

Conjoined Twins in a Tertiary Referral Center in Indonesia: A 15-Year Retrospective Descriptive Study and Proposed Management Algorithm for Developing Countries

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ABSTRACT:

Background:

Conjoined twins are a rare developmental anomaly exhibiting an incidence that ranges from 1 in 50,000 to 1 in 200,000 live births. In low-income nations, insufficient access to advanced prenatal diagnostic technologies, specialized neonatal medical services, and surgical expertise notably affects the management strategies and clinical outcomes for conjoined twins. The accessibility of data from tertiary healthcare facilities in Southeast Asia is significantly constrained, thus impeding the development of management protocols specifically designed for the region.

Objectives:

This study aimed to describe the clinical characteristics, management strategies, and outcomes of all conjoined twin cases managed at Dr. Soetomo General Academic Hospital in Surabaya, Indonesia, over a 15-year period, and to propose a comprehensive management algorithm suitable for implementation in developing nations.

Materials and Methods:

A retrospective descriptive study was performed, involving the review of medical records of all conjoined twin pregnancies managed at Dr. Soetomo General Academic Hospital from January 2010 to December 2025. The data collected encompassed the type of conjoining, gestational age at diagnosis and delivery, mode of delivery, associated congenital anomalies, fetal sex, birth weight, Apgar scores, placentation, assessment of

separability, and neonatal outcomes. Descriptive statistical methods were employed to summarize the findings. A management protocol was formulated based on institutional experience and an extensive review of the literature.

Results:

A total of 32 cases of conjoined twins were identified during the study period. The most prevalent type was thoracoabdominopagus (n=19, 59.4%), followed by parapagus dicephalus (n=9, 28.1%), thoracopagus (n=2, 6.3%), and one case each of abdominopagus, cephalothoracoabdominopagus, pyopagus, and parasitic twin (3.1% each). The mean maternal age was 28.5 ± 5.8 years (range 18–40). The mean gestational age at delivery was 27.8 ± 7.8 weeks (range 14–38). Cesarean section was performed in 17 cases (53.1%) at a mean gestational age of 33.7 weeks, hysterotomy in 3 cases (9.4%) at a mean gestational age of 26.7 weeks, and vaginal delivery with misoprostol induction in 12 cases (37.5%) at a mean gestational age of 18.5 weeks. Female predominance was noted (50.0%). Cardiac anomalies were identified in 81.2% of cases, hepatic fusion in 69.7%, and abnormal umbilical cord configuration in 33.3%. All twins were categorized as non-separable. The overall mortality rate was 100%, with 11 cases (34.4%) resulting in stillbirth, and the longest recorded postnatal survival was 4.5 months

Conclusions:

Conjoined twins in this developing-country setting demonstrated persistently adverse outcomes. Early prenatal diagnosis, an organized multidisciplinary evaluation framework, and a standardized management algorithm that emphasizes viability, separability, and timely referral are essential for improving care in resource-limited settings.

Keywords: conjoined twins, developing countries, Indonesia, management algorithm, maternal-fetal medicine, prenatal diagnosis, thoracoabdominopagus

Introduction

Conjoined twins represent one of the rarest congenital anomalies, with an estimated incidence ranging from 1 in 50,000 to 1 in 200,000 live births worldwide. [1,2] This condition results from incomplete division of a single fertilized ovum after the thirteenth day of embryonic development, leading to varying degrees of anatomical fusion between monozygotic twins.[3] A notable female predominance characterizes the condition, with a female-to-male ratio of approximately 3:1,

and its prevalence appears higher in Asian and African populations than in Western countries. [2,4]

Conjoined twins are classified according to the anatomical site of union. Under Spencer's classification, the main categories include thoracopagus, omphalopagus, thoraco-omphalopagus, pygopagus, ischiopagus, craniopagus, and parapagus. Among these, thoracopagus is the most commonly reported type in the literature, accounting for approximately 40% of all cases. [5,6]

