Management of Anesthesia for Surgical Separation of Newborn Conjoined Twins

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In this paper we report the anesthetic management of the first successful separation of xiph-o-mphalo-ischiopagus twins. Conjoined twins are the result of an abnormality in fission of the primitive streak occurring during the first two weeks of development, and are always of the same sex.1-3 Recent surveys quote incidences of 1 to 166,0004 and 1 to 200,000,5 rather than the 1 to 50,000 to 1 to 60,000 usually mentioned.1-5 The connection may involve the head, thorax, abdomen or pelvis. Apposition is most frequently ventral, but can be lateral or polar. The incidences of union in various locations are stated to be: thoracopagus (including omphalopagus and xiphiopagus), 73 per cent; pygopagus, 19 per cent; ischiopagus, 6 per cent; craniopagus, 2 per cent. Combinations of these forms usually have multiple common organs, and surgical separation with survival is extremely rare.7

The Patients

The infants’ mother was gravida V para III at the time of delivery. At 26 weeks’ gestation, a radiographic examination had been performed because multiple pregnancy was considered. The diagnosis of conjoined twins was strongly suspected.5,9 Cesarean section was performed at 36 weeks’ gestation, following premature rupture of membranes and staining of amniotic fluid.

At birth, the babies were found to be girls joined from the lower chests to the perineal areas. Both babies cried immediately, and their color remained good. Routine nursery care was administered, and they were transferred to Massachusetts General Hospital two days later for further evaluation and surgical treatment.

The infants’ heads were normal in size and shape. Eyes, ears, noses and throats were normal. Palates were intact. Each chest was clear to percussion and auscultation, with no evidence of respiratory distress. The hearts were correctly located, and heart sounds were normal. Abdominal examination was difficult because of the conjoined parts. The extremities were all normal, with good muscle tone and normal reflexes. The buttocks were normal, with pilonidal dimples. In the center of the infants’ common perineum were two vulvas, two urethras, two vaginas and a single pinpoint anal opening.

Extensive radiographic studies were performed. Contrast media injected through the single umbilical artery and single umbilical vein revealed that the livers were fused, with some cross-circulation. There were two separate aortas and four kidneys. A single colon was shared equally. No barium studies from above were done for fear of introducing barium into an obstructed gastrointestinal tract.

Preparation for Anesthesia

Review of 16 reported successful surgical separations of conjoined twins indicated certain areas of importance: 1) A team approach, with duplicate surgical, anesthesia and nursing personnel.10-14 2) Continuous monitoring of multiple systems.11,12,16 3) Precise control of fluid and electrolyte balance to maintain homeostasis.11,12,17,18 In the light of those experiences and the preoperative findings and advice of Dr. Alan Conn,19 conferences were held preoperatively to discuss anticipated problems and anesthesia management. Specifically, these points were reviewed:

Temperature Control. Provisions for positioning the patients on a heating pad were made. Exposure of large areas of uncovered abdominal contents was to be avoided. Room,
Fluid and patients’ temperatures were to be monitored.

Acid–Base Status. Mild acidosis found in the neonatal period would probably be increased by the changes in blood volume secondary to preoperative blood sampling.

Hydration. As a consequence of the common perforate anus, oral fluid administration was avoided. This precaution plus blood sampling and intravascular injections of contrast material suggested the possibility of disturbances of electrolytes and hydration. These were assessed and corrected prior to operation.

Identification. To assure correct identification, each child would be assigned a color. This would be used on all equipment, samples, records and requisitions. The anesthesiologists, too, would be dressed in color-coded garments, and each twin would have a color marker on her forehead.

Airway. With the twins supine, with the left and right shoulders and scapulae forming the pivot, each twin would lie twisted in two planes. Awake endotracheal intubation was decided upon—each intubation being accompanied by oxygenation of the other twin—and nasal intubation was chosen to facilitate fixing the tubes and ready access.

Cross-circulation. The degree of cross-circulation was unknown. Twin A, with the umbilical artery catheter in her aorta, showed fewer signs of activity than her sister. The effect of drugs given to Twin B on the weaker Twin A would be closely watched.

Blood Loss. To facilitate determination of the amount of blood lost by each twin, and replacement for each, both arterial and central venous cannulation were to be done in each twin. The uncertain degree of hepatic cross-circulation presented a major challenge.

Management

On the fourth day of life the twins (figs. 1 and 2) were separated surgically. Their combined body weight was 4.69 kg. Pulse rates ranged from 124 to 150 beats/min, respiratory rates from 20 to 50/min; body temperature was 37 C. Preoperative laboratory findings showed: hematocrit of 46 per cent; serum sodium 138 mEq/l; serum potassium 3.0 mEq/l; total serum proteins 5.4 g/100 ml. The blood was type A, Rh-positive.

