher their chance of awareness (7).

The type of surgery can put a patient at risk of awareness. Obstetric, trauma and cardiac Surgery are known risk factors for intraoperative awareness (8) (9) (10). The duration of surgery too, with longer surgeries lasting more than 180 minutes and surgeries done at night being more at risk of awareness . The technique used during anaesthesia can predispose patient to AWR during GA. Significant is the use of neuromuscular blockers with studies showing higher incidence in patients to whom neuromuscular blockers were administered (11) (12). Light anaesthesia also with low MAC was shown to put patients at risk of AWR as well as low flow anaesthesia (13) (14).

Incidence of awareness with recall under general anaesthesia in patients undergoing general anaesthesia at KNH is limited. The studies done are only two and focus on subsets of patients and not the whole population hence this is a baseline survey of the incidence of AWR in our population. Advances in medical care, longevity and surgical advances have demanded more from anaesthesia with newly diagnosed terminal cases and very sick individuals presenting for anaesthesia for surgery or other interventional procedures.

Younger children are also involved in surgical interventions. Explicit recall may be difficult to assess but they may later present with cognitive dysfunction due to the same and it is of interest for them to be evaluated. Techniques in anesthesia have also advanced and we are now in the era of low flow anaesthesia and we have become bolder in the use of total Intravenous anaesthesia (TIVA). We are still challenged though, in that with these advances, we are yet to start anaesthetic depth monitoring in our set up. We have various methods of monitoring depth of anaesthesia. These methods have their advantages and disadvantages.

These include use of:

1. Non EEG methods
- Autonomic responses
- Isolated forearm technique

2. EEG based methods
- Evoked potentials
- Lower oesophageal contractility
- Bispectral index

## Autonomic Response

Autonomic signs have been used to assess anaesthetic depth. They include heart rate, lacrimation, blood pressure and sweating. The advantage is that there is no need for sophisticated equipment or training to be able to use autonomic responses to assess depth of anaesthesia but they do have several limitations. First it is a very subjective method and can be affected by other factors e. g beta blockers can prevent tachycardia and atropine can cause tachycardia with papillary dilatation. It is also noted that a patient may exhibit signs of light anaesthetic depth using clinical signs but not be aware. We however recognize that should an anaesthetized patient have unexplained tachycardia and hypertension then the anaesthetic agents must be reviewed. It therefore has limited use.

## Isolated Forearm Technique

This is a technique that was introduced by Tunstall in 1977 to assess the processing of information during general anaesthesia. It involves inflation of a tourniquet on the upper arm to pressures above systolic blood pressure before muscle relaxant is administered into the vein on the other arm and the tourniquet is released 15 to 20 minutes after administration of muscle relaxant. In case there is need to top up the tourniquet is re inflated. The patient can then respond to command if the patient is awake. Studies have shown though that wakefulness did not necessarily translate to awareness and complex muscle movements may be involuntary and not necessarily due to wakefulness.

### Evoked Potentials

These measure electrical activity in certain parts of the brain in response to stimulation of specific nerve pathways. General anaesthetics cause changes in amplitude and frequency of the waves but the changes are not consistent with all anaesthetic agents making very reliable as a measure of depth of anaesthesia.

## Bispectral Index

This is a complex statistically based parameter that integrates the electroencephalogram (EEG) and electromyography (EMG). It is presented in numerical form with 100 being awake and 0 being isoelectric EEG. The manufacturers recommend a BIS of 40-60 for adequate anaesthetic depth. Several studies have been done on it. The B-AWARE trial concluded that it helped in reduction of awareness under general anaesthesia with muscle relaxant but the cost was prohibitive (15). Another study by Duarte LT and Saraiva RA concluded that BIS can give false results in different clinical settings(16)

# Methodology

Approval to conduct the study was obtained from the KNH/UoN ethics and research committee. This was a prospective observational study on all patients over 18 years undergoing general anaesthesia at Kenyatta National Hospital theatres.

Evaluation of awareness was based upon three consecutive interviews. The patients were interviewed on the day of surgery (in PACU when fully awake) and then on the 3rd and 7th day post operatively. The interview was conducted using a modified Brice questionnaire(1).

The interviewers were blinded to both the anaesthetic procedure and the medication used.

Suspicion of an episode of AWR was registered together with its characteristics. Patient, anaesthetic and surgical characteristics and the drugs used perioperatively was recorded in a separate form by the person administering the anaesthesia.

# Results

## Patient Characteristics

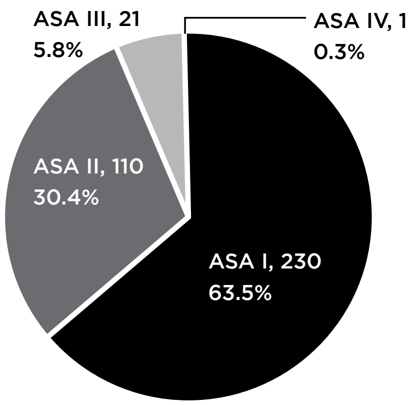
Data were obtained from a total of 369 patients undergoing general anaesthesia in KNH. The mean age of the patients was 38.8 (3 14.5) years with an age range between 18 and 82 years. The most common age group was 18-29 years (30.1%) followed by 30-39 years (28.7%), table 1. There were 186 (50.4%) males giving a male-to-female ratio of 1: 1. Of the 369 patients 138 (42.3%) had primary level education and 133 (40.8%) had secondary education (table 1).

**Table 1:** Characteristics of patients undergoing general anaesthesia at KNH

| | Frequency (n) | Percent (%) |
|---|---|---|
| **Age** | | |
| 18-29 years | 111 | 30.1 |
| 30-39 years | 106 | 28.7 |
| 40-49 years | 77 | 20.9 |
| 50-59 years | 37 | 10 |
| 60 years and above | 38 | 10.3 |
| **Sex** | | |
| Male | 186 | 50.4 |
| Female | 183 | 49.6 |
| **Level of Education** | | |
| No formal education | 16 | 4.9 |
| Primary | 138 | 42.3 |
| Secondary | 133 | 40.8 |
| University/ college | 39 | 12 |

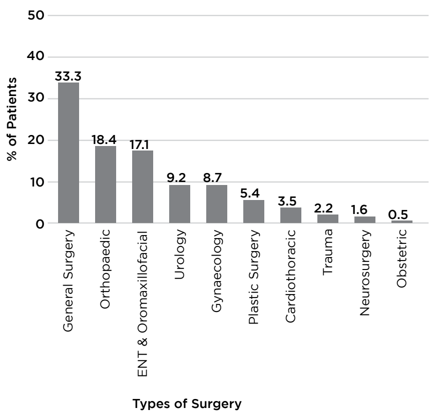
Figure1 shows the physical status of patients prior to surgery. Majority of patients had no systemic disturbance with 230 (63.5%) having ASA I classification. There were 110 (30.4%) patients who had moderate but definite systemic disturbance representing ASA II.

**Figure 1:** ASA physical status classification of patients undergoing GA.




A total of 123 (33.3%) patients undergoing GA in KNH had general surgeries (Figure 2). There were 68 (18.4%) patients undergoing orthopaedic surgery and 63 (17.1%) who underwent ENT surgery.

**Figure 2:** Types of surgery conducted in patients in KNH.




## Incidence of Awareness with Recall

Out of the 369 patients under GA, 2 had awareness with recall (AWR) giving a prevalence of 0.54% on day 1, 3 and 7 (table 2). Thus, the incidence for AWR under general anaesthesia was 5.4 cases per 1,000 patients. Intraoperative dreaming was reported by 45 (12.2%) patients and of these reported that the dreams were disturbing.

**Table 2:** Incidence of AWR based on modified Brice questionnaire.

| | Number of AWR patients (n = 369) | Intraoperative dreaming (n = 369) |
|---|---|---|
| Day 1 | 2 (0.54%) | 42 (11.4%) |
| Day 3 | 2 (0.54%) | 18 (4.9%) |
| Day 7 | 2 (0.54%) | 17 (4.6%) |
| **Total** | **2 (0.54%)** | **45 (12.2%)** |

Table 3 shows that the two patients with AWR were aged 23 years and 34 years, and both patients were male. There was no evidence of an association between patients age (p = 0.842) or sex (p = 0.16) and occurrence of AWR.

**Table 3:** Patient demographics and occurrence of AWR.

| | AWR n (%) | No AWR n (%) | P |
|---|---|---|---|
| **Age** | | | |
| 18-29 years | 1(1) | 110(99) | 0.842 |
| 30-39 years | 1(1) | 105(99) | |
| 40-49 years | 0(0) | 77(100) | |
| 50-59 years | 0(0) | 37(100) | |
| 60 years & above | 0(0) | 38(100) | |
| **Sex** | | | |
| Male | 2(1) | 184(99) | 0.16 |
| Female | 0(0) | 183(100) | |

## Anaesthesia Procedure and AWR

GA was administered by four health provider cadres including consultants 108 (30.7%), anaesthesia trainees at graduate 163 (46.3%) and diploma 32 (9.1%) levels and specialist anaesthesia registered clinical officers 49 (13.9%). As shown in table 4, AWR occurred in a single patient in the group administered GA by consultant anaesthetist and in one patient administered GA by graduate anaesthesia trainee.

