Anaesthesia of conjoined twins — case series

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Abstract
As any complex surgical procedure, separation of conjoined twins requires complex anesthesia management that is a prerequisite of performing the operation, while complex postoperative care is a decisive factor in the survival of the patients. The paper describes the anaesthetic management for surgical operations in ten sets of conjoined twins in the Children’s Hospital of Cracow during 1977–2005. The anaesthetic technique and associated problems are summarized.

Key words: conjoined twins, general anaesthesia

In recent years, attempts to separate conjoined twins have been increasingly common worldwide. As any other complex surgical procedure, surgery of Siamese twins requires appropriate anaesthesia while highly specialist perioperative care determines the survival of children. Due to configuration of malformation, separation surgery has to be performed by the multi-disciplinary team of physicians: anaesthesiologists, general surgeons, cardiac surgeons, orthopaedic surgeons, urologists and specialists in reconstructive surgery (Figs 1, 2) [1–4].

Despite substantial advances in diagnostic procedures and therapeutic options offered by modern medicine, conjoined twins are extremely challenging for both surgeons and anaesthesiologists. Surgical procedures to separate them still carry an extremely high perioperative risk. Each case of conjoined twins causes specific difficulties during diagnosis and therapy and should be approached individually.

The aim of the study is to present problems associated with anaesthesia for separation surgery of conjoined twins. Between 1977 and 2005, nine pairs of conjoined twins were surgically separated in the Institute of Paediatrics, Collegium Medicum, Jagiellonian University in Cracow.

CASE REPORTS

The first pair of xipho-ompgalopagus conjoined twins (IA, B) treated in the Institute of Paediatrics (IP) in 1977 — full term female newborns, gravida 4, para 4, delivered by Caesarean section. The total birth weight of children was 4330g, the Apgar score — 2. The general condition of children after birth was severe and they required resuscitation. After provision of optimal conditions for transportation and preparations carried out by our anaesthesiologist, the girls were transported to the IP on day 2. On admission, the condition of child A was assessed as good; child B was characterised by poor viability and persistent dyspnoea. The conjunction of twins was 31 cm in circumference passing 1 cm below the mammary line and reaching the shared umbilical cord. The upper and lower limbs were normal. The babies were facing each other and tend to bend back their heads and chests; the above features were more pronounced in twin A. Radiologic findings revealed two separate hearts, lungs of normal contours, bone conjunction starting at the level of rib 4, proper contours of diaphragms, joined liver shadows. The intestinal loops symmetrically filled with gas suggested separate gastrointestinal tracts. On post-admission day 2, after intramuscular premedication with atropine and promethazine, angiography performed via umbilical venous access confirmed shared livers yet separate circulatory and urinary systems. During the second week of life, the condition of child B rapidly deteriorated due to developing pneumonia. Emergency separation surgery was decided. Anaesthesia was administered by two teams of anaesthesiologists. Atropine 0.15 i.v. mg was used for premedication. Inhalational induction of anaesthesia was conducted with the mixture of oxygen and nitrous oxide, 1:1 and halothane of incremental concentration using two
Figure 1. Different types of union in conjoined twins (symmetric forms)
anaesthesia machines. The endotracheal intubation of child A was performed after intramuscular administration of succinylcholine chloride 10 mg; a 3.5 ID endotracheal tube was used. Twin B was intubated without muscle relaxants. Anaesthesia was maintained with the mixture of oxygen with nitrous oxide and halothane in variable concentrations; fractionated doses of pancuronium bromide were administered. Prior to liver separation, systolic arterial pressure of twin B decreased to 40 mm Hg; bradycardia 90 min\(^{-1}\) followed by tachycardia to 180 min\(^{-1}\) were observed. Twin A was stable. After separation, twin B was transported to the adjacent operating theatre to complete the procedure. Her condition was extremely severe — arterial pressure was undetectable, bradycardia 49 min\(^{-1}\), rectal temperature 35°C. After intensive therapy and partial improvement of her condition, the surgical procedure was completed. On the second operating table, the skin integuments of child A were simultaneously reconstructed. During anaesthesia the child was stable. The anaesthesia time of twin A was 4 h and of twin B 3 h 45 min. After surgery, children were transported to the ICU. Due to respiratory failure, twin A required prolonged mechanical ventilation — 23 days; after the endotracheal tube removal, she was transferred to the general ward in good condition. Twin B died on postoperative day 2 due to cardiopulmonary failure.

The second pair of *xipho-omphalopagus* conjoined twins (II A, B) was treated in 1980; female newborns delivered by Caesarean section at the gestational week 39. The total birth weight was 4800 g; the Agar score 2 at one minute and also 2 at three minutes. They were admitted to our hospital on the second day of life in the condition assessed as relatively good. The conjunction started at the lower sternum and reached the level of umbilicus; upper and lower limbs were normally developed. Diagnostic radiological procedures disclosed the presence of two separate hearts, fused livers and distended gaseous intestinal loops. Angiography under general anaesthesia using ketamine performed through the umbilical vessels did not demonstrate distinct cross-circulation between twins. At week 4, child A developed pneumonia. The life of twin B was threatened and emergency separation surgery was decided. The total body weight on the surgery day was 4870 g. After preparation for anaesthesia and having discussed the successive stages of surgery, two separate teams of anaesthesiologists started the general anaesthesia.

Children were placed on the operating table equipped with water mattresses and general anaesthesia was initiated; no premedication was used. The range of intraoperative monitoring involved ECG, non-invasive measurements of arterial pressure, measurements of central venous pressure, temperature and diuresis. The oesophageal stethoscope was used to control directly the heart action and lung ventilation.

