4. Anaesthesia for Separation of Craniopagus Twins

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In the available literature on the separation of craniopagus conjoined twins very few details are given of the anaesthetic techniques used. In one case (Hall, Merzig, and Forbes, 1957) the degree of union was obviously far less extensive than in the present cases, and anaesthesia consisted of heavy premedication followed by intubation while awake and then maintenance with nitrous oxide, oxygen, and intravenous thiopentone. Ayre's T-piece was used and blood was replaced from a 10-ml. syringe. Another case (Grossman, Sugar, Greeley, and Sadove, 1953) presented problems similar to those in this report. Heavy basal narcosis was followed by endotracheal nitrous oxide, oxygen, and minimal trichlorethylene, and 6 litres of blood was transfused. One twin died 34 days after operation and during that period was comatose, with decorticate rigidity, periodic breathing, and hypothermia, and had required tracheostomy. The other infant survived with some disability.

Problems

The anaesthetic problems presented by both sets of twins were almost identical. In each case a number of radiological investigations were necessary before the skin flaps were prepared and final separation was attempted. This gave an opportunity for an initial assessment of the twins' reaction to anaesthesia to be made. It soon became obvious that there should be two anaesthetists and their assistants, and that these two anaesthetists should always give the anaesthetics and always to the same twin. In this way it was possible to become accustomed to the individual response of each twin to anaesthesia, to observe changes in this as they grew, and with increasing practice to overcome the anatomical difficulties encountered.

It was decided at an early stage that on each occasion the twins should be induced and intubated one at a time. It was felt that if any complication such as vomiting or laryngeal spasm should arise during induction it would be easier to manage if the other twin was either fully conscious or already intubated and settled. It is interesting to note that on each occasion, in both sets of twins, the one awake became restless and then sleepy about 10 minutes after the induction of the other had begun. More anaesthetic was required for the first twin, and the anaesthetic vapour could be smelt in the expired air of the other.

On each occasion atropine alone was given for premedication as it was felt that heavy basal narcosis was unreliable in action, would make an inhalation induction more difficult, and would complicate assessment of the clinical picture if there should be any non-anaesthetic effects on the vital centres. It was found that an induction with nitrous oxide, oxygen, and diethyl ether from a Boyle's machine, using a semi-closed circuit, was more satisfactory than ethyl chloride and open ether, or nitrous oxide, oxygen, and halothane. The dose of ethyl chloride was difficult to judge and the infants seemed sensitive to it, rapidly developing pallor and respiratory depression. When halothane was used for induction and intubation the tracheal reflexes returned so rapidly that smooth anaesthesia was interrupted. Some difficulty was experienced in intubation owing to the fact that the twins lay in a different axis, and rotation and support of both were necessary to achieve a reasonable position for laryngoscopy. One of the infants had a cleft palate, which added to the difficulty of intubation. An Ayre's T-piece was used during maintenance of anaesthesia and after experience with the first set of twins a special suction union was designed (Ballantine, 1961) so that the efferent and afferent limbs of the T-piece could lie along the chests of the infants. This facilitated very firm fixation of the endotracheal tubes and allowed the heads to be tightly draped.

During the radiological investigations it was found that if one twin was elevated from the horizontal position he became pale and pulseless and his respiration was shallow. This observation has also been reported (Allen, Metcalfe, and Giering, 1959) in the case of twins with a common liver bridge. This postural hypotension was avoided by making sure that the infants were always kept in the same horizontal plane.

The anaesthetic problems associated with the final separation, and partially anticipated from the preliminary anaesthetics, were : (1) the maintenance of perfect airways in both infants in spite of repeated and often complete rotation of their heads and bodies as separation proceeded ; (2) the maintenance of an even plane of anaesthesia with the resultant smooth operative conditions during these manœuvres ; (3) the actual performance of rotation with the twins in different long axes, and the control of the various anaesthetic tubes, blood drips, and recording apparatus ; (4) the support of their circulations during a very long operation in the presence of severe haemorrhage ; and (5) the possibility that their vital functions might become disturbed as a direct result of the surgical procedure.

Technique

The techniques adopted for the final separation in both operations were similar and therefore need not be described separately.

Premedication.—Atropine 0.4 mg. was given subcutaneously 45 minutes before anaesthesia was induced.

Transfusion.—Intravenous drips using polythene tubing were set up via the femoral veins. No attempt was made to start anaesthesia until it was ascertained that the drips could be run at maximum speed. During both operations it was possible to run in blood as fast as was necessary, and there is no doubt at all that without reliable intravenous drips it would have been quite impossible to maintain an adequate circulation.

