Diamedica Portable Anaesthesia Machine (DPA 01)

Clinical use Rwanda/Uganda October 2008

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The Diamedica Portable Anaesthesia Machine (DPA 01) was used to provide anaesthesia during a surgical camp to Gahini Hospital in Rwanda and Kisiizi Hospital in Uganda in October 2008.

Background: hospital facilities
Gahini Hospital Rwanda and Kisiizi Hospital Uganda are both mission hospitals that provide surgical services for the local population, including emergency obstetric care. In addition, there is a surgeon performing eye surgery in Gahini.

Essential services were present at both hospitals (running water, mains electricity), although both hospitals suffered power cuts during the visits.

Drawover anaesthesia was used as standard in both hospitals. Oxygen was supplied by oxygen concentrators in both hospitals: although a J sized oxygen cylinder was present in each hospital, they were both empty. Refills were possible at the nearest large towns, Kigali or Mbarara but they were 1-3 hours distant. The UNFPA donated a Chinese manufactured anaesthesia machine to Gahini hospital that included a circle system and mechanical ventilator. There was no means to attach the anaesthesia machine to the oxygen cylinder and no soda lime available in Rwanda.

Anaesthesia techniques
Anaesthesia was administered via the DPA 01 for all patients, using a high flow oxygen concentrator (8l/min) as a source of oxygen. Anaesthesia was induced by inhalational induction using halothane in oxygen, intravenous induction with propofol or by intramuscular injection with ketamine. Suxamethonium was used to facilitate intubation. Anaesthesia was maintained using halothane in oxygen, ventilating by hand or using spontaneous ventilation. Analgesia was provided using intravenous ketamine or local anaesthetic blocks.

There were no opiates available in either hospital. Postoperative analgesia was provided using oral paracetamol and ibuprofen.

All patients were monitored using a precordial stethoscope and GE integrated anaesthesia monitor, including ECG, NIBP, SpO_2 and $ETCO_2$.

RESULTS

Assembly and transport
The DPA 01 was easily transported in the carrying case, although it drew the attention of the security guards at each airport (carried on plane as hand luggage)!

The details of the patients anaesthetised are shown in the table:

Age (median, range)	4yrs (5 weeks – 66yrs)
Weight (kg) (median, range)	19 (3 - 54)
Duration of surgery (minutes) (median, range)	95 (25 - 355)

The anaesthesia kit was easily assembled using the clear instructions provided. The anaesthesia tubing was lightweight and easy to use.

Patients
A total of 20 patients were anaesthetised for 21 operations, including16 children under 16 years of age. There were 15 plastic surgical procedures (including 3 children and one adult for cleft lip repair, and one child for cleft lip and palate repair), 2 patients for burns contracture release, and three patients for general surgical procedures.

Six children and one adult with a predicted difficult airway were induced using halothane. The Ayre's T-piece was used for induction and maintenance in these 6 children. In the remaining children, anaesthesia was induced using ketamine or propofol and maintained using the self -inflating bag and the Laerdal valve. This was light weight and easy to use, even in children <10kg.

The DPA 01 was used for a total of 34 hours 40 minutes. The position of Laerdal valve kinked the tracheal tube on one occasion (south facing Rae tube); this was rapidly detected from a change in compliance using the self-inflating bag. Water vapour from the anaesthesia system blocked the $ETCO_2$ sampling port on one occasional (no filters used). There were no other complications relating to the anaesthesia equipment.

Vaporiser
The vaporiser was stable, and easy to fill (although a maximum filling line would have been useful – overfilled twice). The large capacity and stability of the vaporiser was a distinct advantage over the OMV vaporiser. It was not possible to measure vapour concentrations, but the vaporiser appeared to deliver halothane concentrations in the expected clinical range.

Inspired oxygen concentrations
Inspired oxygen concentrations were in the range of 86%-90% using the high flow oxygen from the oxygen concentrator. When the electricity supply failed, the FiO_2 reduced to 0.21 over a period of a few minutes.

Carbon dioxide clearance
As expected with the design of the anaesthesia circuit, it was very difficult to eliminate rebreathing during IPPV using the Ayre's T-piece, particularly in the children 10-20kg. One child developed ventricular ectopics during ventilation with a T-piece, possibly related to CO_2 retention in the presence of halothane and injected adrenaline. The ectopics resolved after increasing the minute volume and reducing the inspired halothane concentration.

There was no rebreathing using the self-inflating bag. Our preferred technique for children <10 kg was to perform a gas induction using halothane in oxygen using the T-piece, then to change to IPPV using the self inflating bag during maintenance of anaesthesia. A novice anaesthetist accompanied us and found the T-piece difficult to use; the self-inflating bag was comfortable to use for IPPV by hand, even for the case lasting 5hours 55 minutes!

Conclusion
The DPA 01 performed well in the clinical environment for both adult and paediatric practice, using the high flow oxygen concentrator as a source of oxygen. I would highly recommend its use in resource-limited environments.

For paediatric practice, the Ayre's T-piece is useful for performing an inhalational induction, but for ease, comfort and safety of use, I would recommend the use of the self-inflating bag and Laerdal valve, including for children <10kg.