*Figure 2. Heteropagus twins (asymmetric forms)*
In both children, anaesthesia was induced with ketamine 8 mg kg\(^{-1}\) i.m.; muscle relaxation was provided 5 minutes later with succinylcholine bromide 1 mg kg\(^{-1}\). The endotracheal tube was inserted via the mouth in twin A and via the nose in twin B. Lung ventilation was started with the mixture of oxygen and nitrous oxide, in a ratio of 30% and 70%, respectively; muscle relaxation was maintained with pancuronium bromide in fractionated doses. For the first 1.5 h of surgery, anaesthesia was maintained with fractionated doses of ketamine. Later, halothane in various concentrations was added to the respiratory mixture. Twin B was haemodynamically stable; only during the separation of livers, her arterial pressure decreased from 85/50 to 60/35 mm Hg and central venous pressure to 5 cm H\(_2\)O; after transfusion of 400 mL of blood, the parameters returned to baseline values. After the 5.5-hour procedure, twin B was transferred to the Intensive care Unit and her condition was good. During anaesthesia in twin A affected by pneumonia, the values of haemodynamic parameters fluctuated. Due to persisting tachycardia 190 min\(^{-1}\) and low arterial pressure, the supply of halothane was withdrawn. During the separation of livers, child A developed massive haemorrhage; despite transfusions of blood and fluids, the haemorrhage caused a rapid decrease in arterial pressure and cardiac arrest. Resuscitation was started immediately and the volume of circulating blood was supplemented; the heart action was restored and systolic pressure was about 70 mm Hg. Since symptoms of circulatory failure persisted, dopamine was administered in continuous infusion. After 30 minutes, the baby suffered another cardiac arrest. Indirect heart massage and pharmacotherapy were initiated, the dose of dopamine was increased, and another blood unit was transfused. After transfusing 700 mL of blood and administering fractionated doses of calcium chloride, sodium bicarbonate and continuing the supply of dopamine, the heart action returned, with the heart rate above 100 min\(^{-1}\) and systolic pressure of 80–85 mm Hg. By the end of the procedure, after complete separation, oral intubation was changed into nasal and the baby was transferred to the ICU; her condition was extremely severe, circulation and respiration were inefficient; she was hypothermic with the rectal temperature of 34.8°C. Despite intensive therapy, her general condition was not stabilised and after several hours, still on postoperative day 1, the child died.

The third pair of omphalopagus conjoined twins (III A, B), pre-term male children, para 1, spontaneously delivered at the gestational week 36, was treated in 1986. Multiple pregnancy was not diagnosed earlier. The total birth weight was 3600 g. After birth, twin B, whose condition was extremely severe, required endotracheal intubation and ventilatory support. The extensive delivery trauma observed involved fractures of both femoral bones and the right humeral bone. The boy was substantially hypoxic due to prolonged delivery. The conjoined twins were admitted to the IP at the 5th hour of life. The condition of twin B was assessed as good, the boy was viable, pink; the condition of twin B was very severe with tendency to bradycardia; his skin was of pale bluish colour. The conjunction involved the hypogastrium. In twin A, the everted urinary bladder, rudimentary penis without urethral orifice, scrotum with detectable testes, imperforate anus, and a left talipes equinovarus deformity were found. In twin B, the conjunction bridge in the hypogastrium was partially covered with the amniotic sac. The following were observed: the hypoplastic penis without the urethra, lack of testes in the scrotum, lack of rectal orifice, the upper limbs with elbow and wrist flexion contractures, hypoplastic hands, the lower limbs with hip and knee flexion contractures, bilateral talipes equinovarus deformities. Considering the extremely severe condition of twin B, emergency separation was decided; prior to surgery, acid-base balance was corrected, X-rays of the entire bodies were taken, fresh blood and blood preparations were prepared.

Two anaesthesiologists and two anaesthesiological nurses administered anaesthesia. In twin A, anaesthesia was induced with ketamine; after muscle relaxation with succinylcholine chloride, the trachea was intubated through the nose with the 3.5 ID endotracheal tube without major difficulties. The boy was anaesthetized with fentanyl in an analgesic dose (100 µg kg\(^{-1}\) of fentanyl in three fractionated doses). Muscle relaxation was maintained with pancuronium bromide. Twin B was re-intubated introducing the endotracheal tube through the nose and the anaesthetic procedure was performed as in twin A. Before the procedure in the ICU, the arterial access by puncturing the radial artery and central venous access via cannulation of the right internal jugular vein were provided in the twin B; arterial pressure and central venous pressure were measured (the former using the invasive method). The same invasive monitoring was carried out in twin A. In both boys, intraoperative monitoring involved ECG, invasive measurements of arterial pressure and of central venous pressure, end-expiratory concentration of carbon dioxide, temperature of the oesophagus; oesophageal stethoscopes were inserted. To maintain homeostasis of conjoined twins, the temperature in the operating room was within 25–26°C, a warming water mattress was used and all fluids administered to children were warmed. Intraoperatively, the following were found: two stomachs and two duodenums, fusion of iliac colon at the level of the Meckel’s diverticulum, the large intestine terminating in the single urinary cavity. Since the condition of twin B was very severe, the small intestine was cut off from his side at the site of union; once the bridge joining the children was cut off, the child was transported to another room to continue the procedure. In twin A, the place, where the iliac colon was...
cut off, was sutured, the fusion of large intestine and urinary bladder was separated; the final segment of the intestine was sewn into the integuments as an anus. The urinary bladder was reconstructed using the suprapubic fistula.

During anaesthesia, twin A was stable and intraoperative bleeding was slight; no blood was transfused. At the end of surgery, temperature in the oesophagus decreased to 34°C, despite all the measures used for maintaining homeostasis. After the 3-hour anaesthesia, the boy was transferred to the ICU and his respiration was efficient. The condition of twin B during anaesthesia was changeable — large fluctuations in pressure and pulse with persisting metabolic acidosis (despite therapy), which required continuous infusion of dopamine 5 μg kg⁻¹ min⁻¹. Partial haemodynamic improvement was achieved yet metabolic acidosis persisted. In spite of continuous efforts to prevent heat losses from the extensive surgical wound, the oesophageal temperature by the end of surgery was 33°C. The anaesthetic procedure was about 2 h longer than that in twin A. Twin B was transferred to the ICU; his condition was very severe. Despite intensive therapy provided, symptoms of circulatory-respiratory failure increased and the child died at postoperative hour 15.

**The fourth pair of conjoined twins** (IV A, B), female children, gravida 2, para 2, delivered by Caesarean section, were treated in 1989. The total birth body weight was 4900 g. The Agar score was 6 after birth and 10 at five minutes. The children were transferred to our centre from another hospital. On admission, the following were observed: moderate central cyanosis and accelerated respiration, heart rate of 140 min⁻¹ with audible systolic murmur in the middle of conjunction. The first acid-base balance examination demonstrated moderate respiratory-metabolic acidosis.

The thoraco-omphalopagus conjunction involved the area between the lower part of sternum and the umbilical cord attachment. Twin B showed marked hyperlordosis of the thoracic spine with the body axis curved outward by almost 90° in relation to the division line, normal lower and upper limbs with additional thumb of the left hand. The external body structure of twin A was normal. Full-body radiographic picture revealed a single heart shadow, common liver shadow and gaseous intestinal loops. The contrast examination of the alimentary tract demonstrated two separate gastrointestinal tracts and the shared liver. Echocardiography of twin A disclosed a single atrium with two lower venae cavae, a single ventricle with an apex directed upwards, from which the wide aorta and narrower pulmonary artery originated; in twin B, the examination showed a single ventricle with the aorta branching off and no pulmonary artery. Respiratory failure was increasing and twin B was intubated on day 4; supportive ventilation was used. Twin A, whose general condition deteriorated, was intubated on day 13 and lung mechanical ventilation started. Despite the therapy applied, the general condition of children deteriorated. On day 27, following additional consultations with the American physicians visiting our hospital, who assessed the chances of success at several percent, and considering the explicit attitude of parents demanding surgery, the separation of children was attempted.

