New Glostavent® anaesthesia system

Anaesthesia in a Tanzanian mission hospital

It is difficult for anyone who has never been to Tanzania to imagine the conditions in which anaesthesia practitioners (APs) work there. There are less than 35 physician anaesthetists for the 40 million inhabitants and insufficient nurse anaesthetists.

APs must cope single-handedly with anaesthesia for a wide range of surgical conditions such as emergency caesarean sections, haemorrhagic shock, laparotomy for ileus, infants with acute injuries and surgery for congenital malformations. They are frequently on-call and have little free time. Despite their limited training and practical experience they take on the same responsibility as specialist anaesthesiologists in developed countries.

In addition, hospitals lack basic anaesthetic and monitoring equipment and essential drugs. Pulse oximeters are unavailable in 70% of all East African theatres [1] and 75% of all hospitals in Tanzania do not have a reliable oxygen source [2,3,4]. The supply of electricity is subject to extreme voltage fluctuations and interruptions.

St Benedict's Hospital, Ndanda, Mtwara region.

My experiences as an anaesthetist in Tanzania during 2009-10 began at St Benedict's Hospital, Ndanda, near the border with Mozambique. I had privately organized my volunteering supported by the Missionary Benedictine Sisters. The anaesthetic team consisted of one nurse officer anaesthetist, one nurse with less than a year`s experience, another with only three weeks experience and me. We served three main theatres undertaking major surgery plus a separate theatre for minor surgery and performed theoretical training every week. There were frequent on-call duties with up to five major cases a day.

The only drugs available were thiopentone, halothane, suxamethonium, ketamine, diazepam, pethidine, lignocaine, atropine, adrenaline and, occasionally, ephedrine. I introduced laryngeal masks I had brought with me. All the anaesthetic machines needed a major overhaul. Two of them were more than 30 years old and needed to be replaced. It took more than a year to get all anaesthesia equipment working or replaced.

I found these German machines to be too complicated, too expensive and not robust enough to be suitable for the conditions in such a remote hospital.

St Walburg`s Hospital, Nyangao, Lindi region.

At this neighbouring mission hospital I helped the staff make an assessment of the anaesthesia service so that we could plan improvements.

We found that there was just one nurse anaesthetist who had received one year of training and two or three registered nurses who had been trained on the job but had no theoretical knowledge of anaesthesia.

The equipment included two Oxford Miniature Vaporizers, Oxford Inflating Bellows, endotracheal tubes, laryngoscopes, oxygen concentrators and pulse oximeters. There were no LMA`s, difficult intubation equipment, paediatric anaesthesia breathing system or ventilators. The range of drugs available was similar to that at St Benedict's Hospital.

At the time of our visit most operations were being performed under spinal anaesthesia or with ketamine, or under general anaesthesia with a facemask and spontaneous ventilation. Even patients for major upper abdominal surgery were not usually intubated because of the difficulty of manual ventilation when working single-handed. Infants for hernia repair and other major operations, including intra abdominal surgery, received ketamine alone as equipment for paediatric intubation anaesthesia was absent. As the quality of anaesthesia using these methods was frequently unsatisfactory there was general support when I suggested buying a modern anaesthetic machine.

Sophisticated anaesthesia machines, as used in western hospitals, are unsuitable in this situation due to the frequent power cuts, varying voltage, lack of compressed medical gases, lack of skilled technicians to provide servicing and maintenance. After reviewing the options available, we decided to buy a Glostavent® Anaesthesia System [5, 6] which is specifically designed for use in difficult and remote locations. It consists of an oxygen concentrator, draw-over breathing system, gas driven ventilator and uninterrupted power supply unit (UPS). It is suitable for use in adults and children, is easy to understand, operate and service and can continue to function without interruption if the supply of oxygen or electricity fails. The Glostavent was purchased from Diamedica (UK) Ltd (www.diamedica.co.uk) by the Missionary Benedictine Sisters of Tutzing, Germany from funds raised largely by me.

Results

Before 2009 no specialist anaesthetist had ever worked at St Walburg`s Hospital, so the nurse officer anaesthetists had to be totally self-sufficient. In 2009 two Irish anaesthetists visited for two months and made contact with me in the neighbouring hospital in Ndanda. Together we prepared a training programme which included intubation, use of the LMA and manual ventilation. Six months later I returned to Nyangao to continue the work they had begun.

Table 1 shows how the proportion of patients receiving endotracheal anaesthesia (ETA) or LMA increased from 0.9% in 2008 to 1.6% in 2009, and to 6.9% in 2010, following the introduction of the Glostavent® anaesthesia system and five weeks of intensive training in October-November. It was predicted that this number would reach 20% in 2011. Data is derived from the annual reports of the hospital [7].

With the new anaesthesia equipment installed our aim is now to ensure that standards are maintained. There will be visiting anaesthetists to Nyangao each year and it has been arranged that one anaesthesia nurse each year will receive professional training at the School of Anaesthesia at the Kilimanjaro Christian Medical Centre.

