

## Original Article

## A Survey of the Status of Education and Research in Anaesthesia and Intensive Care Medicine at the University Teaching Hospital in Lusaka, Zambia

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**Background:** Current knowledge of the situation of anaesthesia in developing countries is limited. A survey of the status of education and research based on hospital records, records of the anaesthesia section, nursing records, personal observations as well as personal communication with staff, patients and hospital managers was carried out in a 1863-bed university teaching hospital located in the capital of a least developed Sub-Saharan African Country.

**Methods:** Classification and evaluation of the data was based on the three aspects of the role of university teaching hospitals in Western countries: (I) patient care, (II) university teaching and post-graduation training, as well as (III) research activities. The section "patient care" was subdivided into anaesthesia, intensive care medicine, emergency medicine, and pain therapy. The Department of Anaesthesia at the University Teaching Hospital of Lusaka, Zambia, is organized as a subdivision of the surgical department and is not involved in emergency medicine or pain therapy. Thirteen out of seventeen operating theatres, one recovery room, and a ten bed intensive care unit are serviced by the Department of Anaesthesia.

**Results:** Anaesthetic equipment, medical supplies, drugs, and consumables are all in limited supply. There are limited statistics on perioperative complications and mortality. Anaesthesia at the university teaching hospital of a least developed Sub-Saharan African Country is severely short of both a workforce and resources.

**Conclusion:** We have described strategies which may help to reverse this trend, the most important of which is to promote anaesthesia as an essential specialty within hospitals in developing countries.

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**Keywords:** Anaesthesia • intensive care medicine • least developed countries • university teaching hospital

### Introduction

Anaesthesia in Western countries has grown into a comprehensive medical specialty combining several disciplines such as intensive care medicine, pain therapy and resuscitation. Anaesthesia in less developed countries has often gained little or no interest.<sup>1</sup> The current knowledge of the situation of anaesthesia in the least developed nations is limited.<sup>2,3</sup>

Zambia has a population of 11.5 million people and is classified as a least developed nation<sup>4</sup> with a gross domestic product of 5,320 Mio USD.<sup>5</sup> The total expenditure on health per capita is quoted as

63 USD for Zambia and 2.000 to 6.000 USD for Western countries.<sup>6</sup> The mean life expectancy is 39 years.<sup>7</sup> Whereas the adjusted maternal mortality

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ratio in Western countries varies between 1 to 28 deaths/100,000 live births, 750 of 100,000 mothers die during the peripartum period in Zambia.<sup>8</sup> In 2005, the HIV infection rate was 17% of the population aged 15 – 49 years, and it has been estimated that urban areas contain 54% of all adults living with HIV.<sup>9</sup> Infections, trauma, cardiovascular, and neuropsychiatric disorders constitute the main (~75%) burden of disease in Sub-Saharan African countries such as Zambia.<sup>10</sup> Anaesthesia in the Republic of Zambia is a highly under-developed and under-resourced medical specialty.<sup>11</sup>

The University Teaching Hospital (UTH) of Lusaka was built by the British as a district hospital in 1943. Since then it has grown to be the referral hospital for all of Zambia, taking care of central, district, and provincial healthcare for a catchment area of ~2 million people. The UTH has 1863 beds and employs 208 physicians, approximately 1000 nurses, and 1500 non-medical personnel serving a total of fifteen medical departments. In 2004, 90,563 patients were admitted for in-patient treatment, while 230,813 patients were managed in the out-patient department. UTH mainly depends on government funding, though a small income is generated in terms of medical fees and health care charges met by patients or their relatives.<sup>12</sup>

This survey was aimed to evaluate the status of education and research at the section of anaesthesia at the University Teaching Hospital in Lusaka, Zambia.

## Materials and Methods

The survey was approved by the Research Ethics Committee of the School of Medicine, University of Zambia on 5<sup>th</sup> of January 2006. Data was collected by the study team in Lusaka between 19 January and 15 February 2006. Sources for data recruitment were hospital records, anaesthesia records, nursing records, personal observations as well as personal communication with staff and the hospital managers. Classification and evaluation of the data was based on the three aspects of the role of university teaching hospitals in Western countries: (I) patient care, (II) university teaching and post-graduation training, as well as (III) research activities. The section “patient care” was sub-divided into anaesthesia, intensive care medicine, emergency medicine, and pain therapy.