The features of circulatory-respiratory failure were increasing rapidly; therefore, preoperative preparations were very quick and confined to provision of blood and blood preparations. The total body weight of twins on surgery day was 5300 g. General anaesthesia was administered by the team of two anaesthesiologists and two anaesthesiological nurses. On admission to the operating suite, the condition of children was severe, lungs were ventilated with 100% oxygen due to persisting severe hypoxemia observed in gasometry. After placing on the operating table, twin A was attached to an ECG monitor and arterial blood pressure was measured non-invasively. Due to bad general condition of the child, technical problems and prompt surgical intervention required, twin B was only attached to an ECG monitor and a temperature sensor was inserted into the oesophagus. General anaesthesia was induced and maintained with fractionated doses of fentanyl, to the maximum dose of 100 μg kg⁻¹, and repeated doses of pancuronium bromide. The children were ventilated with 100% oxygen using the Rees circuits. Due to time limitations, central venous pressure was not measured. In twin A, the access to the right radial artery was provided by surgical exposure. During surgery a single pericardial sac, one-ventricle hearts with the common atrium joined within the ventricles were found. Intraoperative verification of heart anatomy excluded the possibility of separation. With the informed consent of parents, the decision was made to sacrifice one twin to save the other one. After cannulation of both aortas and shared atrium, extracorporeal circulation with cooling was initiated to achieve deep hypothermia of 19°C, when the circulation of both girls was arrested. In twin B, the outflow part of ventricle was removed, and the inflow part was used to close the heart of twin A. The common atrium was closed after removal of its part connected with the systemic vein of twin B. With the thoracoabdominal incision on the side of twin B the abdomen was opened, its organs inspected and integuments of twin B asymmetrically cut off, leaving the excess tissue on the side of twin A. After re-cannulation of twin A, the extracorporeal circulation with warming was started. Twin B died 130 minutes after the onset of general anaesthesia.

Forty minutes after the onset of warming of twin A, heart rate of 160 min⁻¹ and mean arterial pressure of 60 mm Hg were restored. The time of anaesthesia from its beginning to completion of the cardio-surgical part with the closure of thorax was 4 h and 35 min. During the second stage of surgery
last ing 2 h 20 min, the abdominal cavity of twin A was closed with the tissues obtained thanks to asymmetrical division of integuments. Moderate losses of blood required transfusion of 500 mL of blood and 100 mL of plasma. Throughout the second stage of surgery, marked pulse fluctuations between 160–80 min⁻¹ and decreases in arterial pressure were observed. The continuous infusion was dopamine was started in the initial dose of 5 μg kg⁻¹, subsequently increased to 7.5 μg kg⁻¹. Despite increased temperature of the operating room (25–26°C), use of a warming mattress and pre-warming of intravenous fluids, the twin’s temperature decreased to 34.5°C. After surgery and transfer to the ICU, the condition of twin A was extremely severe with intensified symptoms of circulatory-respiratory failure. Despite the intensive therapy applied, the child died 12 hours later.