**Table 4:** Health provider cadre and occurrence of AWR.

| | AWR n (%) | No AWR n (%) | Total n = 369 |
|---|---|---|---|
| **Health Provider Cadre** | | | |
| Consultant | 1(1) | 107(99) | 108(30.7) |
| Graduate Anaesthesia Trainee | 1(1) | 162(99) | 163(46.3) |
| Diploma Anaesthesia Trainee | 0(0) | 32(100) | 32(9.1) |
| Registered Clinical Officer Anaesthetist | 0(0) | 49(100) | 49(13.9) |

## Induction agents

Table 5 presents the rate of awareness for different induction agents. Overall, propofol (95.7%), and fentanyl (86.4%) were the most commonly used induction agents. Both patients who had AWR received propofol and one of the two cases reporting awareness also received fentanyl. The two patients with AWR did not have any of the other induction agents administered namely isoflurane, halothane, remifentanil, morphine, ketamine or midazolam (table 5). These induction agents were administered in between 1.6 and 4.6% of the patients who did not report AWR.

**Table 5:** GA induction agents used in patients with and without AWR.

| | AWR n (%) | No AWR n (%) | Total n = 369 |
|---|---|---|---|
| **Induction Agent** | | | |
| Isoflurane | 0(0.0) | 13(3.5) | 13(3.5) |
| Halothane | 0(0.0) | 6(1.6) | 6(1.6) |
| Propofol | 2(100.0) | 351(95.6) | 353(95.7) |
| Remifentanyl | 0(0.0) | 7(1.9) | 7(1.9) |
| Fentanyl | 1(50.0) | 318(86.6) | 319(86.4) |
| Morphine | 0(0.0) | 8(2.2) | 8(2.2) |
| Ketamine | 0(0.0) | 17(4.6) | 17(4.6) |
| Midazolam | 0(0.0) | 14(3.8) | 14(3.8) |
| Other Induction Agent | 0(0.0) | 11(3.0) | 11(3.0) |

## Maintenance Agents

The most frequently administered maintenance agents were isoflurane (93.5%), nitrous oxide (73.7%) and morphine (58.8%), table 6. The two patients with AWR both received isoflurane and one of these patients also received nitrous oxide in addition to isoflurane. Each of the remaining maintenance agents were each administered in less than 5% of patients with none of the patients with AWR receiving these agents.

**Table 6:** GA maintenance agents used in patients with and without AWR.

| | AWR n (%) | No AWR n (%) | Total n = 369 |
|---|---|---|---|
| **Maintenance Agent** | | | |
| Isoflurane | 2(100.0) | 343(93.5) | 345(93.5) |
| Halothane | 0(0.0) | 7(1.9) | 7(1.9) |
| Propofol | 0(0.0) | 1(0.3) | 1(0.3) |
| Remifen-tanyl | 0(0.0) | 14(3.8) | 14(3.8) |
| Fentanyl | 0(0.0) | 8(2.2) | 8(2.2) |
| Morphine | 0(0.0) | 217(59.1) | 217(58.8) |
| Pethidine | 0(0.0) | 1(0.3) | 1(0.3) |
| Ketamine | 0(0.0) | 4(1.1) | 4(1.1) |
| Midazolam | 0(0.0) | 3(0.8) | 3(0.8) |
| Other Main-tenance Agent | 1(50.0) | 15(4.1) | 16(4.3) |
| Nitrous Oxide | 1(50.0) | 271(73.8) | 272(73.7) |

## Total Gas Flow

The mean total gas flow was 3.3 (SD 3 1.1) l/ min with a range between 1 and 7 l/ min. There were 6 (1.7%) patients with low total gas flow rates (≤ 1 l/min). The two patients with AWR had total gas flow rates of 4 l/min and 5 l/min.

## Duration of Surgery and Anaesthesia

The mean duration of anaesthesia and surgery were 2.7 (3 1.3) hrs and 2.4 (3 1.3) hours, respectively. The two patients with AWR had durations of anaesthesia of 1 hour and 2 hours. The corresponding duration of surgery for these patients with AWR was 45 minutes and 1 hour 50 minutes, respectively. The ranges for duration of surgery and anaesthesia in the study were 20 minutes to 8 hours and 20 minutes to 8.5 hours.

**Table 7:** Duration of anaesthesia and surgery in patients undergoing GA in KNH.

| | Mean | SD | Range |
|---|---|---|---|
| Duration of Surgery | 2.4 hrs | 1.3 | 20 min - 8 hrs |
| Duration of Anaesthesia | 2.7 hrs | 1.3 | 20 min - 8.5 hrs |

# Discussion

Awareness with explicit recall is a rare but dreaded, by both patients and anaesthesiologists, complication of general anaesthesia. The implications of AWR include but is not limited to insomnia, anxiety disorders, depression and suicidal tendencies (3) (4)(5). It is also a major medicolegal issue. In this era of balanced anaesthesia and increased monitoring, it can be argued that the anaesthesia provider should have suspected signs of light anaesthesia (17).

Since AWR is based on patient's recollection of the event, the gold standard tool for inquiring about explicit recall is the Brice questionnaire. This tool has been modified over the years but the core questions remain the same. The time of administration has also been varied among the different researchers given that memory evolves. It has ranged from day 1 in PACU to 30 days post surgery. In our case, we conducted three consecutive interviews on day 1, day 3 and day 7 using the modified Brice questionnaire.

We note that majority of our patients were between 18-50 years with the highest percentage being 18-29 years. The male to female ratio was almost 1:1 as shown in table 1. Figure 1 shows us the ASA status of the patients. This was based on what the anaesthesia provider documented in the questionnaire. Of note is that a majority of the patients are in ASA I, 63.5%, which would be more likely in a paediatric or adolescent population as opposed to our age group. This is because smoking, alcohol consumption and pregnancy places one in ASA II. The majority of our patients 79.7% are between the ages of 18-50 years and there is high likelihood of use of alcohol and tobacco in this population as well as it is being the reproductive age of most women. This brought to question the possibility of there being a knowledge gap that needs to be filled regarding ASA classification. Both patients with AWR were documented as ASA II. With regard to patient characteristics which puts patient at risk of AWR and in particular ASA classification, studies report more incidence of AWR with ASA III and IV patients more than ASA I and II (7).

Concerning the types of surgeries done in KNH, most of the cases were general surgical cases and these included mastectomies, thyroidectomise explorative laparatomies for different gastrointestinal pathologies, excisions and biopsies. This was followed by orthopaedic procedures. While in most set ups most orthopaedic procedures are done under regional anaesthesia, in our set up it was noted that regional techniques was mostly used for lower limb surgeries with orthopaedic surgery in another anatomical region other than lower limbs was an indication for general anaesthesia in most cases. There is need for education in regional anaesthesia techniques to fully benefit our population of that essential and safe mode of anaesthesia. On the other hand, for obstetric anaesthesia, regional technique is what is mostly used hence we had very few obstetric patients under general anaesthesia.

While we do a lot of otolaryngeal procedures in KNH, majority of the patients fall in the paediatric age group who were excluded in our study. Significant also is that during the study period, there was no open heart surgery going on in the hospital and so were not able to sample those patients. This is significant in that cardiac surgery is one of the high risk factor for AWR. Most neurosurgical patients were taken to ICU post operative and were therefore unable to communicate which was one of our exclusion criteria.

In our conduct of anaesthesia, during induction, 95.7% of patients received propofol, 86.4% received fentanyl, a few also used midazolam, morphine and ketamine as shown in Table 5. We had very little inhalational induction in adults 1.6% that is 6 patients and this was using halothane since the cost of sevoflurane is still prohibitive. This was mainly used with difficult

airways. Therefore most of our induction combination of propofol and fentanyl was used. 93.5% of patients were maintained on isoflurane with only 1.9% that is 7 patients being maintained oh halothane. Nitrous oxide was used in 73.8% of patients making oxygen, nitrous oxide and isoflurane being the maintenance technique mostly used. On use of neuromuscular blockade, 95.9 patients receive neuromuscular blockade with cisatracurium being the mostly used, 59.9% Table 7. We had two patients out of the 369 patients who had explicit awareness with recall Table 2.

This was revealed in the first interview in PACU and the subsequent interviews on day 3 and 7. Their files were retrieved and their preoperative records viewed, the anaesthetic chart was examined and they were further questioned. They were followed up but they declined any psychological disturbance and were not willing to be seen by a psychiatrist. A total of 12.2% had dreams. They were further interviewed as to the nature of their dreams in case they had AWR thinking they dreamt. To rule out AWR .On further evaluation, the dreams were unrelated to the surgical and anaesthetic procedure and they mostly revolved around their social life and were not disturbing to them. We were not able to identify groups at risk and risk factors for AWR given the methodology used and the rarity of the event. We got two patients who were both male in the same age group. We were therefore unable to draw a statistically sensible conclusion from the result.