Descriptive statistical methods were used to

evaluate and present clinical, educational, and research-related data.

## Results

The anaesthesia section is structured as a sub-division of the Department of Surgery. The staff includes five medically graduated physicians with postgraduate training in the specialty of anaesthesia (all from republics of the former Soviet Union) and eight clinical officers (trained in college for three years and then specialized in a school of anaesthesia for another two years). One of the five medically graduated physicians serves as head of the section of anaesthesia but is involved in every day work in the operation theatre and intensive care unit, too. Except for the intensive care unit (ICU), no nurses undertake anaesthesia related activities. During the night, clinical officers are on duty in the hospital, while medical anaesthetists are available on call. Communication between medical personnel in the UTH depends on private cell phones. A pager-based communication system has been out of order for over five years.

### I. Patient Care *Anaesthesia*

The division of anaesthesia serves a total of seventeen operation theatres, of which thirteen are in regular use. The operative spectrum includes an annual total of ~16000 surgical interventions ranging from cardiac to minor surgeries (Table 1). Airway protection during general anaesthesia includes tracheal intubation in most cases, although mask anaesthesia is performed for minor surgical interventions. Laryngeal masks are rarely used due to their scarcity.

Regional anaesthetic techniques mainly include spinal and local anaesthesia infiltration. Plexus and peripheral nerve blocks are seldom used. The majority (80%) of caesarean sections are performed under general anaesthesia and 20% under spinal anaesthesia. Reasons for the low rate of spinal anaesthesia are contraindications for spinal anaesthesia and in many cases the patients' preference for general anaesthesia.

The most commonly used and available drugs for anaesthesia are presented in Table 2. Atropine is routinely administered before tracheal intubation. Standard intra-operative patient monitoring consists of intermittent manual blood pressure measurements, pulse palpation, and

**Table 1.** Numbers and types of surgical interventions together with numbers and types of anaesthesia cases performed at the University Teaching Hospital, Lusaka, Republic of Zambia (data from 2005)

Type of Surgery	n (%)	Type of anaesthesia	n (%)
Major (e.g. laparotomy, thoracotomy, craniotomy, long bone osteosynthesis)	5012 (31.1)	General anaesthesia	14225 (88.2)
Intermediate (e.g. hernia repair, bilateral tube ligation)	1415 (8.8)	Neuroaxial anaesthesia	1823 (11.3)
Minor (e.g. incision and drainage of abscess, diagnostic hysteroscopy)	9702 (60.2)	Local anaesthesia	80 (0.5)
<b>Total</b>	<b>16129 (100)</b>	<b>Total</b>	<b>16129 (100)</b>

cardiopulmonary auscultation. During general anaesthesia, patients either breathe spontaneously or are manually ventilated using the reservoir bag in a semi-open circuit. Tracheal tubes and laryngeal masks are re-used and are decontaminated by soaking in 0.5% chlorine.

No statistical data on perioperative mortality or the incidence of complications are available. According to personal communication with the clinical officers and medical anaesthetists, hypotension and circulatory failure, as well as airway and respiratory complications (failed intubation, aspiration, post-extubation respiratory arrest) make up the most common anaesthetic complications in the operation theatre. After surgery, all patients are admitted to one recovery room (six beds) where they are cared for by a nurse. Surveillance of vital functions is restricted to vigilance on clinical signs only because no monitors are available. If required to ensure upper

airway patency, oropharyngeal tubes are used. Respiratory arrest has been reported to be the most frequent postoperative complication in the recovery room.

#### **Basic supplies**

Water is available from 0600 – 2200 hours. Electricity is available continuously, but complicated voltage instability requires voltage stabilizers for all technical apparatus. There is no emergency generator available in order to cover unexpected power cuts. Oxygen for each theatre, and the ICU, is provided by the central oxygen unit. Although limited in number, oxygen cylinders and concentrators are available in case of failure of the oxygen supply. Neither fluid soap or alcohol dispensers exist in the operation theatre, and the air conditioning does not work.