The fifth pair of conjoined twins (V A, B), girls, gravida 3, para 2, delivered by Caesarean section, total birth body weight of 4350 g, were treated in 1990. The Apgar score of twin A at one minute was 8 and at fifth minutes 9. The Apgar score of twin B at one minute was 4, the child was less viable. After aspiration and the use of artificial breathing with a self-inflating bag, the condition of twin B improved. Biejnerginal pregnancy was diagnosed early and prior to delivery mother was transported from north of Poland to the Department of Gynaecology and Obstetrics, Collegium Medicum Jagiellonian University to ensure maximum safety of children. This also enabled to start the preparations for separation surgery. The Caesarean section was performed in the presence of the team of physicians and nurses (paediatric surgeon and anaesthesiologist from our hospital). Once stabilised, children were transported to the Institute of Paediatrics. On admission, twin A was more viable and crying loud. Twin B, less viable and not crying, was auscultated and inflammatory changes were found above the lung fields. The xiph-o-mphalo-ischio-pagus tribus conjunction, started 3 cm below the mammary, involving the abdominal cavity and sciatic region and reached the perineal level; slightly rotated so the twins were not facing each other. The separate heads and united thoracic cavities formed the letter Y. The girls had a common umbilicus, common female genital organs, the rectal-axillary fistula, three lower limbs, one deformed developed from two primordia of the opposite limbs. This limb was partially mobile in the hip, the knee was rigid and the foot deformed with 7 toes. The first echocardiography did not demonstrate the conjunction of hearts; moreover, persistent ductus arteriosus (PDA) was found in twin A whereas atrial septal defect (ASD) was suspected in twin B. The secretion of meconium through the fistula was insufficient and on day 2 the decision was made to expose the artificial anus. Scintigraphy of the liver and biliary tract showed a large conjunction of livers, two separate gall bladders and biliary tracts. Catheterisation of the heart under general anaesthesia, the same as the one described below for colostomy, confirmed the presence of two hearts with normal big vessels. Scintigraphy of kidneys demonstrated the presence of three kidneys with three pyelocaliceal systems connected with one urinary bladder. General anaesthesia was performed by two anaesthesiologists and two experienced anaesthesiological nurses. Two independently powered anaesthesia machines were prepared. Children were not premedicated. Since information about the size of cross-circulation was lacking, inhalational induction was applied. Standard monitoring involved ECG, SpO₂, non-invasive measurement of arterial pressure; the oesophageal stethoscope was inserted. Inhalational induction with the mixture of oxygen and nitrous oxide, 30%: 70%, respectively and incremental doses of halothane were started in twin A; simultaneously, twin B was oxygenated. Bain breathing circuits were used. Accesses to peripheral vessels had already been provided in the ICU. After obtaining suitable depth of anaesthesia, suximecholine chloride, i.v. was administered to twin A and with the child slightly elevated endotracheal intubation with the 3.0 I.U endotracheal tube inserted via the mouth was performed. twin B was intubated in the same way. In both girls, pipercuronium bromide 0.2 mg i.v. was administered for relaxation of striated muscles. The anaesthetic procedure was without haemodynamic disturbances, SaO₂ fluctuated between 95% and 97%. During the procedure, i.v. supply of fluids was continued according to hourly requirements. After the procedure, the neuromuscular block was reversed by administering atropine 0.15mg and neostigmine bromide 0.1 mg to each child. The breathing was efficient and the endotracheal tubes were removed. During the formation of artificial anus, the intestines were found to be connected at the level of iliac intestine with joined the common large intestine ended enabling proper development of twins. To have the sufficient amount of skin to cover the defect after separation, it was decided to postpone the separation — until they are several months old. Considering possible sudden deterioration of one of twins and emergency separation needed, the detailed “emergency” anaesthesiological and surgical management plan was prepared. The preparation period was devoted to widened diagnostic procedures and to care enabling proper development of twins. To have the sufficient amount of skin to cover the defect after separation, it was planned to implant expanders about 2.5 months prior to separation. The volume of abdominal cavity was increased by controlled pneumoperitoneum using a special system of valves with the cannula implanted to the abdominal
The total body weight of children on the surgery day was 13800 g. Anaesthesia for separation surgery was administered by two two-man teams of experienced anaesthesiologists and anaesthesiological nurses. Forty minutes prior to the onset of anaesthesia, each twin was premedicated intramuscularly with atropine 0.15 mg, morphine 1.0 mg, and midazolam 1.0 mg. Two separate anaesthesia machines with Bain circuits were used for induction of anaesthesia. Standard monitoring was initiated: ECG, \(\text{SpO}_2\), non-invasive measurement of pressure. After oxygenation, intravenous induction of anaesthesia was provided administering ketamine 10 mg, midazolam 2 mg, fentanyl 150 \(\mu\)g and suxamethonium chloride 10 mg to each child. Subsequently, twin A was slightly elevated and ventilated through the mask while twin B was intubated through the mouth using the 4.0ID endotracheal tube. Twin A was intubated in the analogical way. Remembering problems with maintaining proper body temperature of conjoined twins during long anaesthesia, for intraoperative ventilation the author decided to use two separate ventilators enabling warming of the respiratory mixture. The temperature in the operating room was maintained above 25°C. Anaesthesia was maintained with fractionated doses of fentanyl and midazolam. Striated muscles were relaxed with fractionated doses of pancuronium bromide. Diuresis was monitored via the sterile Foley catheters inserted in both orifices of urethras located in the shared vagina. The core temperature was monitored by placing one thermometer in the oesophagus (together with the oesophageal stethoscope) and another one in the rectum. Accesses to internal jugular veins were placed surgically, which enabled quick supplementation of anticipated high losses of blood and CVP monitoring. Radial arteries were surgically exposed enabling direct measurements of arterial pressure. To avoid any mistakes associated with changes of positions on the operating table (the surgical plan assumed two changes), all the lines and wires monitoring twin A were marked red while those of twin B blue. In child A, the baseline heart rate was 130 min\(^{-1}\) and arterial pressure 90 mm Hg; after induction of anaesthesia and provision of arterial access, 118 min\(^{-1}\) and 90/50 mm Hg, respectively, CVP was 8 cm H\(_2\)O, \(\text{SpO}_2\) 100%. At anaesthesia hour 5, the pulse rapidly increased to 160 min\(^{-1}\), arterial pressure decreased 80/50 mm Hg, and CVP decreased to 2 cm H\(_2\)O. After quick transfusion of fluids, haemodynamic parameters were normalized. Slight, periodic increases in arterial pressure and heart rate returned to normal values following the administration of additional doses of fentanyl. In twin B, the baseline heart rate was 110 min\(^{-1}\) and arterial pressure 100/60 mm Hg. After induction of anaesthesia and provision of arterial access, the parameters were as follows: arterial pressure 100/50 mm Hg, CVP 9 cm H\(_2\)O, \(\text{SaO}_2\) 100%. During surgery, prior to liver separation, the haemodynamic condition was stable. Fearing extensive bleeding during the separation of massive liver conjunction, at hour 13 the arterial pressure of both twins was reduced using the continuous infusion of sodium nitroprusside; systolic arterial pressure was reduced to 75–80 mm Hg and the diastolic to 50–40 mm Hg. After separation of livers and surgical control of bleeding, sodium nitroprusside was discontinued. After 16 hours of anaesthesia, when twins were separated, twin B was transferred to the adjacent operating room to complete the surgical procedure. Further anaesthesia of both twins was uneventful, no temperature decreases were observed. Estimation of blood losses from the large operative field was difficult. The supply of blood and fluids was evaluated on the basis of the amount and weight of sponges and drapes used and the volume of blood sucked from the operative field; haematocrit, haemoglobin and diuresis were controlled at constant intervals. Moreover, ionogram, acid-base balance, total protein and glucose concentration in blood were controlled throughout the anaesthetic procedure at constant intervals (about every hour). Despite the use of controlled hypotension during the separation of livers, the blood loss was extremely high. Twin A received more than 4 litres of blood, which by our estimates constituted more than 6.5-fold volume of circulating blood; twin B received almost 3.3 litres, i.e. 5.5-fold volume of circulating blood. During the several-hour procedure, Ht and Hb slightly changed compared to baseline values. The transfusion of blood conserved with citrates required continuous supplementation of calcium ions. Ventilation was carried out in such a way that pCO\(_2\) did not decrease below 34 mm Hg at good oxygenation of arterial blood. The anaesthesia time of twin A was 18 h 30 min while of twin B — 19 h and 50 min. After that time, children receiving the infusion of fentanyl and pancuronium were re-intubated through the nose and wheeled to the ICU. The postoperative period of twin A was unstable with periodic decreases in arterial pressure (caused by bleeding from the surgical wound and the drain left in the abdominal cavity) and ion disorders abnormalities disturbances. Several days later, partial wound dehiscence occurred. Surgical repair of the wound required several anaesthetic procedures in the ICU.
On postoperative day 10, the girl with efficient respiration was extubated; however, 24 h later the child required reintubation due to increasing symptoms of respiratory failure. During further therapy, the surgical wound infection developed through the large intestine fistula (although dressings were changed every day) and multiple organ failure was observed. On day 27 after separation, the child died. The postoperative course in twin B was stormy. On day 7 after separation, the girl was extubated. The wound dehiscence was healed with the biological dressing made of amniotic membranes and during the final stage — with skin grafts. After two months of treatment in the ICU the child in good condition was transferred to the rehabilitation ward.