Noteworthy is that the last question in our modified Brice questionnaire was on what was their worst experience, most respondents, 62.4%, complained of pain in PACU. This was promptly relieved in PACU. We did not use a visual analogue scale since pain was not what we were investigating but it was a significant finding and further study could be considered so that we may improve our patient satisfaction.

## Strengths

This study is believable because we got an efficiently large enough sample to estimate the prevalence of AWR in KNH during the study period with adequate precision.

The tool used which is the Brice questionnaire, is the gold standard for studies on AWR because it is based on recall and the questions are objective.

The sample was a good representation of the patients who present in KNH for surgical care.

## Limitation

We were limited in that the methodology used is not ideal for a rare event such as AWR. The work was therefore very involving and costly. A better design would have been a case control with the cases being defined by occurrence of AWR. The challenge currently with case control studies is that there needs to be a robust and electronic patient data system which is still not there so a lot of information tends to be missing from patients files.

A group at significant risk of AWR was not present that is the open heart patients.

In conclusion, the overall risk of AWR ranges from 0.1-0.8% depending on a number of factors. In our case..

## Conclusion

- The incidence of AWR in KNH is 0.54%
- There was no specific group of patients that were identified as being at risk for AWR.
- There were no major risk factors for AWR which were identified in this study.
- Of the two patients who had AWR, one had clinical attributes which would predispose him to AWR; successive repeated anaesthesia for resuscitative surgery.

## Recommendations

- A larger study needs to be done to involve as many patients as possible.
- Clear guidelines of prevention of AWR in patients presenting for acute interventions need to be developed

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# Towards the Definition of a Good Anaesthetist

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## Abstract

Becoming a good anaesthetist requires a competent technical preparation, but it is also intuitively evident that being a good anaesthetist cannot be reduced to pure anaesthetic knowledge and skills. The literature indeed confirms that good personal character traits form an indispensable part of being considered a good anaesthetist. In this paper we therefore propose that a 'good anaesthetist' be defined as a person who possesses both the technē (knowledge and skill) of anaesthesia and the good character traits specific to the practice of anaesthesia to an eminent degree.

## Methods

A limited chain referral sampling (snowball sampling technique) was employed to identify articles relevant to the research question: What does it really mean to be a good anaesthetist?[1] A modified narrative analysis was then utilised in interpreting and presenting the relevant findings.[2]

## Results & Discussion

It is instructive that contemporary medical practice may not be replete with calls for 'perfect' anaesthetists but instead 'good' physicians and by extension good anaesthetists, are universally appreciated and sought after. In 2013 The General Medical Council of the United Kingdom published guidelines for good medical practice applicable to and binding on all those registered to practice medicine in the United Kingdom.[3] The first point of the document reads, 'patients need good doctors.' It then goes on to list a number of attributes of a good doctor: patient centred approach, integrity, competence, ability to establish and maintain good relationships, honesty and trustworthiness.

A decade earlier in 2002, the British Medical Journal carried out an online survey on the theme question, 'what is a good doctor and how can we make one?' In reply they received answers from 24 different countries in which the respondents listed up to 70 qualities that a good doctor should have.[4,5] Interestingly, respondents valued the personal qualities of the doctor more than their technical skills or scientific knowledge. Petersdorf writing in an editorial for the Journal of the American Medical Association would summarize the characteristics of a good doctor by saying that the 'good doctor' is the physician who excels at the art and science of medicine in caring for his patients and is the one to whom you would send a family member or entrust your own personal care.[6]

The considerations raised by Petersdorf's editorial, the statement of the General Medical Council that 'patients need good doctors', and the survey of the British Medical Journal concerning the definition of a good doctor lead us to an important observation. All the attributes listed in the definitions of a 'good doctor' are in fact specific character traits or virtues. In other words, the literature understands a 'good doctor' as a technically competent physician who also possesses certain virtues. Indeed, medical educationists have also come to the same realization that a good moral character is indispensable for being a good physician, and research aimed at incorporating virtues into medical training is steadily gaining momentum.[7,8,9]

Interestingly, these findings in the general medical literature are also mirrored in the anaesthetic literature.[10] Almost 40 years ago, a study of the personality profiles of a sample of 231 anaesthetists working in the United Kingdom concluded that "the 'good' anaesthetist… is calm, cooperative, contemptuous of incompetence, conscientious, stable, reliable, takes life seriously, and likes to see results of effort quickly. "[11] In 2003, the Royal College of Anaesthetists formally recognised the need for Anaesthetists' Non-Technical Skills (ANTS) and established the ANTS Framework Courses designed to enhance anaesthetists' understanding of human behaviour and non-technical skills in anaesthesia.[12,13,14] Since then a growing body of literature has attested to the importance of incorporating non-technical skills into formal anaesthetic training.[15,16,17]

This change in mentality is further echoed in a 2017 review on anaesthetic professional competence and patient safety in which the author identified four professional metaphors which best describe the anaesthetist.[18] According to the author these are: "1) The Professional Artist, focusing on the patient as a physiological object, taking responsibility for the patient's vital functions. 2) The Good Samaritan, with the patient as a person in focus, striving to minimise her suffering and making her feel safe. 3) The Commander, focusing on the team in the operating room, organising and leading it. 4) The Servant, focusing on the whole hospital as a complex system, trying to facilitate the work of other doctors and nurses for the good of the patient."[18,19]

Drawing on these findings in the literature, an initial tentative definition of a good anaesthetist could therefore be formulated as: a medical doctor trained to practice anaesthesia who concomitantly possesses certain good character traits or virtues. Before analysing this definition further, it is important to point out that an anaesthetist is first and foremost a human person. This formal distinction between person and profession allows an important question to be asked: can a bad person be a good anaesthetist or a bad anaesthetist be a good person? The answer to this question should lead to a better understanding of how to perfect the anaesthetist, or more simply, how to define a good or virtuous anaesthetist.

Two contrasting approaches to medical care serve to illustrate this point. The first is the case of Dr. Harold Shipman, a General Practitioner working in rural England who over the course of his professional career is thought to have murdered at least 215 of his patients using opioid overdoses. In the year 2000 he was convicted of 15 murders for which sufficient evidence could be adduced. What is interesting , however, is that he was widely regarded as a 'good and caring doctor' by the people who knew him and his patients held him in high esteem and considered him the best doctor in the locality.[20] This case immediately begs the question: is it sufficient to put up a show of being virtuous to be considered a good anaesthetist or does the issue of good character traits go deeper? That is, do character traits merely exist in the eyes of the beholder or do they actually in some sense form part of the very definition of the person?

The second is that of a fictional character in a French novel about medical practice at the beginning of the twentieth century. Dr. Michele Doutreval, a young country doctor, arrives home after a long day at work and meets a man on his doorstep. The man, who looks clearly sorry to trouble the doctor at such a late hour, tells him that his little daughter, Franchina Ray is dying of tuberculosis and wishes to say goodbye. Dr. Doutreval's answer is concise but illustrative: "Yes, sure. I'll be right back". He enters his house to greet his wife and to tell her that once again they will not be able to spend the evening together. Then he sets out on his way to the sick girl's house where he stands by her side until she dies. The episode ends with the remark that it was late when the doctor finally got back home.[21]

Medicine is, as the Greek Classics defined it, a techn iatrik , that is, a profession that combines both knowledge and skill in achieving the goal of health.[22] As such it goes beyond mere scientific information and embraces certain qualities and virtuous dispositions intrinsic to and necessary for the practice of medicine in the context of a healing human relationship.[23,24,25] A physician-patient relationship in which beneficence, trust, truthfulness, compassion, justice, etc. are lacking and in which the physician, or patient, or both, deliberately deceive, exploit or otherwise harm each other, cannot be defined as the practice of medicine nor can it form the foundation for healthcare. There are certain good character traits which therefore are intrinsic to the definition of a physician-patient relationship as a particular form of human activity.

Returning to our initial definition of a good anaesthetist, it can now be refined further and stated as: a good anaesthetist is a person who possesses both the techn (knowledge and skill) of anaesthesia and the good character traits specific to the practice of anaesthesia to an eminent degree. Leaving aside the aspect of the anaesthetic techn which is the competence of medical science and the relevant professional bodies to define, a complementary line of enquiry consists in attempting to isolate the particular character traits or virtues specific to anaesthesia and definitive of a good anaesthetist.

Although at first sight this would appear a simple task, in reality it is not a straightforward exercise as it inevitably leads back to the classic question posed by Plato in his dialogues: is the reality of virtue reducible to a few underlying 'mother virtues' or is it rather that each virtue is a separate entity in its own right? To put it another way, is virtue one or is it many?[26,27] That is, are the virtues (understood as the principles of good behaviour) which define a good anaesthetist, and consequently the anaesthetist-patient relationship as a human activity, limited in number or are they as unlimited as each good human act performed by the anaesthetist within the healing relationship?

As a way of concluding but without attempting to give a definitive list, we propose that the character traits intrinsic to and partially definitive of a good anaesthetist should include: prudence, fortitude, compassion, beneficence, humility, justice, and integrity. The exact nature and number of virtues may not be as important as the realization that to be a good anaesthetist involves more than just technical knowledge and skill. It involves the whole person. It is the person who is the good anaesthetist, not his or her knowledge and skill. Ultimately, to be a good anaesthetist means to cultivate a virtuous character as well as impeccable anaesthetic skills and this should be inculcated throughout the training as indeed these virtuous attributes do eventually contribute to the wholesome advancement of the care in anaesthesia.