Table 1

Types of major operations and anaesthesia at Nyangao Hospital before (2008) and after the presence of visiting anaesthetists (2009) and with availability of an anaesthesia machine (2010).

Type of surgery	Spinal/LA	Ketamine	ETA/LMA	TOTAL
Upper abdominal/Chest superficial	9	52	1	62
Lower abdominal/Genital	852	198	2	1052
Extremities orthopedic/plastic	178	62	-	240
Head, neck	-	12	10	22
TOTAL: 2008	**1039**	**324**	**13**	**1376**
Upper abdominal/Chest superficial	4	59	4	67
Lower abdominal/Genital	826	168	9	1003
Extremities orthopedic/plastic	192	79	-	271
Head, neck	-	1	10	11
TOTAL: 2009	**1022**	**307**	**23**	**1352**
Upper abdominal/Chest superficial	2	21	35	58
Lower abdominal/Genital	799	112	40	951
Extremities orthopedic/plastic	239	42	-	281
Head, neck	-	11	15	26
TOTAL: 2010	**1040**	**186**	**90**	**1316**
Expected TOTAL number: 2011	**900**	**100**	**300**	**1300**

Personal experience at Nyangao Hospital

My first day at Nyangao hospital in October 2010 began by unpacking the new Glostavent® anaesthesia machine. Despite its long journey from the UK, including a 10 hour lorry ride on a rough road from Dar es Salaam, the machine worked perfectly straight away.

On the day's list were two patients for total abdominal hysterectomy (TAH) and one three year-old child with a large umbilical hernia.

Shortly after performing the first intubation and having started mechanical ventilation we experienced the usual daily power cut, which lasted eight minutes until the generator started. The Glostavent's integral UPS successfully bridged the blackout and kept the machine working without the need for any intervention.

For the next patient, a 3-year-old child with umbilical hernia, I planned to induce anaesthesia intravenously, but the veins were almost invisible and there were no small needles in stock. I gave an inhalational induction with halothane and a laryngeal mask airway that I had brought with me from Uppsala. Surgery was uneventful and infant awoke as smoothly as she had fallen asleep.

The second TAH patient was difficult to intubate. The nurse anaesthetist had failed to intubate her and I had not yet unpacked everything I'd brought with me from Sweden. Endotracheal intubation had seldom been performed in Nyangao, so there was little equipment available. John, the trainee anaesthetist, went to fetch my bag while I ventilated the patient with halothane via a face mask. Having never seen an LMA before, he tipped the whole contents of the bag onto the floor, so I could select a suitable LMA and insert it. Surgery and anaesthesia were thereafter uneventful.

Training the local staff to manage the airway and use the Glostavent®

Every Wednesday I provided training sessions for the local staff, including theory and practical training with the Glostavent. Printed handouts were distributed covering the most important topics of anaesthesia, adapted for the local requirements, tables on dosages of drugs and sizes of airways etc. After only one week, the nurses were confident enough to perform ETA without supervision.

Previous anaesthesia equipment

Conclusions

Prior to 2009 in both hospitals the level of anaesthesia could not be regarded as safe as the number of anaesthesia providers was insufficient, professional education was insufficient, and equipment was lacking or broken. During my stay this situation improved significantly. In Nyangao the introduction of an anaesthesia machine along with training in intubation and laryngeal mask anaesthesia led to a significant decrease in the number of patients having major neck and abdominal operations performed under ketamine anaesthesia, with no airway protection and the patient breathing spontaneously ventilation without secure airway for major neck and abdominal operations. Millions of people in developing countries do not currently have access to safe anaesthesia and pain relief during surgery and child birth [8]. According to a recent survey, less than 25% of all anaesthesia practitioners in Uganda are able to provide anaesthesia that meets the WFSA's minimum requirements for safe anaesthesia [8, 9]. In South Tanzania less than 20% of all hospitals fulfil these criteria.

Lack of appropriate equipment is a major problem. Many Sub-Saharan hospitals possess a 'graveyard' of non-functioning anaesthesia equipment donated without knowledge of the local situation and its needs. African APs are disheartened by machines that arrive without instruction manuals, labelled in a strange language, without maintenance instructions and with no way of obtaining spare parts from abroad. So they often continue to use primitive anaesthesia. In contrast, the Glostavent anaesthesia machine proved to be entirely suitable for the local conditions and the local staff quickly learnt to use it with confidence. I recommend it without reservation for any hospital with limited facilities. Improving the quality of anaesthesia is only possible if a realistic assessment of the existing situation is made in advance together with the local anaesthesia staff and surgeons. Appropriate equipment will be needed and should be accompanied by thorough training of local personnel in its use, servicing and maintenance. Emphasis must be placed on the importance of clinical observation and monitoring of vital signs rather reliance on complicated electronic devices. My experience has convinced me that it is possible for individual anaesthetists to make lasting improvements in the provision of safe anaesthesia in some of the poorest parts of the world without excessive financial outlay.

Daniela Kletzmann
Consultant anaesthetist
Uppsala University Hospital

Dr Ryszard Jankiewicz
Surgeon-in-charge at St Walburg's Hospital
Nyangao, Tanzania

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