The sixth conjoined twin, treated in 1992, was a male child with duplicatio caudalis, gravida 1, para 1, delivered by Caesarean section. The Agar score was 1. The child was transported to the Institute on the second day of life due to developmental defects within the epigastrium. Diagnostic procedures demonstrated duplication of the lumbar spine from L1, sacral schisis, wide pyeloschisis, urinary bladder eversion and lack of pelvic diaphragm.

With full approval and informed consent of parents, the multi-stage plan of surgical treatment was prepared. During the first stage, the scrotal fistula was widened and lack of anal sphincters in the region of fistula was confirmed. During the next stage, the everted urinary bladder was removed and a new urinary container was created from the intestine; the final artificial rectum was fixed and the pelvic fundus was formed from the Dacron graft material. The anaesthetic procedures for all stages of surgical treatment were inhalational with halothane and did not differ from other such procedures in children of this age. After each anaesthetic procedure, the child was extubated already in the operating room.

The seventh pair of conjoined twins (VII A, B), treated in 1994, male newborns, gravida 5, para 3, full-term, delivered by Caesarean section. The Agar score at one minute was 8. On the third day of life, once the parents` informed consent was obtained, twins were prepared and underwent separation surgery. Preoperative preparation in the ICU involved catheter insertion for arterial pressure measurements and provision of peripheral vascular access in the bigger child. Monitoring in the operating room included ECG, SpO₂, invasive measurement of arterial pressure, control of diuresis, measurement of oesophageal temperature. After oxygenation of the bigger twin using a face mask, fentanyl 25 μg and pancuronium bromide 0.3mg were administered intravenously; ventilation was carried out through a tight face mask. The trachea was intubated with the 3.0ID tube inserted through the nose; the gastric tube and oesophageal stethoscope were inserted. Substitutive ventilation was performed with the mixture containing 40% of oxygen. The catheter for CVP measurements was placed in the right internal jugular vein. Initially, the child’s condition was stable. Anaesthesia was maintained with fractionated doses of fentanyl to a total dose of 100μg kg⁻¹. Striated muscles were relaxed with pancuronium bromide whose doses depended on demands. An abrupt haemorrhage, which developed during separation of the parasitic twin, resulted in haemodynamic instability. Heart rate increased to 170 min⁻¹, arterial pressure decreased to 50/20 mm Hg, and CVP to 1 cm H₂O. Red blood cell concentrate (RBCC) and fresh frozen plasma were transfused; fractionated doses of calcium gluconate and sodium bicarbonate were administered. Once the parasite was completely separated and the bleeding vessels were surgically secured, arterial blood pressure returned to 70/40 mm Hg. After the administration of dopamine, 5 μg kg⁻¹, pressure increased to 100/60 mm Hg. In total, 400ml of RBCC and 80 ml of electrolyte solution were transfused. No reduction in body temperature was observed. After the 4-hour anaesthesia, the child was transferred to the ICU in good general condition. In postoperative day 4, twin A was extubated. The postoperative course was uneventful.

continued to the nape and back. The pulsation was detectable high on the neck. The right upper limb was hypoplastic with the deformed wrist, lack of the thumb and the remaining fingers fused. The left upper limb was in the form of a small process. The lower body part was missing, below the level of conjunction — the funnel-shaped growth containing bony structures. Twin B (parasite) was found to have no active movements of hypoplastic limbs, no facial expressions even after pain stimuli, no respiratory movements of the thorax. The umbilical stump protruded from the abdominal integuments of the bigger twin. Echocardiography of that twin did not demonstrate any heart defects; in the parasite twin, the picture was ambiguous. Echocardiographic findings revealed the common atrium, ventricular septal defect, single arterial vessels and lack of pulmonary artery.

On the third day of life, once the parents’ informed consent was obtained, twins were prepared and underwent separation surgery. Preoperative preparation in the ICU involved catheter insertion for arterial pressure measurements and provision of peripheral vascular access in the bigger child. Monitoring in the operating room included ECG, SpO₂, invasive measurement of arterial pressure, control of diuresis, measurement of oesophageal temperature. After oxygenation of the bigger twin using a face mask, fentanyl 25 μg and pancuronium bromide 0.3mg were administered intravenously; ventilation was carried out through a tight face mask. The trachea was intubated with the 3.0ID tube inserted through the nose; the gastric tube and oesophageal stethoscope were inserted. Substitutive ventilation was performed with the mixture containing 40% of oxygen. The catheter for CVP measurements was placed in the right internal jugular vein. Initially, the child’s condition was stable. Anaesthesia was maintained with fractionated doses of fentanyl to a total dose of 100μg kg⁻¹. Striated muscles were relaxed with pancuronium bromide whose doses depended on demands. An abrupt haemorrhage, which developed during separation of the parasitic twin, resulted in haemodynamic instability. Heart rate increased to 170 min⁻¹, arterial pressure decreased to 50/20 mm Hg, and CVP to 1 cm H₂O. Red blood cell concentrate (RBCC) and fresh frozen plasma were transfused; fractionated doses of calcium gluconate and sodium bicarbonate were administered. Once the parasite was completely separated and the bleeding vessels were surgically secured, arterial blood pressure returned to 70/40 mm Hg. After the administration of dopamine, 5 μg kg⁻¹, pressure increased to 100/60 mm Hg. In total, 400ml of RBCC and 80 ml of electrolyte solution were transfused. No reduction in body temperature was observed. After the 4-hour anaesthesia, the child was transferred to the ICU in good general condition. In postoperative day 4, twin A was extubated. The postoperative course was uneventful.
The eighth pair of thoraco-omphalopagus conjoined twins (VIII A, B) was treated in 1999; male newborns, gravida 3, para 3, delivered at the gestational week 35; birth weight of both twins — 4900 g. Elective Caesarean section — in the presence the team of physicians and nurses of our hospital. The Apgar score of twin A — 10 and of twin B — 7. Conjoined twinning was diagnosed in the prenatal examination and the decision was made to transport mother from the district hospital to the Institute of Gynaecology and Obstetrics, CMJU in Cracow. Due to persisting respiratory disorders after birth, twin B was intubated through the mouth using the 3.0 ID tube. Once the condition of twins stabilized, they were transferred to the IP in a transport incubator. During transportation the lungs of twin B were artificially ventilated (F\textsubscript{1}O\textsubscript{2}, 0.3). On admission to the ICU, the condition of twins was good, body temperature was normal and no features of circulatory-respiratory failure were observed; twin B was extubated.