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# Osmotic Demyelination Syndrome after Hemodialysis in Chronic Renal Failure patient with Severe Hyponatremia "Case Report"

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## Abstract

Osmotic demyelination syndrome is a well-known clinicopathologic entity characterized by edema and demyelination in the pons and extrapontine areas. The syndrome is most often seen after rapid correction of chronic hyponatremia but other diseases that cause fluid and electrolyte disturbances may also lead to myelinolysis. In patients with Chronic Renal Failure with hyponatremia, osmotic demyelination syndrome may develop as a result of rapid correction of hyponatremia by either hemodialysis and/or rapid infusion of hypertonic saline. Dysequilibrium syndrome is one of the metabolic complications of Hemodialysis that may trigger osmotic demyelination syndrome. This report presents two cases with Acute on Chronic renal ailure with severe hyponatremia, one patient with baseline sodium 102mEq/l developed ODS (confirmed by MRI brain) after starting Hemodialysis (4 hour with standard sodium profile 140mEq/L) , another patient with baseline sodium 95mEq/L ,tolerated Hemodialysis (2 hour with low sodium profile 130mEq/l) without any neurological deterioration. This report emphasizes the fact that demyelination syndrome can occur when hyponatremia is corrected too rapidly, even in uremic patients. Lowering dialysate sodium with multiple, short durations of Hemodialysis should be prescribed during Hemodialysis in severe hyponatremic patients. Once overcorrection has occurred, attempts to reverse it, especially in anuric patients with standard hemodialysis machines, are unhelpful.

## Key words

Hyponatremia, Blood Urea Nitrogen, Serum Creatinine, Hemodialysis, Osmotic Demyelination Syndrome, Central Pontine Myelinosis, ExtraPontine Myelinosis.

## Introduction

The osmotic demyelination syndrome (ODS) is a central nervous system disorder that results from neuronal damage related to abrupt fluctuations of osmolality. ODS is mainly described in relation to the rapid correction of hyponatremia [1, 2]. The ODS is manifested by spastic quadriparesis, pseudobulbar palsy, and mental disorders ranging from confusion to coma [3, 4].

Brain cells are freely permeable to water; in case of hyponatremia water move in to the brain cells from extracellular compartment (blood) and cause cell swelling but with time brain develop osmotic adaptation so the brain doesn't get brain edema. When chronic hyponatremia is corrected rapidly, blood becomes relatively hypertonic to the brain, and osmotic stress shifts water out of the brain [5.] A "dehydrated" brain results in myelinolysis and demyelination syndrome.

However, in uremic patients with hyponatremia, demyelination syndrome following the correction of hyponatremia during Hemodialysis is rare [6]. Uremia was considered a possible protective factor. We describe report of two patients with acute on chronic renal failure and hyponatremia. The patient developed central pontine and extrapontine myelinolysis after the rapid correction of hyponatremia by Hemodialysis (4 hour and standard sodium profile). The second patient tolerated Hemodialysis (2 hour with sodium profile 130mEq/l) well without any neurological effects despite rapid correction of hyponatremia.

The increased awareness of the disorder together with the rapidly rising utilization of magnetic resonance imaging (MRI) helped to improve the detection and evaluation of the ODS.

## Case Report-1

A 54 year male was referred from a peripheral hospital at midnight with diagnosis of Acute on Chronic renal failure, Type II Diabetes Mellitus, arterial hypertension and Benign Prostate Enlargement. As per the history given by the attendant the patient has been having confusion, nausea, vomiting and lower limb swelling for 2 weeks prior to admission.

On admission he was awake but lethargic and confused. He had mild pallor, temperature 36.8, BP 101/59mmHg, Pulse rate 71/min, RR-20/min, grade 3+ pitting edema of the lower limbs; respiratory, abdominal and cardiovascular examinations were unremarkable. His laboratory results at admission were as following:

BUN 18.3mMol/l (Normal range 1.7-8.3 mMol/L), Serum Creatinine 652.0 mMol/l (normal range 35-105), Serum Sodium 102mEq/L (normal range 135-146), Serum Potassium 2.2mEq/l (normal range 3.5-5.0), Serum Chloride 74.0mEq/l (normal range 92-122), Serum Calcium 1.87 mMol/l (normal range 2.0-2.60),Serum magnesium 0.67 mMol/l (normal range 0.45-), Serum Phosphate 3.95 mMol/L (normal range 0.8-1.5 ), Serum Uric acid 4.16 Mg/dl (normal range 2.4-7.0), blood Sugar 11.6mMol/L, hemoglobin 7.8g/dl, WBcs 4.67 10 9 , Platelets 259 106 , Serum Albumin 29.56 mg/dl (normal range 38-51mg/dl), AST 122.9 (normal range 10-38.0 ), ALT 74.3 (normal range10-40), Thyroid Function Test-Normal.

Echocardiogram: Hypertensive Heart Disease, KUB Ultrasound: revealed bilateral renal parenchymal disease and BPE. His urine output was 200 ml in 6 hour after admission. Next morning he was seen by Nephrologist and Hemodialysis was initiated with KCL 200mEq intradialysis in the dialysate bath to correct hypokalemia. He had 4 hour standard session of Hemodialysis with blood flow of 200ml/min, Dialysate flow of 300ml/min with sodium 140 mEq/. Next morning, his renal function test was repeated which were as following; BUN -18.6 mMol/L, S Creatinine- 429.0 mMol/l, S Sodium-114.0mEq/L, S Potassium-2.5mEq/L, S Chloride-85.0mEq/l. His GCS was still 14/15 and vitals were stable. He was taken for second session of Hemodialysis as per Nephrologist's order. He was dialyzed for 4 hour with Potassium 160mEq. On 3rd day of admission he became drowsy, developed dysarthria, dysphagia and decreased power in all limbs, unable to swallow liquid so feeding tube was inserted. He was evaluated for sepsis and CVA but there was no evidence of sepsis and CVA (in NCCT brain). His renal function test were repeated which revealed; Urea-10.2, Creatinine-382.0, Sodium-122.0, Potassium-2.1.He was dialyzed with high Potassium bath. His general condition still remained poor. On 7th day of admission his MRI brain was done which revealed Deep white matter ischemic changes, brain atrophy and Ex Vacuo Ventriculomegaly.EEG was normal. Within next one week he had developed quadriplegia he was taken for a repeat MRI brain revealed feature of Osmotic Demyelination Syndrome(ODS):T2 Hyperintensity in the pons (Figure 1) and bilateral basal ganglia and thalami (Figure 2) suggestive both Central Pontine Myelinosis(CPM) and Extrapontine Myelinosis(EPM).

**Figure-1:** T2 Hyperintensity in the pons sparing peripheral rim.

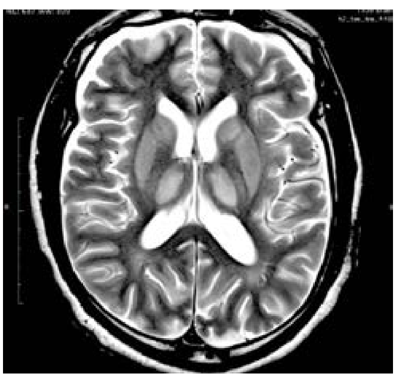

**Figure-2:** T2 Hyperintensity in bilateral basal ganglia and thalami

He was discharged to the medical ward for nursing care and regular dialysis. The patient had slow recovery, he was able to follow some simple verbal commands, was able to swallow liquid diet with assistance but he was still quadriparetic. After 9 week of hospitalization he was discharged for home based nursing care and regular dialysis 3 times in a week. After one month he was readmitted with deep septic bed sores and unfortunately died because of Multi-organ Failure due to sepsis.

## Case Report -2

A 32 male known patient of Diabetes II and Hypertension on regular medication was referred from another hospital with history of bilateral leg swelling and breathlessness for 2 weeks; he was diagnosed as Acute on Chronic Renal Failure with left sided massive pleural effusion which was drained by chest tube twice at outside hospital. On admission he was having breathlessness, he was fully conscious and oriented and gave us a brief history. He was put on oxygen mask. His initial vitals: BP-160/89 mmHg, HR-85/min, RR-28/min, Temp-37.0˚C, SpO2 – 100 % on Oxygen mask. On auscultation had decreased air entry on left side. He was having significant bilateral pedal edema. Chest X ray revealed left sided Pneumothorax with complete left lung collapsed. He was planned for urgent chest tube insertion on left side. His lab result: Hb- 10.1gm/dl, WBc-9.63, Platelets-315.0, CRP-103.9, BUN-21.1mMol/L, Serum Creatinine-861.0mMol/l, Serum Sodium 95mEq/l, Serum Chloride-65mEq/L, Serum Potassium-4.8 mEq/L, Serum albumin -24.02 mg/l, Nephrologist was consulted and was planned for Hemodialysis. He underwent through Hemodialysis (2 hour with low sodium profile 130mEq/l). He tolerated Hemodialysis, after 6 hour of Hemodialysis his serum sodium was 110mEq/l without any neurological deterioration. On day 2nd of admission he had another Hemodialysis (3 hour with sodium profile 130mEq/l). On following day his sodium was 119mEq/l without any changes in his neurological status. He underwent through CT chest which revealed loculated pleural effusion? Empyema thoracic and was planned for thoracotomy and decortication but unfortunately post decortication he had developed MDR bacterial infection in ICU and had gone in MOF and passed away.

