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Estimation of Anaesthesia Related Deaths in Elective Surgical Operations in Khartoum, Khartoum North and Omdurman Teaching Hospitals from October 2011 to October 2012

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Abstract

This study dealt with estimation of anesthesia related deaths in elective surgical operation in Khartoum state teaching hospitals (Khartoum, Khartoum North and Omdurman Teaching Hospitals) in the period between October 2011 to October 2012. The estimation of anaesthestic death is a useful tool for quality improvement and maintenance of high safety standards in anesthetic services. The problem of the study has come from the absence of accurate statements about the causes of deaths on table and no systematic formal reporting of deaths was being followed. The objective of the study was to estimate the number and causes of anaesthesia related death in elective surgical operation under general anaesthesia. It was prospective study, used descriptive longitudinal design. The study has shown thirteen thousand one hundred thirty four elective surgical operations were performed during the study period. Twelve anaesthesia related deaths were observed with proportion of 0,091%. The deaths which occurred in surgical operation found in general surgical departments, all of deaths occurred during intra and postoperative periods. However, the majority of death occurred postoperative period. Deaths due to anesthesia complications were higher than other contributing related factors. Primary causes of death were divided into three major groups (anaesthesia related death caused by cardiovascular complication, respiratory complication and medication error).The human errors, equipment and monitor devices were contributed in these three groups. It can be recommend that continuous education program for anaesthesia providers (anaesthesia technician, anaesthesia assistants and anesthesiologists). Attention and vigilance is required in even the most straight forward cases and improve the equipment and monitor devices to improvement in the safety and quality of anaesthesia services.

Keywords: Anaesthesia; Surgery; Anaesthestic deaths; Hypertension

Introduction

The term "anaesthestic deaths" was used to denote the death occurring unexpectedly either during or shortly following administered anaesthesia during surgical operation, whether it was directly or indirectly attributable to anaesthesia [1]. Anaesthesia is risky to patients in a number of ways. Respiratory suppression by an anaesthestic leads to hypoxia, while maneuvers to control the airways can lead to injury. Hypo or hypertension, cardiac depression or medication reactions or interactions, are potentially life-threatening problems. Anaesthesia was long considered more risky than surgery itself. During the past two decades in industrialized countries a systematic approach to identifying and addressing failures in anaesthesia care has resulted in a sustained marked reduction in anaesthestic risk [2]. Changes were made in technological and engineering designs, and manufacturing standards for anaesthesia equipment. For example, the sequence and size of dials were standardized, as was the direction for turning them on and off. Locks were incorporated to prevent accidental administration of more than one anaesthestic gases. Controls were changed so that the concentration of delivered oxygen could not be reduced below its concentration in the room air. Most recently, pulse oximeters and Capnograph have been designated as essential instruments for monitoring vital functions during anaesthesia. Since these modifications, deaths due to misconnection of the breathing system or intubating the esophagus rather than the trachea have become virtually unknown instead of being common causes of death during anaesthesia [2]. Studies in mortality from anesthesia began in the 1950s. It was often difficult to sort out mortality due to surgery or patient's disease from those occurred due to administration of anesthesia. Very few patients die in operating rooms and unstable patients transferred to critical care unit [2]. Different studies used different definitions of anaesthesia related death. A critically ill patient with impaired functions of multiple organs seems to be at a higher risk of anaesthesia related death than a healthier one. To our knowledge not a single study has so far identified preoperative risk factors of anaesthesia related death in Sudan.

A multi-hospital study done in the Netherlands in 2010 showed a number of causes were attributed to anaesthesia related deaths [3]. Another study was conducted to explore deaths in operating room and recovery room in Los Angeles during a ten-year period at one hospital revealed that there were 59 deaths associated with 57,132 surgical procedures [4].

The objective of this study was to estimate proportion of anaesthesia related deaths in elective surgical operations in three main Khartoum teaching hospitals.

Methodology

This study was conducted in three teaching hospitals (Khartoum Teaching Hospital, Khartoum North teaching Hospital and Omdurman teaching hospital). University hospitals were chosen for several reasons: Firstly, they provide teaching services for medical and health related students. Secondly, they provide medical and health care for a big sector of different people from different areas of the country and wide spectrum of patients and health problems. Finally, they provide low cost services and have available insurance services.

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A descriptive longitudinal design was used in this study.

This study recruited all working anesthesiologists from whom we collected data about deaths and observed 13143 patients who were subjected to elective surgical operations, under general anaesthesia in order to explore and estimate the death proportion among them.