#### **Medical equipment**

Continuous flow anaesthesia systems with

**Table 2.** Drugs supplied for anaesthesia at the UTH and those most commonly used in the Department of Anaesthesia at the University Teaching Hospital, Lusaka, Republic of Zambia

Type of drug	Drug most commonly used	Available drugs
Inhalational anaesthetic	Halothane	Halothane
Induction anaesthetic	Thiopental	Thiopental R-S Ketamine
Opioid analgesic	Pethidine	Pethidine Morphine
Neuromuscular blocking drug	Succinylcholine	Succinylcholine Pancuronium
Non-opioid analgesic	Metamizol	Metamizol Paracetamol Diclofenac
Local anaesthetic	Lidocaine	Lidocaine Bupivacaine
Antidotes	Neostigmine	Neostigmine
Cardiovascular active drugs	As needed	Dopamine Hydrocortisone Calcium

UTH=University Teaching Hospital, Lusaka, Republic of Zambia

halothane vaporisers are used to provide anaesthesia (Figure 1). Two enflurane vaporizers are available but are not used due to the lack of enflurane. Connectors for ether and cyclopropane exist as well as rotameters for nitrous oxide and air, however none of these gases have been available for some years. During anaesthesia patients are ventilated with 100% oxygen and halothane. For children and infants, Bain systems if available, are in use. Anaesthesia machines are over 20 years old (exact age unknown) and cannot be serviced. A total of three ECG monitors, one non-invasive blood pressure device, one pulse oxymeter, and three volume controlled ventilators are available. No invasive pressure or cardiac output monitoring exists nor end-tidal carbon dioxide. Each theatre has a suction machine which is shared between surgical and anaesthetic colleagues. All medical equipment has been donated from Western countries. Although the hospital-based engineering department can repair selected equipment, there is no regular maintenance.



**Figure 1.** Anaesthesia machine as used in the operation theatre of the University Teaching Hospital, Lusaka, Republic of Zambia

### **Supporting disciplines**

#### **Laboratory**

Except for open heart surgery, no laboratory testing is performed during anaesthesia. During cardiac surgery ( $n \sim 6/\text{year}$ ), intra-operative measurement of arterial blood gas analysis and coagulation parameters depend on the availability of laboratory reagents and the financial resources of the patient.

#### **Transfusion service**

A hospital-based transfusion department, which is also the centre of the National Blood Transfusion Service, provides blood products, mainly whole blood but also erythrocyte concentrates, fresh frozen plasma, platelet concentrates, and cryoprecipitate. Standard testing of blood includes screening for the human immunodeficiency virus, hepatitis B and non A non B viruses, as well as syphilis. Bedside testing consists of AB0 and rhesus compatibility tests.

#### **Intensive care medicine**

The ICU of the UTH is a ten bed unit receiving patients from all medical departments (Figure 2). It is run by the division of anaesthesia and employs 28 nurses. Of these, eleven are state registered nurses (three years training) and seventeen enrolled nurses (two years training). Anaesthetists visit the ICU once daily for medical prescriptions. During



**Figure 2.** View of two beds in the Intensive Care Unit of the University Teaching Hospital, Lusaka, Republic of Zambia

the remaining daytime and evening hours, the medical anaesthetist on call, who is also responsible for anaesthetic procedures, provides urgent medical support for the ICU. In 2005, 345 patients were treated in the ICU. Table 3 displays the most common diagnoses leading to ICU admission with associated mortality rates. Except for the management of patients with ketoacidotic coma, medical treatment in the ICU is not standardized. Routine documentation of patient data includes hourly recording of vital signs and the Glasgow Coma Scale in patients with an altered conscious level.

### **Medical equipment**

#### **Drugs and consumables**

The stock of drugs and consumables at the ICU is poor, with particular shortages of ECG electrodes, tracheal tubes and nursing materials such as dressings, catheters and nasogastric tubes.