Induction.—The infants were induced separately, using nitrous oxide, oxygen, and diethyl ether ; each trachea was sprayed with 4% lignocaine hydrochloride, and non-bevelled flexometallic tubes were inserted. The tubes chosen were the largest that could be passed and larger than would be used in normal circumstances. It was decided that the maintenance of absolutely perfect airways was so important that it outweighed the risk of post-operative laryngeal oedema. After the first operation, lasting 11 hours, one twin required tracheostomy, and after the second operation, lasting 16 hours, the survivor was returned to the theatre for tracheostomy two hours after the end of anaesthesia.

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Maintenance of Anaesthesia

Anaesthesia was maintained, using nitrous oxide, oxygen, and halothane with Ayre's T-piece. Each circuit was arranged to include a water manometer which would blow off if any obstruction developed in the inflow or outflow tubing, and which allowed the tidal movements to be watched and measured continuously. A reservoir bag was included in the circuit and could be switched in if the respiration required assistance (Ballantine and Jackson, 1960). Precordial stethoscopes and blood-pressure cuffs were applied. Halothane was added from a "fluotec" vaporizer in a concentration of 0.5 to 1%. It was found that if the concentration fell below 0.5% anaesthesia became too light and the infants would strain and hold their breath, rapidly becoming anoxic and hypotensive. With an increase in vapour strength above 1% respirations became shallow and the blood-pressure gain tended to fall. Between 0.5 and 1% a constant level of anaesthesia seemed to be established which allowed postural changes without reflex reaction. Although all the infants responded quite independently of one another their individual reactions followed a similar pattern.

An attempt was made to measure blood loss, but this was made difficult by the large number of postage-stamp swabs, towels, and lintine used. However, on both occasions an effort was made to replace blood as quickly as it was lost, and this meant applying pumps to the drips from time to time. Some idea of the severity of the haemorrhage is given by the fact that in the first operation a total of 4.5 l. of mostly fresh blood was transfused and in the second operation the amount transfused was 10 l., with calcium gluconate added in the later stages. The estimated total combined blood volume of the twins in each case was approximately 1.5 l. The general condition of the infants remained surprisingly good for the major part of the very long and haemorrhagic operations. The value of using large endotracheal tubes was proved by the quality of the airways it was possible to keep in spite of the changing posture. The anaesthetic charts of the first separation have been published elsewhere (Ballantine and Jackson, 1960), and at the end of the anaesthesia both infants cried and moved their limbs immediately and were in remarkably good condition. The twin who had a tracheostomy and who ultimately died required several post-operative bronchoscopies for the removal of thick casts of the bronchial tree, in spite of high humidification in the oxygen tent. The survivor of the first operation had a fairly straightforward post-operative course.

At the second operation one twin died as separation was completed after 13½ hours of anaesthesia. During the last hour before separation her blood-pressure had been difficult to obtain and in the last few minutes respiration became shallow and irregular. Prior to that all had been well apart from one short period when mucus partially obstructed the endotracheal tube and required aspirating. The rapidity with which respiratory and circulatory insufficiency became apparent on this occasion served to emphasize again the vital importance of the clear airway. The survivor of this separation required several post-operative bronchoscopies in spite of early tracheostomy, and she tended to become obstructed with thick mucus and later by tracheal casts—this again in the presence of high humidity.

Conclusions

The main technical difficulty for the anaesthetists was rotating the twins in the same horizontal plane without altering the relationship of their long axes. This had to be done without interfering with the airways, without entangling the anaesthetic, monitor, and drip tubing, and without contaminating the surgical field. This manœuvre became increasingly difficult as the separation proceeded, for there was a danger that actual brain damage might be caused if the rotation was not smoothly and simultaneously performed. At one of the preliminary operations the twins were bandaged into fibre-glass casts, as it was thought that this might facilitate rotation, but in fact this did not work as well as anticipated.

If craniopagus twins with this complicated and extensive degree of union should have to be anaesthetized again the general anaesthetic technique described here would be used. However, an attempt would be made to improve the measurement of blood loss. The body temperature would be measured and controlled, but at what level might be difficult to decide. Some degree of hypothermia would probably be beneficial. Finally, some means of rotating the twins mechanically would be evolved.

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5. Plastic Repair after Separation of Craniopagus Twins

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The separation of craniopagus twins must inevitably result in two heads in which most of the cerebrum is devoid of covering. In the two sets of twins which we have treated freeze-dried dura mater has been used to replace the missing portion of the meninges and it has been the task of the plastic surgeon to provide skin cover for the exposed brains.

A plaster model of the skull (Fig. 1) of one infant after separation of the heads gives a good idea of the magnitude of the scalp defect, and in practice the problem is accentuated by the oedematous brain projecting above the level of the divided skull. Our objective in planning the repair was to provide immediate and complete cover for the brains of both children, and we tried to achieve this end with a minimum number of preliminary operations.

The technique of transferring a skin flap from a distant site—for example, an abdominal flap transferred to the head on the wrist—was thought to be impracticable as this type of repair would require too many operations and much difficulty would probably be encountered in trying to fix the conjoined

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