Critically ill patients were excluded. Critically ill patients, class VI and V according to American Society of Anesthesiologist (ASA), have high mortality rate due to patients' health situation. Obstetric operations were excluded because they are done under regional anaesthesia.

Data was collected through observation of deaths and interview with anesthesiologists using a structured questionnaire.

Ethical Considerations

This study didn't pose any risk to both, anesthesiologists and patients. The importance and objective of the study were discussed with the attending anesthesiologists in each hospital. Privacy and confidentiality were maintained. A written informed consent was obtained from each participant prior the commencement of the study. Ethical approval was obtained from Khartoum North Teaching hospital health research ethics committee.

Results

Thirteen thousand one hundred thirty four elective surgical operations were performed under general anesthesia; about 12 anaesthesia related deaths occurred during the study period from first October, 2011 to 31 October 2012, in the three surveyed Khartoum teaching hospitals. Death proportion was estimated to be 0,091%. It was observed that higher proportions of death were found in Khartoum North and Omdurman hospital respectively and no case was detected in Khartoum hospital (Table 1).

The age of patients ranged from seven month to 75 years. Seven deaths (58.3%) occurred in patients who were less than 60 years, while five (41.7%) of deaths occurred in patients older than 60 years. The male: female ratio 1:1.

According to American Society of Anesthesiologists classification of physical status of patients, the study revealed that six (50%) of patients were classified in class I, two (16.7%) classified in class II and four patients (33.3%) were classified in class III.

Eight (66.7%) of died patients underwent general operation, two (16.7%) of them had orthopedic surgery and other two (16.7%) died in operations in urinary system.

Five (41.7%) of deaths occurred intraoperative, three deaths (25%) occurred within 24 hours post-operative and four (33.3%) occurred after 24 hours postoperative.

The study revealed different causes of deaths among surveyed patients. Result is illustrated in Table 2.

Some patients had undergone cardiac resuscitation; results are illustrated in Figure 1.

Discussion

This study was done to estimate the proportion and causes of death either attributed or partial contributory to anaesthesia.

In order to calculate the proportion of anaesthesia related deaths, it was necessary to have accurate data on the number of deaths and the number of anesthetics. Unfortunately, it is rarely possible to obtain completely accurate data of this type, and so best estimates could be used. There was no way of ascertaining whether all anaesthesia-related deaths were reported or classified correctly. Nevertheless, it is unlikely that a large number of cases would have been missed or classified incorrectly that we did not find any previous attempts, of this type or on this scale has been made in the Sudan. No efforts were made to assign causes of anaesthesia related deaths. All reports dealt only with deaths arising from flagrant error or accident. The reports are made by the surgeons or by anesthetists, not by both working as a team or by pathologist after postmortem examination. The reports are voluntary and incomplete, and some of death reports were not sent to the statistic central office in the hospital. The cause of death was characterized as due to patient's disease, error in diagnosis, error in surgical judgment, not related to anaesthesia [5].

Our study observed that higher proportions of death were found in Khartoum north and Omdurman hospital respectively due to poor equipment and monitoring devises, lack of important drugs in the study period and no death case was detected in Khartoum hospital.

It is not easy to compare the intraoperative deaths and mortality rates reported in this work with previous studies, as methods are substantially different. Many were based on case series. In the present study it was found to be (9.14/10000) which was considered low compared to study done in a Brazilian university teaching hospital over a 9-yr period result in 186 (34.6/10000 anesthetics) [6].Current estimates of avoidable mortality associated with anaesthesia in Australia and Europe vary from about 1/10000 to about 1/185000. In

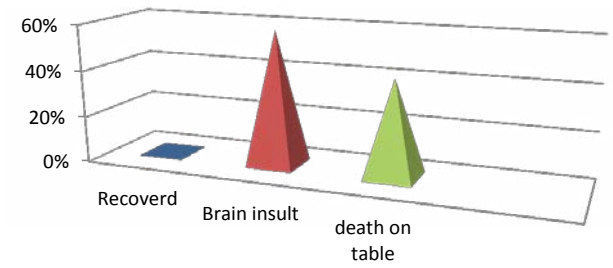

Figure 1: Outcome of cardiopulmonary resuscitation outcome among surveyed patients.