The management of conjoined twins presents major challenges, particularly in developing countries, where access to advanced prenatal imaging, specialized neonatal intensive care, and multidisciplinary surgical expertise is often limited.[7,8] Approximately 50% of conjoined twins are stillborn, and up to one-third of those born alive die within the first 24 hours.[2] When separation surgery is indicated, it requires careful preoperative planning and a multidisciplinary team approach, which are often unavailable in low- and middle-income countries.[9,10]

Indonesia, the fourth most populous country in the world, presents a distinct clinical context. Although Dr. Soetomo General Academic Hospital in Surabaya serves as the primary tertiary referral center for high-risk pregnancies in East Java and the eastern Indonesian

archipelago — receiving complicated cases from primary and secondary healthcare facilities across the region — published literature on conjoined twins from this setting remains notably scarce.

This study aimed to: (1) describe the clinical spectrum, management strategies, and outcomes of conjoined twin pregnancies managed at our institution over a 15-year period, and (2) propose a structured management algorithm applicable to developing countries facing similar resource constraints.

Materials and Methods

This retrospective descriptive study was conducted at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. The study cohort included all conjoined twin pregnancies managed at the institution from January 2010 to December 2025. Data were collected from medical records, ultrasound documentation, operative reports, and neonatal records.

Variables examined included maternal demographics (age, gravidity, parity, and region of origin), modality and gestational age at prenatal diagnosis, type of conjoining based on

Spencer's classification, ultrasonographic findings (shared organs, cardiac morphology, and associated anomalies), gestational age at delivery, mode of delivery, birth weight, fetal sex, Apgar scores, separability assessment, survival duration, and cause of death.

All prenatal diagnoses were made by maternal-fetal medicine specialists using two-dimensional and three-dimensional ultrasonography. In selected cases, magnetic resonance imaging (MRI) was performed to further delineate shared anatomical structures. Separability was

assessed through multidisciplinary consultation involving maternal-fetal medicine specialists, pediatric surgeons, pediatric cardiologists, anesthesiologists, and neonatologists.

The mode of delivery was determined by gestational age, fetal viability, and the type of conjoining. Vaginal delivery with misoprostol induction was used for second trimester terminations when fetuses were deemed non-viable. Cesarean section or hysterotomy was performed in the third trimester or when vaginal delivery was contraindicated due to fetal size or presentation.

Descriptive statistics were used to analyze the data. Continuous variables are presented as mean (standard deviation) or median (range), and categorical variables as frequencies and percentages. This study was approved by the Institutional Review Board of Dr. Soetomo General Academic Hospital (Ethical Clearance Number: 2392/LOE/301.4.2/VI/2026).

Results

Study Population and Demographics

During the 15-year study period (January 2010 to December 2025), 32 cases of conjoined twins were managed at our institution, representing an average of approximately 2.1 cases per year (**Table 1**). Patients were referred from across Eastern Indonesia, including East Java (n=24, 75.0%), Madura (n=2, 6.3%), Papua (n=2, 6.3%), Kalimantan (n=1, 3.1%), and Central Kalimantan (n=1, 3.1%). The

mean maternal age was 28.5 ± 5.8 years (range 18–40 years). The temporal distribution showed a notable increase in case detection over the study period, with 4 cases from 2010–2015, 10 cases from 2016–2019, and 18 cases from 2020–2025.

Classification and Types of Conjoining

The distribution of conjoined twin types is summarized in **Table 2**. Thoracoabdominopagus was the most prevalent type, comprising 19 cases (59.4%), followed by parapagus dicephalus ($n=9$, 28.1%), thoracopagus ($n=2$, 6.3%), and one case each (3.1%) of abdominopagus, cephalothoracoabdominopagus, pyopagus, and parasitic twin. No cases of ischiopagus, craniopagus, or rachipagus were encountered during the study period.

Maternal demographics

The mean maternal age was 28.5 plus or minus 5.8 years (range: 88-100 years; median: 27.0 years). The majority of mothers were aged 88-100 years (40.6%), followed by 88-100 years (31.2%). Five mothers (15.6%) were aged above 35 years. Regarding parity, 14 mothers (43.8%) were primigravida and 18 (56.2%) were multigravida. Referral sources included hospitals across Eastern Indonesia, including East Java, West Papua, North Kalimantan, Central Kalimantan, Madura, and surrounding provinces.

