## ANAESTHESIA IN CHILDREN USING THE EMO SYSTEM

*Mr Peter Bewes, Continuing Medical Education, c/o Department of Surgery, Makerere University Medical School, PO Box 4127, Kampala, Uganda*

In some places, by necessity, children undergo anaesthesia with inadequate facilities. Transport to another unit is frequently not an option and the following article describes a method to adapt the EMO system for use in children under 15kg. The technique requires anaesthesia training and should not be attempted by someone without the ability to intubate.

The concept is to use the EMO with a T piece and continuous flow. Two people are required; the anaesthetist who anaesthetises the child using a standard T piece and an assistant who pumps the Oxford inflating bellows continuously so that there is always a flow of ether in air +/- oxygen through the T-piece. This minimises the work of breathing for the child and ensures adequate amounts of ether are produced by the EMO.

The Oxford inflating bellows should have the magnet removed from the flap valve and the T piece connected to the bellows outlet. The T piece can be used with a mask or endotracheal tube (fig. 1).

**Induction of anaesthesia using ether.** With a larger child you may be able to get good co-operation by "talking the patient to sleep" as you administer the anaesthetic, but in babies it is often easier to wrap them in a blanket to keep the arms and legs still while the baby cries and inhales the anaesthetic ether.

Ether is a very strong smelling vapour that stimulates a lot of secretions. In order to prevent problems give atropine in appropriate doses (around 0.02mg/kg) intravenously or intramuscularly before induction of anaesthesia.

The strong smell of ether frightens many patients, so introduce it gradually. I like to let them breathe through the mask for a few breaths before attaching it to the T piece. This allows time to check that the mask fits the face properly and reassures the patient that they are not being suffocated. Then tell the patient that they will smell a strange smell (not unpleasant) and, with the ether concentration lever on the EMO set to transit, connect up the face mask to the T-piece. At this point start your assistant pumping the Oxford inflating bellows 8 times per minute to produce a near continuous flow of gas until the end of the operation when anaesthesia is finished.

Initially the child will detect the residual vapour from the rubber tubing, and will get used to the smell without the feeling of being poisoned! After a minute or two, nudge the ether concentration lever from the transit position to give a weak concentration of ether. Reassure the child that the "nice smelly stuff" will make him feel sleepy. Keep the face mask snugly fitted to the patient's face, so that there is no leak. Slowly nudge the concentration up to 2%, always allowing at least four cough-clear breaths between nudges, and never increase the concentration by more than one half per cent. If the patient coughs or objects, nudge it back one step and wait for six clear breaths (without swallowing or breath-holding) and talk reassuringly to the patient saying all is well - then increase the ether concentration slowly. All the time keep talking gently, quietly and confidently until you have reached an ether concentration of around 10%.

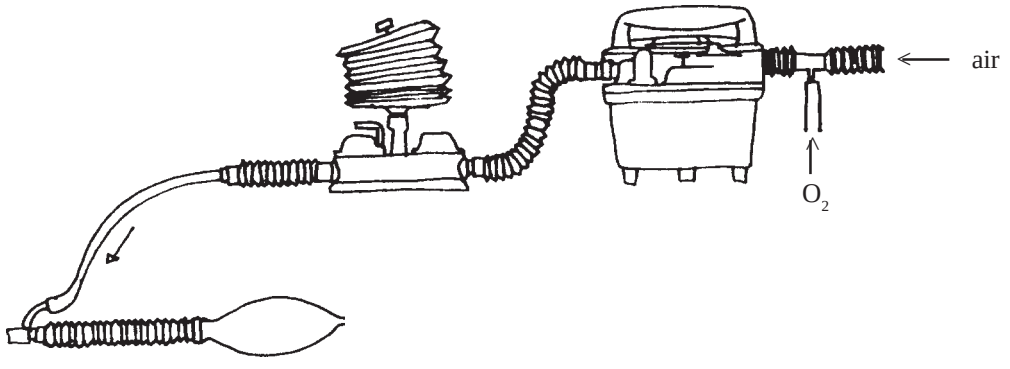


*Fig.1. A slow steady pumping action will provide a near continuous flow of ether vapour.*