The thoraco-omphalopagus conjunction — 20 cm in circumference; children were fused with parts of thoracic cavities and upper parts of abdomens to the level of the umbilical cord containing double umbilical vessels. Heads, necks, upper thoraxes, upper limbs, hypogastrium and lower limbs were normal. The head of twin B was bent back about 30°. Twins had male urogenital organs, testes in the scrotal sac, two anuses normally located and patent. Initial echocardiographic findings demonstrated two hearts in a shared pericardial sac, highly unlikely fusion of both hearts. In twin B, the inferior vena cava, hepatic veins, superior vena cava on the right side were found normal. The interatrial septum was not accurately visualized and the anatomy of atria was not defined; pulmonary veins drained into the atrium. Two atrioventricular valves and grade I tricuspid incompetence were found; the tricuspid valve was continuous with the right ventricle (on the right) from which the pulmonary artery originated with visible left and right pulmonary arteries. There was no arterial duct. The mitral valve was connected with the left ventricle (left-sided) from which the aorta with a normal valve exited; the left-side aortic arch was present. Ventricles were well developed without interventricular septal defect. In twin A, apart from the shared pericardial sac and grade I/II tricuspid incompetence described earlier, no abnormalities were found. Abdominal ultrasound demonstrated fused livers, later confirmed by scintigraphy, and the presence of two separate systems of external biliary ducts. Contrast examination of gastrointestinal tracts revealed two separate systems. The urinary systems were found normal. Based on the results of diagnostic examinations and our experience acquired during treatment of previous pairs of conjoined twins, the decision was made to postpone the separation surgery. A meticulous plan of management was prepared in case emergency surgery was needed. Considering the extent of conjunction, to obtain “the additional skin”, expanders were implanted at month 7. On the surgery day, the general condition of twins was assessed as good, their total body weight was 10,500 g. Twins were placed on the operating table equipped with a mattress and standard non-invasive monitoring was connected: ECG, SpO\textsubscript{2}, measurement of arterial pressure and measurement of rectal temperature. Children were not premedicated. Two anaesthesia machines with Bain circuits were used. While twin B was receiving oxygen through the mask, twin A underwent inhalational induction of anaesthesia using the mixture of oxygen and nitrous oxide in a 30%:70% ratio, respectively and sevoflurane in incremental doses. When the proper depth of anaesthesia was obtained, the intubation dose of rocuronium bromide was administered; twin B was elevated and twin A intubated with the 4.5ID tube. The endotracheal tube was fixed and the same manoeuvres were repeated in twin B, who was awake during the induction of anaesthesia in twin A. During the further stage of anaesthesia, fentanyl was administered in the total dose of 6\(\mu\)g kg\(^{-1}\) and doses of rocuronium bromide were repeated several times. To prevent heat losses, the entire surface of the twins’ bodies, except for the back and anterior surfaces of thoraxes, were wrapped in plastic foil. All measurement and infusion lines in twin A were marked red and those in twin B — blue. Anaesthesia for implantation of expanders was uneventful. After placing and partial filling of expanders, pulse and blood pressure in twin A increased to 140–165 min\(^{-1}\) and 80/50–110/58 mm Hg, respectively and in twin B to 130–160 min\(^{-1}\) and 90/60–110/70 mm Hg, respectively. After 10 \(\mu\)g of fentanyl, the parameters returned to baseline values. Accurate haemostasis and endoscopic control of the expander site showed that there was no blood loss. During the 5 h 45 min. procedure, 800 mL of crystalloids and 105 mL of 5% albumin were transfused. After surgery, twins were extubated and wheeled to the ICU; their general condition was good, circulation and respiration — efficient. The postoperative period was without complications. At post-implantation week 3, twin B developed wound dehiscence above one of the expanders, which had to be secured in the operating suite. General anaesthesia was similar to that during implantation. After the 45-minute anaesthetic procedure, twins were awoken and transferred to the ICU. In the successive days the condition of twins deteriorated; symptoms of bronchitis and pneumonia were observed with periodic decreases in saturation, especially during anxiety. Despite the therapy used, increasing respiratory failure was successively developing, particularly in twin B. At night, both twins rapidly deteriorated. It was decided to intubate them and support breathing. During endotracheal intubation in twin B, whose condition was worse, twin A developed quickly increasing symptoms of hypoxia and bradycardia.
After intubation twin A required resuscitation. Following indirect heart massage as well as intravenous adrenaline and sodium bicarbonate, efficient heart action was restored and the general condition of the patient improved. During resuscitation of twin A, the condition of twin B was stable. To correct acid-base imbalance, cannulae were inserted into internal jugular veins to monitor CVP and radial arteries were injected for direct measurements of arterial pressure in both twins. Due to growing circulatory insufficiency (despite the treatment used) and symptoms of hypoxia in the central nervous system observed in twin A, having discussed the case, the team involved decided to perform separation earlier. The total body weight of twins on the surgery day was 12000 g. Anaesthesia was carried out by two anaesthetic teams. Twins were re-intubated through the nose in the ICU and transported to the operating theatre where the following was monitored — ECG, SpO₂, invasive monitoring of arterial pressure, and CVP; a rectal temperature sensor and oesophageal stethoscopes were inserted. To prevent losses of heat, children were placed on a warming mattress pad and their bodies wrapped in plastic foils, except for parts within the operative field. Intravenous fluids were pre-warmed. All measurement and infusion lines were marked with different colours for each twin. The analgesic anaesthesia was administered using high doses of fentanyl (100 µg kg⁻¹) and pipecuronium bromide as a muscle relaxant. Doses were repeated when the monitor of neuromuscular block showed about 50% of neuromuscular conduction return. The choice of this relaxant resulted from tachycardia to 140–145 min⁻¹, which persisted in twins prior to anaesthesia. Lung ventilation was carried out using Servo 900C ventilators with 45% oxygen concentration. After 3h and 25 min., during the 45-minute liver separation, haemorrhaging increased. Despite the transfusion of blood before liver separation and a slight “extra amount” used compared to the estimated blood loss, arterial pressure dropped to 90/60 mm Hg and CVP to do 2–3 cm H₂O while heart rate increased to 160 min⁻¹. Transfusion of additional volume of blood and plasma within several minutes restored the baseline values of haemodynamic parameters. During the entire separation procedure, twin B received 660 mL of RBCC, 700 mL of fresh frozen plasma, 450 mL of crystalloids, 100 mL of 5% albumin and 120 mL of platelets.

After liver separation, further anaesthesia was uneventful. No body temperature decreases were noted. After the 5-hour general anaesthesia, twins were separated. Twin B was transported to the adjacent operating room. After another 2 h and 30 min of general anaesthesia, the procedure was completed closing the defect of integuments. Twin B with stable circulatory parameters — arterial pressure 120/70 mm Hg, pulse 120 min⁻¹, rectal temperature 37.8°C and administered controlled ventilation was wheeled to the ICU.