	Khartoum	Omdurman	Khartoum North	Total
NO. surgical operation and Proportions	4531 34.5%	4945 37.7%	3658 27.8%	13134 100%
NO. Anaesthesia-related deaths	0	5	7	12
Anaesthesia-related deaths%	0.0%	0.10%	0.19%	0.091%
Total anaesthesia related deaths %	0.0%	0.038%	0.053%	0.091%

Table 1: Number of surgical procedures under general anaesthesia and proportion of deaths among three teaching hospitals from first Oct.2011 to 31 Oct 2012.

Cause of death	Account	Deaths %
Wrong intubation	3	25%
Medication error *	3	25%
Massive hemorrhage	2	16.7
Fat embolism	1	8.3%
Sever hypotension	3	25%

*Over dose and wrong drug

Table 2: Causes of death among study population.

published series, avoidable mortality associated with anaesthesia was as high as 1/3000 in Zimbabwe, 1/1900 in Zambia, 1/:500 in Malawi, 1/387 in Nigeria and 1/150 in Togo [7].

Our estimates are higher compared to recent reports from Australia, where there is a national registry for anesthesia-related deaths, the mortality rate was estimated to be 0.5 per 100,000 [8].

The majority of the deaths in our study occurred in patient's age 60 year and above (41.7%), in France anaesthestic procedures increased from 6.6 in 1980 to 13.5 per 100 people in 1999. The increases were greater in the elderly and those with higher ASA physical status [6]. In south western Uganda the deaths occurred in children younger than 14 years old (on-table deaths 7.7 deaths per 10 000 operations) [9]. These findings are similar to ours. That death in the age seven month-20year was estimated to be 25%.

The female/male ratio of in THAI Study that represented patients undergoing surgery in Thailand, were 1:1.2. The more frequent adverse event that occurred in males was likely to die more than female [10]. That was little different from our study which was 1:1.

Respiratory complication still play the major role in anaesthesia related deaths. Difficult tracheal intubation accounts for 17% of the respiratory related deaths and results in significant morbidity and mortality. In fact up to 28% of all anaesthesia related deaths are secondary to the inability to mask ventilate or intubated [11]. In our study the percentage of difficult intubation, and displacement of tube (oesophageal or bronchial) was 25% of cases. Also Keenan and Boyan reported 27 intra-operative cardiac arrests in 160,000 anesthetics, eleven of these were due to respiratory problems, including oesophageal intubation, disconnection, and dislodgement of the tracheal tube. Hence routine pulse oximetry was recommended. Similar findings were reported by. Taylor et al., who collected data from malpractice suits in California involving unexpected cardiac arrests during anaesthesia. They found hypoxia from hypoventilation and low levels of inspired oxygen to be the chief cause of cardiac arrest [12].

Many studies have demonstrated equal proportions of deaths from respiratory and cardiovascular causes during anaesthesia. In other reports and in this study, cardiovascular causes of deaths were more frequent than respiratory [13]. Other studies have shown respiratory causes being more frequent than cardiovascular causes [14].

The level of physical status has been quantified according to the scale of the American Society of Anesthesiologists patients' status (ASAPS). It classifies patients as follow: Status-I (normal healthy patient), Status-II (patient with mild systemic disease) and Status-III (Patient with severe systemic disease) [15]. In our study six (50%) of patients were classified into group I of ASA. That constitutes the higher proportion of mortality among surveyed patients. It suggests that in these healthy patients no other factors but anaesthesia could be implicated in contributing to death or coma.

Our study revealed that three patients died from receiving overdose and an unusual response to the standard dose. Medication errors are common in health care system and reported to be the seventh most common cause of death overall [16]. A survey by the Canadian Anesthesiologists' Society found that 85% of participants had experienced at least one drug error or "near miss". Most of these errors were of minor consequence. However, 1.8% resulted in major morbidity (cardiac arrest, stroke, permanent injury) or death. The misidentification of a syringe was the most common cause [17].

Our study showed that inadequate preparation and human factors constituted 66.7% and inadequate monitor about 33.3%. This includes devices' checking and monitoring of the patients' hematological and serum biochemical parameters, arterial oxygen saturation and the cardiovascular system preoperatively and during maintenance of anaesthesia and postoperatively. Human error by an anesthesia practitioner contributed to 3 of the 115 (2.6%) perioperative deaths at the suburban university hospital network and 11 of the 232 (4.7%) perioperative deaths at the urban hospital network. Anesthesia-related mortality due to human error occurred at a rate of 0.79 per 10,000 (1:12,641) anesthetics in the suburban setting and 0.75 per 10,000 (1:13,322) in the urban setting [18].

Five (41.7%) of the 12 died on table, seven (58.3%) had brain insult and died in the Intensive Care Unit.