Keep your finger on the patient's pulse during the entire induction, or better still have a paediatric stethoscope attached to his chest. Keep listening and watching the chest to make sure that air is going in and out freely. In stage 1 of anaesthesia, the eyelash reflex goes. In stage 2 there may be some struggling, and the patient will need reassured while an assistant holds their limbs. The patient may vomit at this stage and need to be turned on their side and have their pharynx cleared with suction. During this stage the pupils may dilate, and breathing begins to become irregular. In stage 3 (the stage of surgical anaesthesia) there are 4 described planes. The first is plane 1 during which the respiration becomes more regular but the pupils are not central. The second is plane 2 when the pupils are central and it is safe to insert a Guedel airway. With deeper anaesthesia the pupils may begin to dilate (although the atropine may mask this).

Minor surgery can be done in plane 1 (incision of abscesses etc.). Most general surgery can be performed in plane 2. In plane 3 there is progressive paralysis of the intercostal muscles, which can be detected by careful observation of the pattern of breathing. If it becomes "see -saw" in character, with paradoxical movement of the chest (falling instead of rising on inspiration) anaesthesia is becoming too deep and the face mask should be removed for a few breaths whilst reducing the ether concentration to a more satisfactory maintenance level. In general this is 6 to 8% for surgical procedures that do not require any muscular relaxation, or nearer 8-10% for intra-abdominal procedures requiring relaxation. Be careful not to overdose the patient.

Stage 4 of ether anaesthesia is marked by shallow respiration and if it occurs should be treated immediately by removing the mask and reducing the ether concentration. Be prepared to assist ventilation and if respiratory arrest occurs switch the ether setting to "Transit" and ventilate the patient via the T-piece.

During the operation continue to monitor the child closely paying particular attention to his colour, airway, respiration and cardiovascular signs. Towards the end of the operation allow the patient to lighten by adjusting the ether setting towards 2% or less. With abdominal surgery do not do this too early as closure may prove difficult. At the end of the operation the patient should be breathing air and the face mask may be removed. Ensure that the airway is completely clear before handing the patient over to the nurse in the recovery position.

**Practical points:** Aim at a steady level of anaesthesia and do not allow the patient to get too deep. Never let the surgeon start until you are ready. If laryngeal stridor develops, allow a few breaths of air and then continue more slowly. However, if spasm develops during surgery, it means the patient is too light for the procedure. Ask the surgeon to stop and deepen anaesthesia until the stridor stops. Add some oxygen to the circuit if possible.

The safety of this technique is considerably increased by adding oxygen to the inspired mixture. It should be put into the circuit upstream (before) of the EMO vaporiser using some sort of reservoir. Around 1 litre/minute is adequate during maintenance. During induction this should be increased to around 3 to 4 litres/minute.

The technique may also be used with intubation and controlled ventilation. This is the preferred technique for longer procedures and in smaller children. If muscle relaxants are used then an intravenous induction may be performed, less ether will be required for maintenance and recovery will be faster.

**Editor's note:** The EMO can also be used with a T piece by connecting the vaporiser inlet to a source of continuous gas flow (eg Boyles machine, oxygen cylinder etc). Connect the T piece to the outlet of the EMO. The EMO does not work so efficiently when used as a plenum vaporiser and needs a continuous fresh gas flow of 10 litres/minute to produce adequate concentrations of ether.

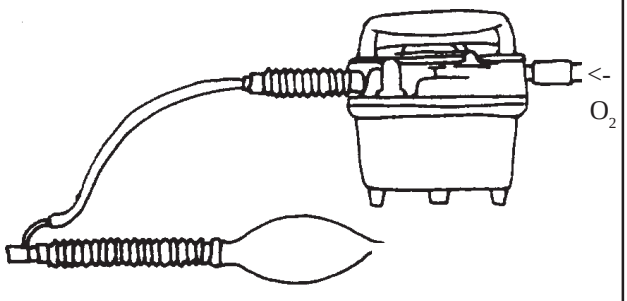


*Fig.2.*