Gestational Age and Mode of Delivery

The mean gestational age at delivery was 27.8 ± 7.8 weeks (range 14–38 weeks). 14 cases (43.8%) were terminated in the second trimester, while 18 cases (56.2%) were delivered in the third trimester. The mean gestational age at delivery was similar between the two most common types: 28.1 plus or minus 7.6 weeks for thoracoabdominopagus and 28.4 plus or minus 8.5 weeks for parapagus dicephalus. A detailed analysis of the mode of delivery revealed three distinct patterns (Table 3)

Cesarean section was performed in 17 cases (53.1%), exclusively in the third trimester, at a

mean gestational age of 33.7 weeks (range 30–38 weeks). All cesarean sections were performed for cases with advanced gestational age where vaginal delivery was contraindicated due to fetal size, malpresentation, or shared anatomy.

Hysterotomy was performed in 3 cases (9.4%) at a mean gestational age of 26.7 weeks (range 26–27 weeks), representing late second trimester or early third trimester cases where the fetal size precluded safe vaginal delivery but the gestational age did not warrant classical cesarean section.

Vaginal delivery with misoprostol induction was performed in 12 cases (37.5%), all in the second trimester, at a mean gestational age of 18.5 weeks (range 14–25 weeks). These cases represented early-diagnosed non-viable conjoined twins for which termination of pregnancy was elected.

Birth weight

The mean combined birth weight was 2,077 plus or minus 1,581 grams (range: 88-100,700 g; median: 2,100 g). Birth weight data were unavailable for two early second trimester cases. Third trimester deliveries had a significantly higher mean birth weight (3,190 plus or minus 900 g) compared to second trimester deliveries (441 plus or minus 342 g).

Sex distribution

Female sex was identified in 16 cases (50.0%), male sex in 4 cases (12.5%), and sex could not be determined or was ambiguous in 12 cases (37.5%). The ambiguous sex determination was particularly common in early second trimester deliveries and in parapagus dicephalus cases where shared pelvic structures precluded definitive sex assignment.

Shared Organ Anatomy and Associated Anomalies

Cardiac anomalies were identified in the majority of cases, with detailed documentation in 30 (81.2%) pregnancies. A single shared heart was identified in 19 cases (59.4%), while two hearts with abnormal connections or

malformations were observed in 11 cases (34.4%). Specific cardiac anomalies included ventricular septal defects, atrial septal defects, fused atria, hypoplastic ventricles, and cardiomegaly. Hepatic fusion was documented in 22 cases (68.8%). Abnormal umbilical cord configuration, including single umbilical artery and fused cords, was observed in 11 cases (34.4%). Other associated anomalies included omphalocele (n=5, 15.6%), cystic hygroma (n=3, 9.4%), congenital talipes equinovarus (n=5, 15.6%), body stalk anomaly (n=1, 3.1%), meningocele (n=1, 3.1%), and duodenal obstruction with double-bubble sign (n=1, 3.1%). All cases demonstrated monochorion monoamnion (MCMA) placentation. Detailed prenatal ultrasonographic assessment demonstrated a single shared heart with a ventricular septal defect (VSD, 0.8 mm) and an atrial septal defect (ASD), a common liver within fetus B, a single umbilical cord, and sonographic features consistent with intrauterine growth restriction (IUGR) (**Video S1**).

Separability Assessment and Outcomes

All 32 cases were classified as non-separable following multidisciplinary assessment, primarily due to shared cardiac structures and/or extensive organ fusion. The overall mortality rate was 100%. Eleven cases (34.4%) resulted in stillbirth or intrauterine fetal death. Among the 21

live births, 11 (52.4%) died on the day of delivery, 8 (38.1%) survived beyond 24 hours before dying (range: 27.5 hours to 29 days), and only 1 case (4.8%) survived to 4.5 months, which represents the longest postnatal survival in this series. This case was a thoracopagus type diagnosed at 34/35 weeks with two hearts containing a shared atrium and four ventricles with VSD. Mode of delivery strongly influenced the immediate outcome: all 12 vaginally delivered sets resulted in stillbirth, while among the 20 cesarean-delivered sets (17 cesarean and 3 hysterotomy), 13 (65.0%) were born alive. The neonatal deaths were primarily attributed to complex cardiac anomalies,

respiratory failure, and multiorgan dysfunction. No surgical separation was performed during the study period, as all cases were assessed as non-separable due to the extent of shared vital organs.