#### **Monitoring equipment**

Nine beds are equipped with ECG monitors which cannot be used regularly because of the lack of ECG electrodes. Oxygen saturation monitors are available for three beds. Blood pressure cannot be measured automatically, but must be checked manually. There are no facilities for invasive arterial or central venous pressure monitoring. For central venous cannulation (external or internal jugular veins), peripheral venous cannulas are used. The ICU is equipped with twelve gas powered ventilators which provide volume-controlled ventilation. No renal replacement therapy can be provided at the ICU. The haemodialysis service of the UTH exclusively cares for patients with chronic renal insufficiency and is not accessible for critically ill patients. Peritoneal dialysis is also available providing the costs can be covered by the patient since fluids must be imported from South Africa.

### **Supporting disciplines**

#### **Laboratory**

A 24 hour laboratory service is available, providing standard blood tests (full blood count, serum glucose and electrolytes, blood smear for malarial parasites, urine dipstick, and stool exam). Specific tests (renal and liver function tests, coagulation tests) can be made on request, but depend on the availability of test reagents. Apart from daily measurements of serum glucose in diabetic patients, no routine laboratory tests are performed in critically ill patients.

#### **Radiology**

The mobile X-ray machine of the ICU is not functional. Sonographic examinations cannot be performed in the ICU and require intra-hospital patient transport. The UTH runs one CT-scanner which is usually not accessible for ICU patients because of the necessity for patient transport and high costs.

#### **Infection control**

Although dispensers for hand disinfection are available in the ICU, there is no regular supply of disinfectant. Hand hygiene is restricted to routine hand washing using water and soap. At night stored water is provided by containers. A shortage of examination gloves does not only increase the risk of hospital acquired infection but also increases the risk of nurses and doctors developing an occupational infection.

#### **Emergency medicine**

The Division of Anaesthesia does not provide assistance in the management of emergency or critically ill patients in other areas of the hospital. Emergencies outside of the operating theatre and the ICU are managed by physicians of the relevant specialty. Most units have emergency medical supplies including variable amounts of emergency

**Table 3.** Most common diagnoses leading to ICU admission at the UTH (2005)

<b>Rank</b>	<b>Diagnosis</b>	<b>Admission No. (% of total)</b>	<b>Mortality rate No. (% of diagnosis)</b>
1	Trauma from RTAs	77 (22.3)	53 (68.8)
2	Hypertensive emergency	37 (10.7)	24 (64.9)
3	Meningitis	11 (3.2)	10 (91)
4	Major tumour surgery	14 (4.1)	10 (71.4)
5	Acute renal failure	13 (3.8)	10 (76.9)
6	Other diagnoses	193 (55.9)	86 (44.6)
<b>Total</b>	—	<b>345 (100)</b>	<b>193 (55.9)</b>

ICU=intensive care unit; UTH=University Teaching Hospital, Lusaka, Republic of Zambia; RTA=road traffic accident

drugs, but no ventilation bag, intubation set or defibrillator.

### **Pain therapy**

Pain therapy is not structured as a sub-speciality of anaesthesia. There are no physicians or nurses specialized in pain therapy. Outside of the operating theatre and the ICU, the anaesthetists are not involved in pain management which is left to the physicians of each specialty. The main indications for pain therapy in the UTH are neoplastic diseases, trauma and postoperative pain. Neither the World Health Organisation's scheme for pain management nor other guidelines are followed institutionally. Available analgesics are pethidine and in small amounts morphine, as well as metamizol, paracetamol, and diclofenac. The UTH pharmacy provides an oral opioid preparation (morphine syrup, 1 mg/mL).

## **II. University teaching and postgraduate training**

In the undergraduate curriculum anaesthesia is taught as a sub-speciality of surgery. There are no lectures on intensive care medicine, emergency medicine or pain therapy. Although a post-graduate training program exists for obstetrics, surgery, internal medicine and paediatrics, none is available for anaesthesia.

## **III. Research**

There were no clinical or experimental research activities by the division of anaesthesia during the last 5 years.