The incidence of perioperative cardiac arrest has decreased significantly over the last 25 years. Keenan et al .noted that the cardiac arrest rate halved over two decades at their institution (21/10 000 in (1969-1978) versus 1.0/10 000 in (1979-1984), predominantly because of a decrease in respiratory complications [19]. Most studies in the last 10 years quote incidences of anaesthesia related cardiac arrest of 0.12-1.4/10 000, with associated mortality rates of 0.06-0.6/10 000. Morray's study on children quoted a similar incidence (1.4/10 000), with 55% of events occurring in infants less than one year old. The commonest causes of cardiac arrest included medication related events, cardiovascular causes including hypovolaemia, and poor airway management [19].

Anesthesia related complications occurred intraoperatively represented about 41.7% of cases. Causes of death on table included, 16.7% bleeding, 8.3% fat embolism 8.3% medication error and 8.3% sever hypotension.

Postoperative mortality is an objective endpoint that can be used to evaluate anesthesia safety, within and between institutions, and to test the effectiveness of changes in practice. Our findings suggest that 24 hours postoperative mortality at three hospitals were 16.7% due to medication error, 8.3% due to sever hypotension. Anesthesia related complications caused deaths after 24 hours were particularly related to respiratory system such as three cases (25%) died as a result of difficult intubation and one case due to sever hypotension. Postoperative mortality is associated with three major categories of risk factors: patient co-morbidity; the surgical procedure itself; and risks directly related to anesthesia management.

Our study showed that 75% of cases died due to anaesthesia. The remaining case (25%) was due to anaesthesia combined with surgical operation (severe bleeding and fat embolism).

The outcome of cardiac arrest and cardiopulmonary resuscitation (CPR) is dependent on critical interventions, particularly early defibrillation, effective chest compressions and assisted ventilation. Over the last 50 years, after the introduction of modern CPR, there have been major developments and changes in the performance of resuscitation. But, despite considerable efforts to improve the treatment of cardiac arrest, most reported survival outcome figures are poor.

Even in the hospitalized patients, the rate of successful CPR has been reported by some studies to be as low as 2-6%, although most studies report successful CPR outcome in the range of 13-59% [20], from our study all patient deaths after faulty resuscitation or had brain insult that causes prolonged stay in hospital and deaths at the end the percentage of faulty resuscitation were 5 case (41.7%) deaths on table and 7 case had brain insult (58.3%) were deaths in ICU. Although

the resuscitation done as team work with good monitoring but when cardiac arrest happen that indicate to poor prognosis.

We could interpret higher mortality rate revealed by our study as compared to developed countries may be due to the fact that the country does not have an effective primary and secondary health care systems. So, tertiary care hospitals deal with more poorly optimized sicker patients.

Conclusion

According to our study we could conclude that, anaesthesia related death in our country (Sudan) which is classified as developing country, was found to be in midline when compared with other African countries and relatively high when compared with developed countries. The majority of death proportion occurred in patients of ASA I physical status than patients of ASA III physical status. Deaths among patients in ASA III are caused by inadequate preoperative preparation, human errors, failure of equipment and monitor devices and medication error. The main causes of anesthesia related deaths were attributed to mal-management cardiovascular problems, respiratory events related to anesthesia and drug administration. Moreover, the proportion of postoperative deaths was higher than intraoperative and there were no deaths in the preoperative phase. A higher number of intraoperative and postoperative deaths have occurred during general surgeries, followed by urology and orthopedic surgeries. Even though not all anaesthestic accidents or errors are preventable, but they can be decreased to a minimum to improve the quality of medical service.

Recommendations

Human factors in modern anaesthesia are more obvious than administration of drugs. The anaesthesiologist must be familiar with both changes induced by surgery and response to drugs in sick patients. Extensive training is required for anaesthesia providers (anaesthesia technician, anaesthesia assistants and anaesthesiologists). Attention and vigilance is required in even the most straightforward cases, because unanticipated problems may happen at any moment. Fatigue, stress, lack of sleep may slow responses to critical events. Standardized global definitions of anaesthesia mortality should be developed. Every avoidable death is a tragedy, and lessons should be learnt from each instance of death during anaesthesia in order to reduce the risk of recurrence.

Quality assurance activity, prevention of human and equipment failure, systemic management perioperative care, development of post anaesthestic care unit, availability of intensive care unit, efficient blood bank, and adequate and knowledgably anaesthesia provider are suggested corrective strategies to improve quality and safety of anaesthesia service.

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