## Discussion

Victor and Adams first described central pontine myelinolysis in 1959 in a series of 4 patients with the clinical findings of quadriparesis, pseudobulbar paralysis, and a characteristic pattern of myelin loss confined within the central pons[7,8].At that time, this syndrome was felt to most likely be a sequela of alcoholism or malnutrition, and its relation to electrolyte disorders and renal failure was not apparent because of the lack of routine measurement of serum electrolytes during the 1950s and 1960s.

The name "osmotic demyelination syndrome" became more popular when it was discovered that extrapontine sites basal ganglia and thalamus were also affected [9, 10, 11]. The exact process by which the edema and demyelination occur is unclear. Seventy-eight percent of patients with osmotic demyelination syndrome have either electrolyte disturbances or abnormal blood gas levels, so metabolic factors are considered to play an important role [3, 12].The clinical presentation of CPM is variable; it can be asymptomatic when the lesion is small. Classically, CPM is associated with dysarthria and dysphagia when the corticobulbar tract is involved. Quadriparesis also occurs when a corticospinal tract lesion exists [13]. In severe cases, patients can be left in a state of mutism and paralysis with relatively intact sensation and comprehension. EPM is characterized by tremors and ataxia. Several conditions increase the risk of ODS, including hypokalemia, chronic liver disease, diuretics (thiazides), and malnutrition [14].

Theoretically during hyponatremia water move in to brain cells and causes brain edema. However, the detrimental consequences of brain edema are more likely to occur with the acute severe hyponatremia rather than with the chronic one. The brain adapts to hyponatremia by losing extracellular water into the cerebrospinal fluid and by extruding sodium, potassium and certain organic solutes (osmolytes) out of the brain cells [15]. Both mechanisms result in diminution of the brain volume toward the normal thus reversing or minimizing brain edema [15]. Organic osmolytes move and re-accumulate slowly compared to inorganic ions [16, 17]. Therefore, in the setting of chronic hyponatremia the overly rapid correction of serum sodium before giving time for osmolytes to re-accumulate may further shift the water from the brain cells resulting in more shrinkage of the brain volume [15]. That further shrinkage is believed to induce neuronal cell injury resulting in osmotic myelinolysis.

Numerous studies have investigated the development of demyelination and CPM in general medical patients when hyponatremia is rapidly corrected.

Conversely, ODS in uremic patients caused by the rapid correction of hyponatremia by Hemodialysis is rare. Uremia was considered a possible protective factor.

In previously published reports two patients with severe hyponatremia, one with serum sodium 104mEq/l [6] and another patient with serum sodium 100mEq/L [18], developed Osmotic Demyelination Syndrome within one week after starting Hemodialysis.

In this presentation we report two cases both of them presented as Acute on Chronic Renal failure, Diabetes type II and Hypertensive. First patient with base line serum sodium 102mEq/l developed ODS after started on hemodialysis with standard setting (4 hours, Sodium profile 140mEq/L). Second patient with base line serum sodium 95mEq/l (To the best of our knowledge, this is the lowest sodium value associated with uremic hyponatremia patient that has been reported) tolerated Hemodialysis (2 hour session with low sodium profile 130mEq/l) without any neurological deterioration despite of rapid correction of hyponatremia.

In patients with Chronic Renal Failure with Uremia elevated blood urea levels were thought to protect these patients from developing demyelination syndrome when hyponatremia is rapidly corrected during hemodialysis. Urea has been utilized to treat hyponatremia [19] .In a series of studies; Soupart et al. demonstrated that exogenous urea protected animals from myelinolysis in a rat model of hyponatremia [20]. In uremic patients with hyponatremia, serum BUN levels declined during Hemodialysis, and this decrease may counteract hypertonic stress by the usual administration of Dialysate sodium 140 mEq/L. Therefore, in addition to possible rapid re-accumulation of brain osmolytes, elevated BUN levels decreasing during H hemodialysis may offset hypertonic stress during hemodialysis.

Additionally, the protective effect of elevated BUN may be limited during Hemodialysis hour only. Therefore, the first patient still developed demyelination syndrome. In a previous review, Dialysate sodium level ≤15–20 mEq/L above the plasma Na level was suggested for uremic patients with hyponatremia. In addition, multiple, short Hemodialysis sessions at a low blood flow rate were considered [21].

Tarhan et al. retrospectively reviewed the cases of 17 patients with end-stage renal disease who were diagnosed with osmotic demyelination syndrome on the basis of MRI findings between April 1996 and

April 2001 at Department of Nephrology, Baskent University Faculty of Medicine, Ankara, Turkey [22]. Eight of 17 patients were hyponatremic (110–136 mEq/L) at the time of episode. During follow-up with repeated brain MRI, most demyelinating lesions were rapidly reversible (mean, five weeks) with clinical improvements.

These rapid reversible MRI findings indicate that the lesions represented edema rather than myelinolysis.

Tarhan et al. also concluded that osmotic demyelination syndrome in Hemodialysis patients may be asymptomatic. In our patient, who developed ODS, the serum sodium level prior to initial Hemodialysis was lower (102 mEq/L) than mean value reported by Tarhan et al., and this may increase the risk of osmotic demyelination after Hemodialysis.

## Conclusion

In patients with Acute on Chronic Renal Failure with Severe Hyponatremia Osmotic Demyelination Syndrome can occur after the rapid correction of hyponatremia even in Hemodialysis patients. In patients with extremely low serum sodium levels before Hemodialysis, Dialysate sodium profiling and short, multiple dialysis sessions at low blood flow rate are recommended.

** None of the authors have any competing interest in the manuscript.

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# The Factors Affecting The Timing Of Scheduled Elective Operations At The Kenyatta National Hospital Main Theatres

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## Background

Preparation for elective surgery involves: planning, consultation, optimization and organization

Improper scheduling of cases leads to delay, postponement, decreased staff / patient satisfaction, and increased cost to patient and hospital.

## Methodology

Data was collected over 2 months after informed consent. The theatre number, patient's serial number, diagnosis, type of operation, time of starting and ending operation, time operating room is ready for another procedure and reason for delay were noted. Allocated block time for each surgical discipline was obtained from the weekly theatre schedule. On-time starts, adjusted percentage utilization, turnover time and case times were calculated from the data and all variables analyzed using SPSS (Statistical Package for Social Sciences) version 11.5.

## Results and Conclusions

377 operations were evaluated. Orthopedics had the largest block time per week, 108 hours (21.8%) and largest number of cases performed , 95. E.N.T had the least block time allocated,18 hours (4%) and a large number of cases performed (33 cases). 99% of first cases did not start on time due to surgeon's absence 82 cases (31.7%) and inadequate preoperative patient preparation 57 cases (25.7%). Consultants had more case time as compared to SHOs, 33 minutes longer. Anesthesia S.H.Os were 10 minutes earlier than consultants in the start times. The higher the number of elective cases scheduled per block, the higher the adjusted percentage utilization of the block. The average case time was 2 hours 36 minutes. The average turnover time was 18 minutes 46 seconds.

## Introduction

Elective surgeries unlike emergencies, are scheduled in advance, allowing patient and doctor to plan. Preparation for elective surgery involves:

**Planning:** Decision, strategies, tasks and schedules to perform the surgery.

**Consultation:** Specialists' inputs concerning the surgery.

**Optimization:** Patient preparation to maximize on surgical benefits.

**Organization:** preparation and scheduling.

## Organization

### Theatre Space

First-come-first-served basis (open block system), works if there is little competition for theatre time and room and has poor predictability for starting urgent cases, utilization of complex equipment and skilled personnel. Theatre efficiency is poor. In block scheduling, surgical disciplines are given specific rooms on specific days, permiting development of specialized rooms with complex equipment for complex procedures hence increased efficiency. Full-day blocks of 9 hours work better than half-day blocks due to predictable patient flow and case start times[1]. Release time is the time when the block is reserved for a particular service. Procedures with urgency (short lead time), should have shorter times from release to surgery date than services with a more elective practice. Available hours remaining in a room (unused block time), should be available for emergencies. Block time utilization is used to determine thresholds for gaining or losing block time for surgical disciplines.

### Theatre Equipment

In block scheduling, the first case encounters set-up time, while the rest of the surgeries incur actual procedure time. Operating room idle time is reduced. There is better prediction of cases due to reduced variability. The number of operations done during allocated block time is more than that performed during open block[2]. Manual entry of data is less efficient than computerized systems in tracking posted cases to verify availability of equipment and resources needed for an operation[3].