## **Discussion**

In contrast to anaesthesia departments in Western university hospitals, anaesthesia is only a sub-discipline of surgery at the UTH in Lusaka. While more than half of the anaesthetists are non-physicians, their fields of activity are restricted to the core concepts of anaesthesia such as the intra- and postoperative care of surgical patients. A major factor preventing the autonomy of the section of anaesthesia at the UTH is the shortage of well-educated, medically qualified anaesthetists. As in many other Sub-Saharan African countries,<sup>13,14</sup> few medical students are interested in becoming anaesthetists in Zambia. Moreover, the few Zambian physicians educated overseas in the specialty of anaesthesia prefer to continue their work in Western hospitals than return to Zambia

and work under difficult conditions. Zambia is among the African countries most severely affected by this brain drain.<sup>12,15</sup>

Worldwide, the main duties of a university hospital are patient care, research and teaching. This requires the presence of a qualified medical staff as well as the availability of basic supplies and medical equipment. Under such conditions competent patient care, professional medical training for young doctors as well as capable research is possible. So far anaesthesia is not taught as its own medical speciality in the undergraduate curriculum at the UTH, and no postgraduate training for anaesthesiologists is offered. In addition, no clinical or experimental research has been carried out by the Division of Anaesthesia at UTH during the past five years.

The lack of routine audit and clinical governance structures hampers the identification of problems faced in anaesthesia care. In 1989, the perioperative mortality rate within the first six postoperative days at the UTH was reported as 0.76% (80 deaths for 10,592 surgical interventions).<sup>16</sup> Perioperative mortality observed in other Sub-Saharan African countries varies strongly between 0.26 and 2.6%.<sup>17,18</sup> Information reported by anaesthetists of the UTH regarding intra-operative complications concur with published reports.<sup>17-20</sup> Poor haemodynamic control and airway management are the main causes of perioperative morbidity and mortality. The reasons are multiple and include: limited experience and knowledge about the recognition and management of difficult airways, poor pre-anaesthetic assessment, lack of airway strategies other than direct tracheal intubation and long acting anaesthetic drugs, without reversal agents, predisposition to respiratory complications in the immediate post-extubation and recovery period.<sup>21</sup> Cardiovascular complications may arise from a lack of physiological and pharmacological experience and knowledge in their management, a lack of diagnostic methods to provide early recognition and diagnosis, a lack of colloid infusions and cardiovascular active drugs other than dopamine and an increased rate of surgical bleeding and blood loss.<sup>18,22</sup>

The mortality of critically ill patients is strikingly high. There are multiple reasons which include: limited staffing and training, a shortage of diagnostic and monitoring tools and our impression that many patients are admitted in a pre-morbid state, due to limited pre-treatment. According to

the 2004 UTH annual report, 4,846 patients died during their hospital stay (pneumonia, 26%; pulmonary tuberculosis, 24%; malnutrition, 18%; malaria, 15%; others, 17%). With an annual admission rate of around 350 patients, it is clear that the majority of critically ill patients are managed on the wards, reflecting either a restrictive admission policy of the ICU, or low referral rates.

As with many other Sub-Saharan African hospitals<sup>23</sup>, no organised approach to pain therapy exists due to the lack of experts and availability of analgesics.<sup>23-25</sup> It is well recognised, however, that the requirements for analgesia are exceptionally high in hospitals of developing countries. It is commendable that while other countries are in need of oral opioid formulations,<sup>23,24</sup> the pharmacy of the UTH offers such a preparation.

According to the results of this survey, there are several requirements needed to improve the development of anaesthesia and improve peri-operative patient care in UTH.

- Improved staff training, recruitment and retention in anaesthesia is essential. In particular promotion of anaesthesia to improve its image as a postgraduate specialty, the creation of a local postgraduate training scheme for local graduates is required, and the establishment of its own department of anaesthesia.
- Reliable supplies of basics such as water, electricity, oxygen, drugs and consumables.
- Introduction of functional and locally serviceable medical equipment.
- Improved management of the anaesthesia systems including ordering, supplies and supervision.
- An international strategy to reduce medical migration.
- Introduction of clinical audit and governance procedures.
- Regular maintenance facilities.

In conclusion, the status of education and research of anaesthesia at the university teaching hospital of a least developed Sub-Saharan African country is severely short of workforce and resources. We have described strategies which may help to reverse this trend, the most important of which is to promote anaesthesia as an essential specialty within hospitals in developing countries.

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