The team consisted of five anesthesiologists—two assigned to each infant and the fifth acting as coordinator. Two similar sets of anesthesia and monitoring equipment were prepared, each including a Boyle’s anesthesia machine, with Cyprane halothane (Fluothane) vaporizer and modified Ayre’s T piece system; laryngoscopes with no. 0 and no. 1 Miller blades; Forger implantation-tested clear plastic uncut sterile endotracheal tubes, sizes 2.5, 3.0, 3.5, and 4 mm i.d.; sizes 5, 8, and 12
french suction catheters; drugs, including atropine, succinylcholine (Anectine), sodium bicarbonate, calcium chloride, epinephrine, and isoproterenol. All equipment, anesthesia records, laboratory sample tubes, and requisitions were color-coded red for Twin A and blue for Twin B.

Each infant was given 0.1 mg of atropine by intramuscular injection 45 minutes prior to induction of anesthesia. The anesthesia team undertook a “surgical scrub” before handling the infants. The twins were placed on a warming mattress and each fitted with a precordial stethoscope, sphygmomanometer cuff, axillary thermistor probe, and electrocardiographic leads.

After oxygenation, a 3.5-mm nasotracheal tube was placed in Twin B with a Magill forceps. After this had been secured and oxygenation established, Twin A was similarly intubated. Esophageal stethoscopes were then fixed in position.

With the twins under local anesthesia, radial artery cutdown and cannulation in the right forearm of each twin were done. Next, central venous catheterization was accomplished via the right antecubital vein in each child. The venous catheter did not pass the shoulder in Twin A, and values obtained only approximated central venous pressure. The pressures were visualized on a Hewlett-Packard Sanborn monitor along with the electrocardiogram.
Induction. Because Twin A was less active than Twin B, anesthesia was induced with 50 per cent nitrous oxide and oxygen to Twin B. Twin A showed signs of anesthesia while Twin B was still responsive to stimuli. Halothane, 0.5 per cent, was added to her circuit, while Twin A was given nitrous oxide and oxygen, 50 per cent only. A full-body surgical preparation, with each set of arms, neck and head wrapped in a separate drape, was done. The operation then commenced and continued uneventfully for five and a half hours.

Maintenance. Oxygen, nitrous oxide and halothane were the sole inhalation agents used, no more than 1.5 per cent halothane being needed at any time. It was necessary to administer halothane to Twin A through her own breathing circuit as surgical separation progressively diminished cross-circulation. Surgical separation was completed in six hours. Reconstruction of Twin A, then Twin B, each required three more hours of anesthesia. Ventilation was controlled manually without neuromuscular blockers. The assistance of the Anesthesia Acute Care Laboratory in providing rapid blood gas, electrolyte, hematocrit and serum protein analyses was essential to the prudent management of fluid balance and blood replacement.

Fluid and Electrolytes (figs. 3 and 4). Basal fluid requirements of 4 ml/kg/hr were provided each infant in the form of 5 per cent dextrose in lactated Ringer's solution. Further, to compensate for electrolyte and protein

![Graph showing cumulative replacement and total blood loss over hours of surgery](image-url)
losses from exposed areas, 4 ml/kg/hr of 5 per cent albumin in physiologic saline solution were infused. Incremental doses of 0.2 mEq of potassium chloride were given when serum potassium estimates fell below 3.0 mEq/l. Base deficits were corrected with appropriate sodium bicarbonate administration using the formula: base deficit x kg body weight x 0.3. Towards the end of operation, serum sodium concentrations began to rise. Basal fluid replacement was then changed to 5 per cent dextrose in water, and within three hours normal values were restored.

**Blood Replacement.** Each twin was calculated to have a blood volume of 207 ml and an erythrocyte mass of 95 ml, representing a blood volume of 9 per cent of their combined body weight and a preoperative hematocrit of 46 per cent. Theoretically, at a hematocrit of 40 per cent the erythrocyte mass should be 83 ml, a difference of 12 ml of erythrocytes or 28 ml of blood for each twin representing the acceptable blood loss before transfusion would be required.

Blood loss was measured by weighing dry sponges, direct measurement of suction loss, and estimating spillage. Twin A was used as the indicator for initial blood monitoring and replacement. During the first hour and a half of operation, hydration was accomplished by infusing 20 ml of 5 per cent dextrose in lactated Ringer’s solution and 10 ml of 5 per cent
albumin in physiologic saline solution. The hematocrit then was 41 per cent; minimal blood loss was seen at this time. As blood loss commenced, fluid replacement was given to Twin A, whose hematocrit rose to 45 per cent, while that of Twin B remained at 41 per cent. It was assumed at this time that the twins' circulatory systems were effectively separated, and measurement and calculations were then individualized. Heparinized whole blood was used in expectation of large blood losses and possible immaturity or inability of the infants' livers to cope with large amounts of ACD solution.