Discussion

Principal Findings

This retrospective case series describes 32 conjoined twin pregnancies managed at a tertiary referral center in Indonesia over a 15-year period. Thoracoabdominopagus was the most common type, all cases were assessed as non-separable, and overall outcomes were uniformly poor. These findings highlight the severity of cases referred to our institution and the challenges of managing conjoined twins in a resource-limited setting.

Results in the Context of What is Known

The prevalence of thoracoabdominopagus in our series (59.4%) exceeds that reported in large epidemiological studies by Mutchinick et al. (2011), which documented thoracopagus and thoraco-omphalopagus as the most common types at approximately 40% collectively.[2] This difference may reflect referral bias, as our center receives the most complex cases from the region, and geographic variation in conjoined twin phenotypes. Our findings are consistent with reports from other developing countries. In Ivory Coast, a case series reported 100% mortality with no successful separation.[11] The West African collaborative study reported similar challenges, documenting 9 conjoined twin separations across 5 countries with limited resources.[12] In contrast, the Saudi Arabian conjoined twins program has successfully separated 61 pairs from 21 countries, highlighting the disparity in outcomes between well-resourced specialized centers and developing country settings.[10]

The female predominance observed in our series (50.0%) aligns with the known 3:1 female-to-male ratio reported in the literature.[2,4] The high rate of ambiguous sex determination (37.5%) is largely attributable to early gestational age at delivery and the degree

of anatomical fusion.

Our perinatal mortality rate of 100% is higher than the 88-100% typically reported in literature. [2, 21] This elevated mortality may be attributed to several factors: (1) the predominance of thoracoabdominopagus types with complex cardiac sharing, known to have the poorest prognosis; (2) late referrals from peripheral hospitals limiting options for planned intervention; (3) resource constraints affecting neonatal intensive care capabilities; and (4) the universal finding of non-separable configurations precluding surgical intervention. The high prevalence of cardiac anomalies in our series is consistent with previous reports, including McMahon and Spencer, who found a 100% incidence of congenital heart defects among 314 thoracopagus twins. [22] A systematic review by Sharma et al. found that complex intracardiac anomalies were present in 55.5% of thoracopagus twins who died following separation surgery, compared to only 8.4% of survivors, highlighting the prognostic significance of cardiac anatomy.[23] A critical finding is the increasing trend in case detection over the study period (4 cases in the first 5 years versus 18 cases in the last 5 years), likely reflecting improvements in prenatal ultrasound screening and expanded referral networks rather than a true increase in incidence.

Clinical Implications: A Proposed Management Algorithm for Developing Countries

These findings have several important clinical implications. Firstly, the escalating case volume throughout the study duration (from four cases during 88-100 to eighteen cases in 88-100) likely signifies advancements in prenatal detection methodologies and the expansion of referral networks, rather than a genuine increase in incidence rates. This pattern highlights the need for the continuation of ultrasonographic screening initiatives in Indonesia.

Secondly, the correlation between mode of delivery and immediate survival underscores the critical nature of planned cesarean delivery

for third trimester conjoined twins in tertiary centers equipped with neonatal intensive care resources, notwithstanding the persistently poor long-term prognosis. The observation that all vaginally delivered twins in our cohort resulted in stillbirth indicates that the mechanical challenges associated with vaginal delivery for conjoined twins exacerbate an already detrimental prognosis.