### Theatre Personnel

Centralizing authority in one knowledgeable individual with authority for global operating room matters leads to effective adaptation to changing needs[4]. Anesthetists, surgeons or theatre nursing officers are good candidates. Policy manuals should be provided to new staff to enhance team work[5]. Theatre activities were managed by the overall administrator who had little experience in theatre management with support services having separate administrative structures making smooth running of the theatres difficult[6]. If a hospital has a large number of additional cases other than those scheduled, the surgeons must perform these later in the day, and the schedule should be constructed to properly staff and support these times with the required personnel[7]. The game theory described how rational individuals make decisions when they are mutually interdependent. In the Non Cooperative game, players do not enter into a binding and enforceable agreement with one another as is the case in the operating room, this explains dynamics of hoe operating room staff relate[8]. When the patient is in theatre, the quality of that patient's care must be the main focus despite the challenges. The theatre team must be familiar with all the various agencies and regulations to ensure compliance for hospital accreditation.[9]

## Time Management

A procedure time glossary has been accepted by the American Society of Anesthesiologists (ASA), Association of Operating Room Nurses (AORN), and the American College of Surgeons (ACS) [10].

For an operation to start on time, patients must arrive at facility earlier and have complied with preoperative instructions, preoperative/admitting process must be organized, operating room (OR), staff and equipment must be ready and surgeons must be available to have any patient questions or needs addressed.

Measures that can increase on-time starts are proper use of guaranteed block time, special rooms dedicated for complex cases standardized preoperative requirements and review of patients the day before surgery

**Turnover time** is the time when one patient is moved out of the operating room until the next patient is moved in. Activities taking place during turnover time can lead to delay. The major barrier to smooth flow of patients in the operating rooms is poor scheduling.[11] The post anesthesia care unit (PACU) must function well to allow efficiency and patient flow[12]. If turnovers are reduced by a few minutes there will be enough time to complete all the scheduled cases[13].

**Case time :** time from beginning of room setup to room cleanup. It is the time the OR is dedicated to the performance of a procedure and not any other purpose.

**Resource hours**: total number of hours a room is staffed and available for the performance of procedures.

**Raw utilization**: the time that patients are in the OR divided by the available resource hours. It does not take into account time spent in getting the OR ready or turnover time; it underestimates the actual time that the OR is committed to the total number of cases.

**Adjusted percent utilization** is similar to raw utilization, but includes case setup time and turnover time. More closely reflects use of the OR in performance of cases. Utilization should be tracked regularly and reassessment of block times made to achieve the necessary balance of available times for surgical division s.As utilization increases above 80%, there may be difficulty scheduling patients into the time available, and the waiting time may create patient dissatisfaction. Utilization percentages that are very low, (<60%) represent lost opportunities to generate revenue**.** A graph constructed of block utilization against total number for cases scheduled out of each blocks reveals 4 quadrants defining four types of surgical groups: high utilization / low out of block case numbers, high utilization / high out of block case numbers, low utilization / low out of block case numbers and low utilization / high out of block case numbers.

Surgeons in category 2 should be added more block time as they were more efficient and did more extra schedule cases out of their block. The surgeon in category 4 should have the block time reduced as this represented services that needed less block time, or the block time allocated needs to be done at more appropriate times. Using block utilization in concert with percentage total time scheduled out of block is a much better assessment tool to determine threshold for losing or gaining time[14]. Use of utilization to assess how well an operating room is working is inaccurate as it is actually a measure of resource consumption rather than a surgeon's efficiency. Hospitals are beginning to analyze operating room performance by looking at the revenue generation and the associated cost for each surgeon which has been shown to vary widely[15].

Improper scheduling of cases leads to delay and postponement of elective cases with an increased incidence of post-operative infection. [16]. Intra-operative anesthesia costs are approximately 5.6% of the total hospital cost[17]. The operating rooms are expensive to furnish and run. It is important that operating rooms are highly efficient to prevent incurring fixed expenses while generating little revenue[6]. Proper scheduling practices, substantial reduction of waiting time and expenditure could be obtained and the costs incurred in the operating room reduced by a factor of 3[18]. Underutilization incurs fixed costs for the hospital without revenue generation. Overutilization (cases running late) may result in the need for nurses hired on locum basis, resulting in higher costs. Cost accounting provides the director with the terms and methodology to improve decision making in the theatre[17].

Most delays were due to occupation of the emergency theatre by an ongoing elective operation[19]. The higher the number of add-ons and cancellations, the more complicated running the schedule becomes. [20-21]An equivalent to three quarters of an operating room's working day is wasted each week[22]. The theatre utilization comfort zones for various team players are as follows: [23]

**Table 1**[23]

| Utilization | Hospital Administration | Anesthesiology | OR Nursing | Surgeons |
|---|---|---|---|---|
| >100% | ++ | -- | --- | ---- |
| 85%-100% | +++++ | ++ | - | -- |
| 70%-85% | +++ | ++++ | + | +/- |
| 55%-70% | + | +++ | +++ | ++ |
| <55% | -- | - | ++ | ++++ |

## Methodology

The study was performed at Kenyatta National Hospital Main theatres over 2 months after informed consent. Data was collected with a structured questionnaire and adjusted percentage utilization, turnover time, resource time and case times were calculated. All variables in the data collecting sheets were compiled and analyzed using SPSS

(Statistical Package for Social Sciences) version 11.5. Pearson's correlation test was used to examine the association between the variables. The chi-square test was employed to examine whether the parameters of interest differed significantly. Odds Ratio and its associated 95% confidence interval (CI) were employed to assist in determining the factors that were more likely to explain the explanatory variable (mean time). P-Value of less than 5% was considered statistically significant.

## Results

377 cases were studied, 275 cases, (72.9%) were adults, 102 cases (27.1%) children , 203 cases (53.8%) male, while 174 cases (46.2%) were female.

**Figure 1:** Distribution of Patients By Age

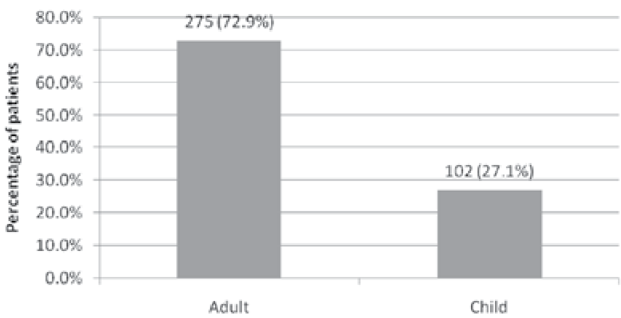



**Figure 2:** Distribution of Patients By Sex

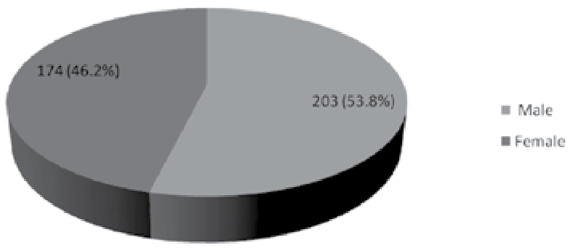
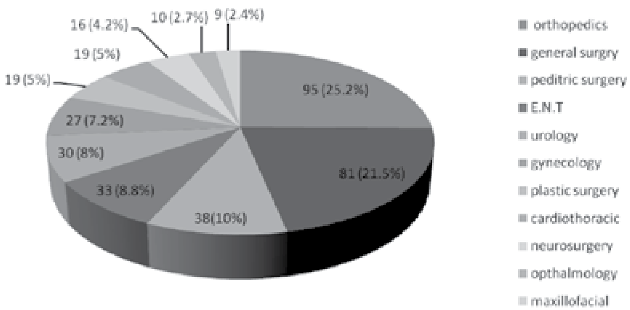
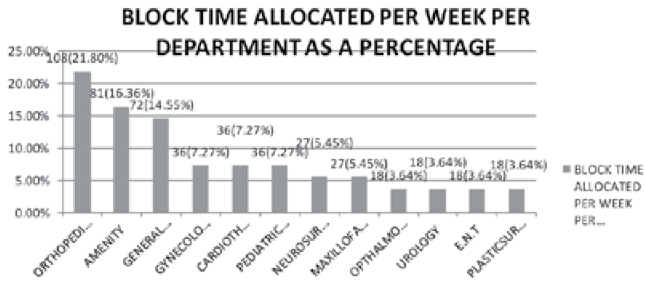



**Figure 3:** Distribution by Department (n=377)



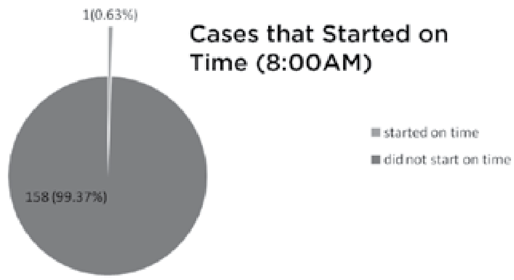

The department with most cases was orthopedics 95 (25.2%) and the least maxillofacial 9 (2.4%).