After six hours of operation, the livers were transected. Blood loss was replaced evenly in each infant until a sudden severe hemorrhage of 150 ml, when Twin A first became hypotensive, then cardiac asystole developed. Tracheal and internal cardiac massage was applied immediately and fluid was rapidly infused. Within two minutes, adequate cardiac function was restored. Calcium chloride, atropine and sodium bicarbonate were administered in support. At this time Twin A's hematocrit was 30 per cent, and normal systolic pressure was maintained. A further 50 ml of packed cells elevated her hematocrit to 42 per cent. She needed only 20 ml of packed cells in the following three hours while ureteroureterotomy, iliocolotomy, colostomy, pubic apposition, perineal closure, and resulting omphalocele repair were accomplished. She left the operating room with a hematocrit of 43 per cent.

During the completion of these procedures on Twin A, Twin B required continuous replacement of blood because of oozing from the many incisions. This amounted to half her estimated blood volume during this period and a similar quantity during her repair. When the operation was completed, the twins had received similar quantities of replacement fluids, although their fluid losses had taken place in quite different ways.

During completion of Twin B's operation, Twin A was given intensive care in the operating room by the anesthesia team, with assisted ventilation and monitoring. She was allowed to breathe room air for 30 minutes to help assess her condition and plan postoperative management. In consideration of their lengthy stay in the operating room, the major alterations in both anatomy and physiology, the possibility of fatigue, and the availability of a fully committed intensive care team, we elected to leave the nasotracheal tubes in place and allow each twin to breathe without mechanical assistance. Both twins were awake when the drapes were removed. They were transferred to the recovery room 13 hours after arrival in the operating theatre.

Postoperative Management (fig. 5). In the recovery room, the infants were nursed in heatedIsolets with appropriate humidity, oxygen and monitoring. An intensive chest physiotherapy regimen was instituted, with frequent suctioning and re-expansion of the lungs using the Ayre's T piece with a 0.5-1 breathing bag. 

$P_{a}CO_{2}$ measurements were made hourly. Oxygen concentrations in the incubators were frequently measured and kept between 30 and 40 per cent. Deflation of the stomachs was ensured by connecting gastrostomy tubes to suction.

Packed erythrocytes, 5 per cent albumin in saline solution, and 5 per cent dextrose in water were infused for maintenance and to replace fluid and blood losses from the surgical wounds and drainage tubes and blood lost by sampling. Both tracheas were extubated ten hours postoperatively and the infants were carefully observed for signs of respiratory distress, coupled with frequent arterial blood gas determinations. Critical care data sheets for the first 24 postoperative hours are shown (fig. 5).

Staged removal of the silo abdominal walls covering the omphalocles was started on the third postoperative day and completed on the seventh postoperative day. Each child required three further anesthesias, each of short duration, to facilitate abdominal closure. The skin was closed by the seventh day. During that interval the infants received hyperalimentation through a plastic cannula passed into the right atrium. Castrostomy feeding was started after skin closure. The infants were kept in the recovery area for the first seven postoperative days, and were transferred to the children's ward when the abdomens were closed.

$\S$ American Medical and Surgical Research Corporation, Catalog #461.
CONCLUSION

Successful management of anesthesia for extensively joined neonates during surgical separation was facilitated by: 1) the use of a team experienced in the management of premature infants; 2) frequent measurements and continuous monitoring of body function; 3) careful and aggressive management of fluid and electrolyte balance; 4) continuous postoperative intensive care; 5) valuable advice from others more experienced in this area.

We report this case with the hope that others may similarly be helped.

The authors express their appreciation to Dr. L. Essember, the referring pediatrician, and the Massachusetts General Hospital pediatric surgical house officers for the excellent preoperative condition of the twins, and appreciation and admiration to Dr. W. Hardy Hendren and his surgical team for their encouragement and skill during this extensive surgical experience.

REFERENCES

8. Wells E: Personal communication.
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Obstetrics

METHOXYAMINE IN OBSTETRICS Maternal and fetal cardiovascular and acid–base changes resulting from spinal hypotension and methoxamine administration were observed in seven pregnant ewes near term. Spinal hypotension resulted in signs of placental hypoperfusion in the fetus. Administration of methoxamine corrected the hypotension, but the condition of the fetus deteriorated further, with increasing hypoxia, hypercarbia, and metabolic acidosis. (Shnider, S. M., and others: Vasopressors in Obstetrics, II. Fetal Hazards of Methoxamine Administration during Obstetric Spinal Anesthesia, Amer. J. Obstet. Gynec. 106: 680 (March) 1970.)

ABSTRACTER'S COMMENT: This report should be contrasted with the authors' earlier work, which showed that reversal of maternal hypotension with ephedrine also reverses the fetal deterioration.