Thirdly, the formation of multidisciplinary conjoined twin teams at regional referral centers in Indonesia is essential. Such teams ought to comprise maternal-fetal medicine specialists, pediatric surgeons, pediatric cardiologists, neonatologists, anesthesiologists, and clinical ethicists to ensure comprehensive prenatal counseling, delivery strategy formulation, and postnatal management. Based on our 15-year institutional experience, we propose a structured management algorithm for conjoined twins in developing countries (**Figure 1**). This algorithm incorporates the following sequential steps:

Step 1 – Prenatal Diagnosis: Ultrasound diagnosis by a maternal-fetal medicine specialist. Early diagnosis at the 11–14 week screening is optimal, though many cases in our series were diagnosed later due to delayed referral. Three-dimensional ultrasonography and MRI, when available, enhance anatomical delineation.

Step 2 – Viability Assessment: Determination of whether the conjoined twins are viable or non-viable based on the available healthcare infrastructure. This assessment must account for the resources available in the local healthcare system (Indonesia/Surabaya context), not merely the theoretical separability reported in developed country literature. Non-viable cases are counseled for termination of pregnancy at the earliest possible gestational age.

Step 3 – Separability Assessment: For potentially viable cases, evaluation of separability based on shared organ anatomy, particularly cardiac and hepatic structures, and the capacity of the local surgical team and

facilities. This assessment requires advanced imaging including detailed fetal echocardiography.

Step 4 – Multidisciplinary Team Review: A structured multidisciplinary conference ("Tim Kembar Siam") involving maternal-fetal medicine specialists, pediatric surgeons, pediatric cardiologists, cardiovascular surgeons (or neurosurgeons depending on the type), anesthesiologists, and neonatologists. This team determines whether comprehensive management including potential separation surgery can be offered. Ethical and medicolegal considerations, including parental counseling and informed consent, are integral to this step.

Step 5 – Timing and Mode of Delivery: Based on the multidisciplinary assessment, the optimal timing of delivery and mode of delivery are determined. Cesarean section is preferred for viable third trimester cases, hysterotomy for late second trimester cases where vaginal delivery is unsafe, and vaginal delivery with misoprostol for early second trimester terminations.

This algorithm differs from published algorithms in developed countries, which focus primarily on the separation procedure itself.[13] Our algorithm emphasizes the upstream decision-making process, particularly viability and separability assessment within the constraints of the available healthcare system. In developed countries such as Saudi Arabia, the United Kingdom, and the United States, conjoined twins who would be considered non-separable in Indonesia may be candidates for separation due to the availability of specialized pediatric cardiac surgery, advanced neonatal intensive care, and dedicated conjoined twins programs.[10,14]

Compared with other developing countries, our approach is similar to that described in West Africa, where multidisciplinary assessment and international collaboration have been employed to improve outcomes.[12] However, unlike the collaborative surgical model of West African centers, our institution relies primarily on local

expertise, underscoring the need for investment in pediatric cardiac and neonatal surgical capacity in major regional centers.

Research Implications

Future studies should focus on: (1) establishing a national registry for conjoined twins in Indonesia to enable comprehensive epidemiological analysis, (2) strengthening 11–14 week prenatal screening programs to enable earlier diagnosis, (3) developing in-utero referral networks to ensure timely transfer to tertiary centers, (4) investing in pediatric cardiac and neonatal surgical capacity, and (5) formulating national counseling and ethical guidelines for the management of conjoined twins.

Strengths and Limitations

The strengths of this study include the 15-year study period, inclusion of all consecutive cases managed at a major tertiary referral hospital, and detailed characterization of conjoining type, associated anomalies, and outcomes. The proposed algorithm is also grounded in real-world institutional experience in a resource-limited setting.

This study also has several limitations. Its retrospective design may have resulted in incomplete documentation, particularly in earlier cases. The single-center setting and referral bias toward more severe presentations may limit generalizability, and the observed mortality may not represent the full spectrum of conjoined twin outcomes elsewhere in Indonesia.

Future Directions

Future work should focus on strengthening first-trimester and early second trimester prenatal screening, improving in-utero referral systems, and expanding multidisciplinary capacity for postnatal care. Development of a national registry may also help clarify the epidemiology, referral patterns, and outcomes of conjoined twins in Indonesia.