**Figure 4:** Weekly Allocated Block Time



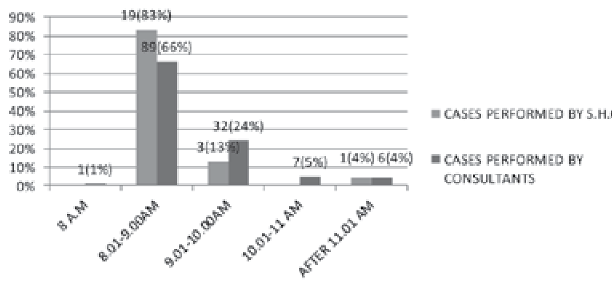

The department allocated the most block time was orthopedics 108 hours ( 21.8%) the least plastic surgery 18 hours (3.64%).

**Figure 5:** On Time Starts




1 case (0.63%) started on time (8.00 A.M), 158 cases (99.37%) did not:

**Figure 6:** Starting Time Of Cases Performed By Consultants and S.H.O's




An association between cadre of anesthetist and starting time was found (P-value= 0.003). Anesthetist S.H.O's were found to be 10 minutes earlier than consultants in starting their lists, and this was found to be significant (p 0.001).

**Table 1:** Operations That Were Delayed

| | **Frequency** | **Percent** |
|---|---|---|
| Yes | 221 | 58.6 |
| No | 148 | 39.3 |
| Total | 369 | 97.9 |
| Missing | 8 | 2.1 |
| | **377** | **100.0** |

**Figure 7:** Delayed Cases

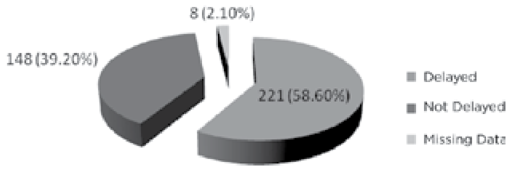



**Figure 8:** Reason for Delay

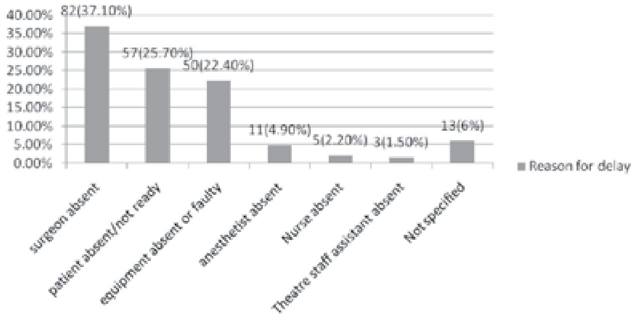


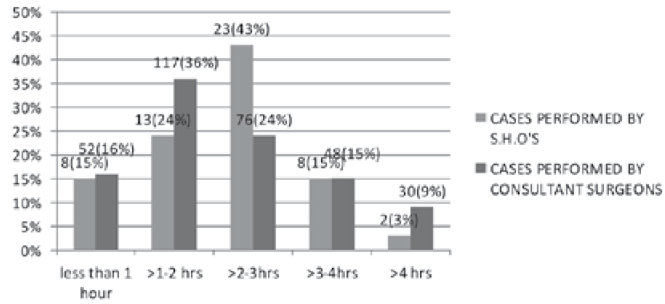

**Table 2:** Case Times

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Case time | 377 | 0:15:00.000 | 11:15:00.000 | 2:36:13.784 | 1:36:15.095 |

The average case time was 2 hours 36 minutes with a range of 15 minutes to 11 hrs 15 minutes and a standard deviation of 1 hour 36 minutes.

**Figure 9:** Case Times

Case Times of Operations Performed By SHO's and Consultants.




An association was found between cadre of surgeon and case time (p value 0.05). The mean time taken to perform a case by S.H.O surgeons was 2 hours 7 minutes and consultant surgeons 2 hours 40 minutes.

**Figure 10:** Cadre of Anesthetist


No Association between cadre of anesthetist and case time was found (P-value= 0.237).

**Table 3:** Type of Anesthesia

| Type of Anesthesia | Percent |
|---|---|
| G/A | 73.5 |
| Spinal | 21.0 |
| Regional Block | 1 |
| Local Anesthesia | 0.5 |
| Missing | 4.0 |
| **Total** | **100.0** |

Majority of the operations were done under general anesthesia 277 (73.5%). No association was found between type of anesthesia and case-time.

**Table 4:** Receiving Area Waiting Time

| | N | Minimum | Maximum | Mean |
|---|---|---|---|---|
| Receiving Area Waiting Time | 377 | 0:05:00.000 | 5:40:00.000 | 0:37:28.378 |

**Figure 11:** Receiving Area Waiting Time

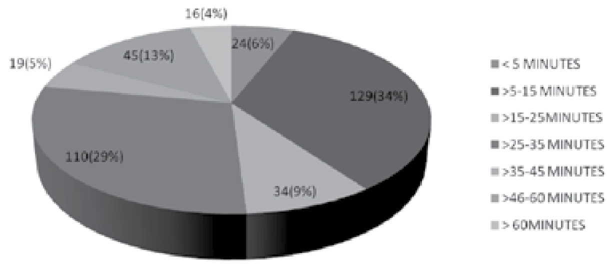



**Table 5:** Turn Over Time

| | N | Minimum | Maximum | Mean |
|---|---|---|---|---|
| TOT | 207 | 0:05:00.000 | 2:30:00.000 | 0:18:46.087 |

**Figure 12:** Turnover Time

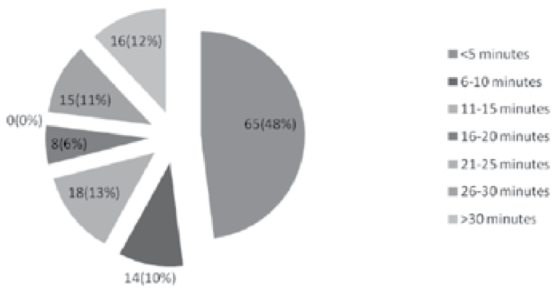



**Table 6:** Time Spent in Post Anesthetic Care Unit

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Post Anesthetic Waiting Time | 339 | 0:09:00.000 | 6:0:00.000 | 3:02:44.071 | 1:33:29.255 |

**Figure 13**: Length of Stay at P.A.C.U.

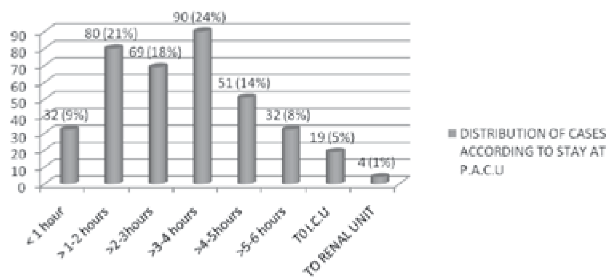
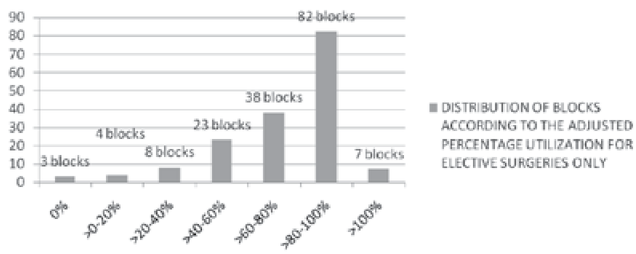



**Figure 14:** Adjusted Percentage Utilization Per Block




No significant relationship was found between the adjusted theatre utilization and the number of cases done. (P-Value =0.363) A positive significant association was found between the case time and the adjusted theatre utilization. P-value=0.001.

**Figure 15:** Adjusted Percentage Utilization Per Department

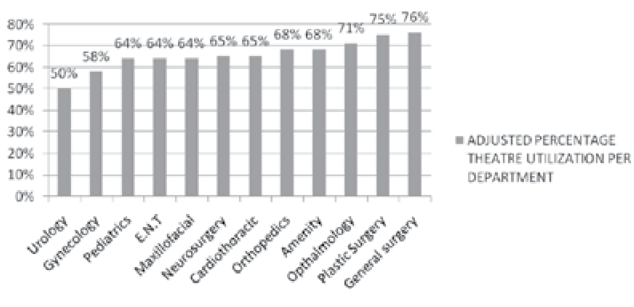



**Table 7:** Additional Operations Performed After the Scheduled List.

| PROCEDURE | NO. OF CASES |
|---|---|
| PROSTATECTOMY | 1 |
| EMERGENCY C/S | 4 |
| NEPHERECTOMY | 1 |
| RECTAL PROLAPSE REPAIR | 1 |
| P.D. CATHETER INSERTION | 1 |
| RECURRENT INGUINAL HERNIA REPAIR | 1 |
| I&D OF RIGHT BREAST ABSCESS | 1 |
| LYMPHOCOELE DRAINAGE | 1 |
| T.U.R.P | 1 |
| **TOTAL NO. OF CASES** | **12** |

**Table 8:** Operations Performed Instead Of Scheduled Elective Cases.

| PROCEDURE | NO. OF CASES |
|---|---|
| INCISION AND DRAINAGE | 1 |
| EMERGENCY C/S | 2 |
| AMPUTATION OF GANGRENOUS FOOT | 1 |
| DILATATION AND CURRETAGE | 1 |
| TOTAL NUMBER OF CASES | 5 |

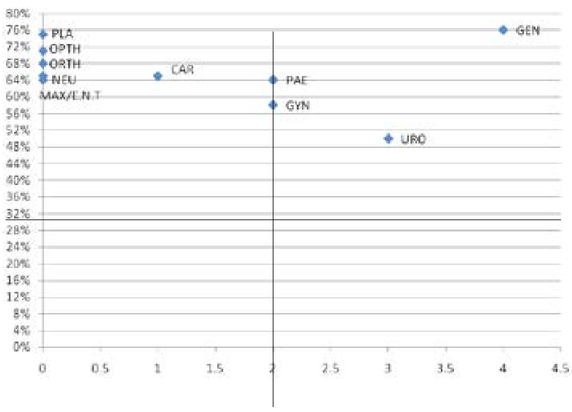
Departments whose blocks had additional cases performed after completing the scheduled elective operations were as follows.