The course of anaesthesia in twin A was changeable with fluctuations in pulse and arterial blood pressure. Although dopamine infusion was continued and fluid loss controlled, at CVP 15–19 cm H₂O, there was a tendency to tachycardia 130–160 min⁻¹, low arterial pressure 90/60 mm Hg — 80/60 mm Hg and reduced body temperature to 35.0°C. After additional use of external radiators, the child’s temperature returned to normal. During the entire separation surgery, twin A received 660 mL of RBCC, 690 mL of fresh frozen plasma, 500 mL f crystalloids and 100 mL 5% of albumin. Once the defect of integuments was closed, 20 minutes earlier than in twin B, twin A was wheeled to the ICU. During the early postoperative period, twin A had symptoms of circulatory failure with tachycardia 150–160 min⁻¹ and low arterial blood pressure 70/50 mm Hg. Despite the intensive therapy used, the child died on postoperative day 15.

The ninth pair of conjoined twins (IX A, B) was treated in 2002; female twins, grāvida 3, para 3 delivered by Caesarean section at the gestational week 38. The total birth weight of twins was 2780 g. The Agar score at one minute — 2, at three minutes — 6 and at five minutes — 8. Twins were transported to our Institute on the first day of life in severe condition. The trachea of conjoined twins was intubated.

The gemini asymetrici (fetus parasiticus) conjunction. In twin A (bigger), the cranium was asymmetrical; three low-placed auricles on the left side of head, one auricle on the right side; twin B (parasite) conjoined with twin A at the level of the upper anterior thoracic surface. Upper limbs of the parasite — right next to the thorax of twin A; lower dorsum and buttocks with the normally placed rectum visible below. Twin B had genitourinary organs and to lower limbs. Peripheral perfusion was maintained, pulse was detectable on the dorsal arteries of feet. In twin A, the skin was pale, warm, pulse well detectable on brachial and femoral arteries; on auscultation — acute vesicular murmur above the lung fields, heart sounds — best audible in the upper thorax. Moreover, umbilical hernia was found in the intact hernial sac with intestinal loops showing through.

Laboratory tests performed on ICU admission demonstrated marked acid-base balance abnormalities (respiratory alkalosis) and low SpO₂ — 45%. Continuous infusion of prostaglandin E₁ was started, parameters improved and saturation increased to 77%. Diagnostic procedures of the anomaly were initiated — echocardiography and ultrasound of the head.

The complex heart defect required haemodynamic tests and angiography under general anaesthesia. The anaesthetic procedure was uneventful. Catheterization of the heart confirmed the presence of two hearts fused at the level of atria and partially at the level of ventricle (subaortal part),
the heart with two ventricles. Only the aorta with coarctation exited from the right-sided heart, partially collecting blood also from the left-sided heart, the pulmonary artery originated from the left-sided heart, branched into three pulmonary arteries and joined the descending aorta by the wide arterial duct. Cross-circulation was predominantly observed at the level of atria, to a slight degree — at the interventricular defect level as well. This rare heart defect functioned as transposition of great arterial trunks. One day after angiography twin A deteriorated and circulatory failure increased. Separation surgery was decided. Standard monitoring was used during general anaesthesia: ECG, SpO2, invasive measurement of arterial pressure, diuresis and oesophageal temperature. Anaesthesia was performed with fentanyl 100 μg kg\(^{-1}\) administered in three fractions, muscles were relaxed with pipercuronium bromide; a Servo 900C ventilator with 85% oxygen concentration in the breathing mixture was used. The course of anaesthesia was changeable — periodic tachycardia to 180 min\(^{-1}\) and pressure decreases, SpO2 — within the range of 80—87%. During the final stage of separation of the lower part of twin B (parasite), once the peritoneal cavity of twin A was opened and decompressed, CVP suddenly decreased to 4 cm H\(_2\)O and arterial pressure to 30/15 mm Hg. The volume was quickly supplemented and the general condition gradually normalised — arterial pressure 80/40 mm Hg and CVP 13–14 cm H\(_2\)O. Acid-base balance, ionograms and blood glucose levels were determined every 45–60 minutes. During the further stage of anaesthesia, pulse decreases were observed, three times below 100 min\(^{-1}\), arterial pressure ranged from 60/40 to 70/45 mm Hg, while CVP from 12 to 16 cm H\(_2\)O and SpO2 — 82–83 %. Despite the extensive surgical wound, the use of pre-warmed respiratory mixture and a warming mattress prevented heat losses in twin A. There were no body temperature decreases throughout the anaesthetic procedure. Anaesthesia lasted 4 h 15 min, separation surgery — 3 h. In total, 220 mL of RBCC, 100 mL of fresh frozen plasma, 350 mL of electrolyte solution were transfused. The child, still intubated through the nose with the 3.5ID tube, returned to the ICU and required continuous supply of dopamine. At the ICU, normal haematocrit, haemoglobin, ionogram and acid-base balance confirmed proper evaluation of circulating blood loss and its appropriate correction. The only abnormalities found included reduced platelet count and low serum levels of protein. On postoperative day 1, disorders of diuresis and circulatory failure developed. Despite the intensive therapy applied, twin A died on postoperative day 2.

The tenth pair of conjoined twins (X A, B) was treated at the end of 2004 and the beginning of 2005; female babies, gravida 1, para 1, delivered by Caesarean section at the gestational week 30. The total birth weight of twins was 2200 g. Children were transported to our hospital intubated, their condition was severe and respiration inefficient. The thoraco-omphalopagus conjunction involved the thoraces from the level slightly below the mammae to the iliac alae reaching the attachment of shared umbilical cord. Children presented features of prematurity; their heads, necks, upper thorax, upper limbs, hypogastrium and lower limbs were normal. Female genitourinary organs, two anuses normally located and patent were found. Supportive ventilation was applied. Radiological findings revealed two separate hearts, lungs of proper contour, bone fusion from the level of rib IV, normal contours of diaphragms, fused shadows of livers, symmetrically filled intestinal loops suggestive of separate gastrointestinal tracts. Blood cultures were positive for Staphylococcus epidermidis; airway secretion contained Ureaplasma urealyticum. Targeted antibiotic therapy was instituted. On successive days, the condition of children improved.

Cardiac ECHO of twin A demonstrated the congenital heart defect: the double-orifice right ventricle with limited inflow of blood to the pulmonary artery (duct-dependent pulmonary circulation). Alprostadil was included.