**Table 9:** Add on Cases After Performing Elective Surgery

| DEPARTMENT | NO. OF ADDITIONAL CASES |
|---|---|
| GENERAL SURGERY | 4 |
| UROLOGY | 3 |
| GYNECOLOGY | 2 |
| PEDIATRIC SURGERY | 2 |
| CARDIOTHORACIC SURGERY | 1 |
| **TOTAL NUMBER OF ADDED CASES** | **12** |

A graph of adjusted percentage theatre utilization against out of block cases performed per department was as shown below:

**Figure 16:** Adjusted % Theatre Utilization Against Out of Block Cases Performed



**PLA** - PLASTIC SURGERY **E.N.T** - EAR, NOSE, THROAT
**OPTH** - OPTHALMOLOGY **CAR** - CARDIOTHORACIC
**ORTH** - ORTHOPEDICS **PAE** - PAEDIATRICS
**NEU** - NEUROSURGERY **GYN** - GYNECOLOGY
**MAX** - MAXILLOFACIAL **URO** - UROLOGY
**GEN** - GENERAL SURGERY

1. **Surgical groups with high adjusted theatre utilization and low out of block cases.** Plastic surgery, ophthalmology, orthopedics, neurosurgery, cardiothoracic, maxillofacial and E.N.T.

2. **Surgical groups with high adjusted theatre utilization and high out of block cases.**

Pediatric surgery, gynecology, urology and general surgery.

None of the surgical disciplines were found to be in low adjusted theatre utilization / low out of block cases and low adjusted theatre utilization / high out of block categories

## Discussion

A preponderance of males: females, (53.8:46.2) % was noted especially in orthopedics and urology. Full day 9-hour Block Systems and specific rooms were allocated[1]. Block time per week was 495hrs. Orthopedics had 8 hours (21.82%). Many patients were yet to buy the implant. ENT, ophthalmology and plastic surgery had least block times 18 hrs weekly, and had satellite theatres elsewhere.

The latest start time was in orthopedics (1.40 pm) due to consultant surgeon absence. There was only1 on time start. Many case set up delays were due to equipment set up[2]. Pearson's correlation test revealed no association between surgeon cadre and start time. Cadre of anesthetist and start time had positive correlation. Senior house officer anesthetists start times were 10 minutes earlier than consultants. Absence of Surgeon (31.7%) and patient (25.7%) was most common cause of delay. This was replicated in a study[24]. Patient absence was due to inadequate preparation while reasons for surgeon could not be established. Data on posted cases was manual, with lots of equipment unavailability, malfunction and delay. Computerized systems are more efficient[3].

The average case time was 2 hours 36 minutes. 2 shortest case times of 15 minutes each were, a compound fracture tibia for external fixation and sequestrectomy of compound fracture tibia/fibula. Surgical toilet was performed instead due to lack of equipment. The longest case time, 11 hours 15 minutes was a multidisciplinary maxillofacial/ plastic surgery case; Enucleation and reconstruction of a right maxillary tumor. Majority of operations were performed by consultants; anesthetists (51%) and surgeons (85%). A strong positive correlation was found between surgeon cadre and case time. Consultants case time was 2 hours 40 minutes and senior house officers 2 hours 7 minutes p-value 0.005. Consultant surgeons performed more complex procedures. No association was found between type of anesthesia used and length of operation. Anesthesia type does not impact on overall case time[6].

Receiving area waiting time was 37 minutes. Longest waiting time was in orthopedics 5 hours 40 minutes due to consultant surgeon absence. Long waiting times were attributed to patients' arrival before the case in the operating room was completed. The average turnover time was 18 minutes which was within the recommended length of 15 to 45 minutes[24]. The cases following the first case were more predictable with less case set up time as seen in a previous study.[2] 65 cases (48%) had a turnover time of 5 minutes or less. Patients arrived at the receiving area and wheeled to the corridor before the ongoing case in the operating room was completed. 3 cases in orthopedics had turnover times of 2 hours or more due to absence/ failure of equipment and absence of a porter to transport the patient from the ward to the operating room. Orthopedics recorded longest turnover times mainly due to patient absence. Patient absence, equipment failure and surgeon absence was mentioned as frequent cause of long turnover times.

73% of the cases took more than 1 hour at the P.A.C.U. reducing efficiency[12]. The longest stay in the P.A.C.U was an orthopedic patient.

Adjusted theatre utilization of 0% was noted in 3 blocks. In orthopedics department, a patient scheduled for arthroscopy had no investigations hence an emergency caesarian section was performed. However, complications of postpartum hemorrhage led to all other cases being cancelled. The case time for the emergency was 6 hours 25 minutes. An adjusted theatre utilization of over 100% was recorded in blocks allocated to general surgery, Amenity, gynecology, pediatrics, ophthalmology and maxillofacial. Despite a utilization of 125% by the maxillofacial department, only one case was performed. Utilization is a measure of resource consumption rather than a surgeon's efficiency.[15] More than half of the allocated blocks (54%) were within the utilization comfort zone of the hospital administration[23]. The emergency theatre was overwhelmed as was demonstrated in 2008 [19]. 23 % of allocated block time was below the recommended utilization. Lots of theatre time was cumulatively lost per week with lost opportunity to generate revenue. [22] Increased theatre efficiency can lower the operating room costs[18]. No relationship was found between adjusted theatre utilization and number of cases done (P-Value =0.363). An association was found between case time and the adjusted theatre utilization (P-Value=0.001). Adjusted theatre utilization increased as the number of scheduled elective operations increased[13]. The low adjusted theatre utilization in some theatres suggests that several cases were cancelled making daily running of the schedule more complicated [20]. General surgery had highest adjusted theatre utilization of 76% and highest out of block case numbers of 4. General surgery was the most efficient surgical discipline and deserved the most block time instead of orthopedics. Maxillofacial surgery which had the least out of block cases, was not allocated the least block time as expected. Being a multi-disciplinary case, it required scheduling at a more appropriate time when all the concerned teams and patient were ready.

12 emergency cases were performed as additional cases. The emergency theatre may be overwhelmed 19. The low number of add-on cases was due to lack of staff to handle cases that run into overtime21

No association was found between the starting time and performing of an additional case13. Improvement of the start times would eliminate need for cases running late past the block time allocated.

## Conclusion

Full day Block System of 9 hours, 8.00 A.M to 5.00 P.M was used. Orthopedics was allocated the most weekly block time of 108 hrs (21.8%). 1 case (0.63%) out of 159 first cases of the day started on time (8.00 A.M.) There was positive correlation between cadre of anesthetist and starting time of a case Most delays were attributed to absence of the surgeon (31.7%) Average case time was 2 hours 36 minutes. There was significant relationship between cadre of surgeon and case time. 50% of blocks had Utilization of 80 to 100%. A significant positive association between case time and adjusted theatre utilization was found. Average turnover time was18 minutes 46 seconds, 65 cases (48%) had a turnover time less than 5 minutes, Average receiving area time was 37 minutes and average P.A.C.U was 3 hours 2 minutes.

## Recommendations

The threshold for a department gaining or losing block time should be determined by the adjusted theatre utilization against out of block cases, with general surgery being allocated the most block time, and ENT the least.

A simple checklist for equipment required should be drafted and placed in the respective theatres or saved in a computer system, and reviewed the day before surgery with faulty/missing equipment replaced.

A specific porter should be assigned to transport patients to and from theatre with no other duty allocated to them to enhance smooth flow of patients reducing waiting period at the P.A.C.U and prolonged turnover.

Teams should be recruited on locum basis to handle cases that run into overtime increasing higher adjusted theatre utilization, and add-on cases.

Only patients with up-to-date investigations and reviewed by both surgeon and anesthetist should be scheduled for elective surgery.

## Study Limitations

Reasons for delay by surgeons, patients, anesthetists, nurses or theatre assistant could not be established.

A large number of variable operations in different disciplines were performed by different surgeons. It was difficult to analyze the case time of each operation and compare the results.

Few studies have previously addressed factors affecting scheduled elective surgeries.

Some aspects of staff motivation, effective communication and team satisfaction which would play an important role in the scheduling of elective cases were difficult to analyze and beyond the scope of this study.

Relating increased hospital expenses as a result of factors affecting the scheduling of elective operations were beyond the scope of this study.

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