At month 2, ophthalmic tests disclosed retinopathy of prematurity (ROP), treated with cryoapplication in the ICU under analgesia with potent analgesics. Lungs of children were still mechanically ventilated. No complications developed in the postoperative period; the ophthalmic follow-up demonstrated good outcome of treatment.

In November 2004, angiography was performed under general anaesthesia; two days later, the Blalock-Taussig shunt was carried out; the left subclavian artery and left pulmonary artery of twin A were connected using a Goretex tube. The body weight of children on angiography day was 4 kg. Anaesthesia for angiography was administered by two anaesthesiological teams. Girls were not premedicated, intravenous induction was performed. Each child received midazolam 5 mg, fentanyl 10 μg and rocuronium bromide 2 mg. Children were intubated through the nose. During intubation of the first conjoined twin, lungs of the other were ventilated via the mask with the mixture of oxygen and air (1:1). During the 3-hour angiography, children were ventilated with the mixture of air and oxygen (40%) and sevoflurane; fractionated doses of fentanyl and rocuronium were used to the total dose of 40 μg kg\(^{-1}\) and 6 mg, respectively. The course of anaesthesia was uneventful; in the twin with heart defect SpO2 was 74–77%, arterial pressure 80/40 — 90/50 mm Hg, heart rate 130–140 min\(^{-1}\). Children were not awoken and were transported to the ICU intubated, planning to perform the Blalock-Taussig shunt in two days time. In the ICU, the central venous access was provided and direct arterial pressure measurements could be taken. General anaesthesia for the shunt was administered by 3 anaesthesiologists and 3 nurses. All measurement and
infusion lines were coded with different colours to avoid mistakes. Children underwent inhalational anaesthesia with sevoflurane with 40% content of oxygen in the respiratory mixture; the following agents were administered: fractionated doses of fentanyl to the total dose of 50 μg, pancuronium bromide down titrated — 0.5 mg followed by 0.3 mg, to the total dose of 1.6 mg. The condition of twins was stable during the surgical procedure; SpO₂ — 86–91%, heart rate 120–170 min⁻¹, arterial pressure 90/40 do 110/65 mm Hg, and CVP 3 — 6 cm H₂O. The total time of anaesthesia was 3h 45 minutes; after anaesthesia, girls were in good condition and returned to the ICU.

During hospitalization, girls were repeatedly treated for infections and sepsis caused by various pathogens (Staphylococcus epidermidis, Staphylococcus aureus, Staphylococcus hominis, Klebsiella pneumoniae, Enterococcus faecalis, Pseudomonas aeruginosa). In April 2005, preparations for final separation surgery were started. Under general anaesthesia, Broviac central intravenous accesses were provided and expanders implanted to obtain the additional skin. The anaesthetic procedure administered was similar to that in cardiac surgeries. Unfortunately, the postoperative period was complicated with sepsis and multiple organ failure; after 16 months of intensive therapy, both girls died.

DISCUSSION

The paper present case reports of 9 pairs of conjoined twins and one child with duplication caudalis, who were treated in the IP in the years 1977–2005 underwent separation surgeries. The treatment was partially successful — one child from each pair survived, except for pair IV, in which both girls died shortly after separation surgery. Surgical treatment of pair X was not successful due to septic complications. As far as two asymmetric pairs are concerned, one child of each pair survived, except for pair IV, in which both children died shortly after separation surgery. Surgical treatment of pair X was not successful due to septic complications. As far as two asymmetric pairs are concerned, one child of each pair survived, and the other one died on postoperative day 2.

The major problems during general anaesthesia and surgery are the maintenance of patent airway, lung ventilation, optimal positioning of patients on the operating table, extremely high blood losses, long duration of surgery, and involvement of many members of medical personnel.

Conjoined twins can develop a possible life-threatening condition immediately after delivery; therefore, during diagnostic and pre-separation procedures, possible emergency surgical interventions should always be considered [4–7] and emergency plans prepared. Our Institute decided to provide 24-hour duties of teams of surgeons and anaesthesiologists. Many authors stress the fact that in thoraco-omphalopagus conjoined twins, their heads facing each other hinder the maintenance of patent airway while inducing general anaesthesia with a face mask; moreover, it hinders the larynx exposure during intubation. The rotation of heads from the lateral to almost sagittal position to facilitate intubation can in turn distort the upper airway [3, 8–10]. In all the children treated by us, thanks to proper positioning, i.e. elevation of one twin during intubation of the other one, no serious intubation-related problems were observed. After intubation, it is essential to secure the endotracheal tube. Frequent changes in positions of children necessary during surgery can result in tube displacement or unintentional removal, which is an intraoperative threat to children’s life [9, 11]. Based on my experiences, the best method to prevent displacement of the tube or extubation is to intubate through the nose (Fig. 3).

A serious problem during separation surgery of conjoined twins is hypothermia caused by an extensive surgical wound increasing heat losses and long duration of surgery. The measures applied by us to protect children did not ensure full control. The use of pre-warmed respiratory mixture proved very beneficial to maintain normothermia [2, 3, 5, 6].

The main objective of diagnostic procedures is to determine the anatomy of conjunction. Thanks to the newest techniques of scintigraphy, computed tomography and magnetic resonance, the anatomy of conjunction can be thoroughly assessed, which helps to make therapeutic decisions [12–15]. In our material, such diagnostic procedures were not always possible and some anatomical details of fused organs were learnt intraoperatively.

The lack of prenatal information about conjoined twinning and spontaneous deliveries always cause perinatal trauma in at least one twin; surgery and anaesthesia in such cases are performed with limited diagnostic details, which together with the critical condition of one child markedly worsens prognosis.

In conjoined twins with fuse thoraxes, abdomens or heads, there is a risk of connecting the circulatory systems of both children that can be crucial during induction of general anaesthesia, particularly intravenous [5–7].

Meticulous planning and multiple discussions of all the specialists involved regarding surgical management based on full diagnostic findings are essential not only for the surgical team. In the material presented, the plan of anaesthetic management of conjoined twins was based on current information modified according to further diagnostic test results.

The anaesthetic management plan included premedication, types of drugs used for induction and maintenance of anaesthesia, range and way of monitoring vital signs, and sequence of anaesthetic procedures in twins. Our findings reveal that new drugs and anaesthetic methods proved effective in anaesthesia of conjoined twins.

To sum up, it should be stressed that full success of treatment of this unique malformation relies on accurate determination of functional abnormalities of all systems,
to enable peaceful cooperation of various specialist teams involved in the therapeutic process and strict observance of the surgical management plan prepared earlier.

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