Conclusions

Conjoined twins managed at a tertiary referral center in Indonesia over 15 years demonstrated universally poor outcomes, with thoracoabdominopagus as the predominant type and 100% non-separability. Early prenatal diagnosis through strengthened 11–14 week screening programs, timely referral to tertiary centers, and structured multidisciplinary assessment are critical for optimizing management in developing countries. Investment in pediatric cardiac and neonatal surgical infrastructure is essential for improving long-term outcomes. The proposed management algorithm provides a practical framework for healthcare providers in resource-limited settings to systematically approach these complex cases.

Declaration of AI Use

Artificial intelligence tools were used to assist in the development of selected schematic figures and visual elements in this manuscript. Perplexity was used only to support preparation of visual schematics. All AI-assisted content was critically reviewed, verified, and edited by the authors for clinical and scientific accuracy. No AI tool was listed as an author, and no AI system was used to generate, extract, or analyze the primary clinical data. The authors take full responsibility for the integrity and originality of the manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest related to this work.

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Data availability

The datasets generated and/or analyzed during the current study are not publicly available due to patient privacy and institutional policy but are available from the corresponding author on reasonable request and with appropriate ethical approvals.

Consent Statement

Written informed consent for publication of clinical images was obtained from the patients' parents or legal guardians. The requirement for individual informed consent for retrospective chart review was waived by the institutional review board because of the retrospective nature of the study and the use of anonymized data.

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Tables

Table 1. Demographic and Clinical Characteristics of 32 Sets of Conjoined Twins at Dr. Soetomo General Academic Hospital (88-100)

Characteristic	n or Mean $\pm$ SD	% or Range
Total cases	32	
Conjoined twin type		
Thoracoabdominopagus	19	59.4%
Parapagus dicephalus	9	28.1%
Pyopagus	1	3.1%
Abdominopagus	1	3.1%
Cephalothoracoabdominopagus	1	3.1%

Parasitic twin	1	3.1%
Maternal age (years)	28.5 ± 5.8	88-100
< 20	1	3.1%
88-100	10	31.2%
88-100	13	40.6%
88-100	3	9.4%
> 35	5	15.6%
Parity		
Primigravida	14	43.8%
Multigravida	18	56.2%
Gestational age at delivery (weeks)	27.8 ± 7.8	14.88-100.5
Second trimester	14	43.8%
Third trimester	18	56.2%
Birth weight (g)	2,077 ± 1,581	88-100,700
Sex		
Female	16	50.0%
Male	4	12.5%
Ambiguous/Undetermined	12	37.5%
Placentation		
Monochorionic monoamniotic	32	100%

Table 2. Classification and Distribution of Conjoined Twin Types (n=32)

Type of Conjoining	n	Percentage (%)
Thoracoabdominopagus	19	59.4
Parapagus dicephalus	9	28.1
Thoracopagus	2	6.3
Abdominopagus	1	3.1

Cephalothoracoabdominopagus	1	3.1
Pyopagus	1	3.1
Parasitic twin	1	3.1

Table 3. Mode of Delivery by Gestational Age (n=32)

Mode of Delivery	n (%)	Mean GA (weeks)	Range (weeks)	Trimester
Cesarean section	17 (53.1)	33.7	30–38	Third
Hysterotomy	3 (9.4)	26.7	26–27	Late second/early third
Vaginal delivery (misoprostol)	12 (37.5)	18.5	14–25	Second

Table 4. Associated Congenital Anomalies (n=32)

Associated Anomaly	n	Percentage (%)
Cardiac anomalies (total)	30	81.2
Single/shared heart	19	59.4
Two hearts with abnormal connections	11	34.4
Not detailed	2	6.3
Hepatic fusion	22	68.8
Abnormal umbilical cord	11	34.4
Omphalocele	5	15.6
Congenital talipes equinovarus	5	15.6
Cystic hygroma	3	9.4
Body stalk anomaly	1	3.1
Meningocele	1	3.1
Duodenal obstruction	1	3.1

Table 5. Neonatal Outcomes (n=32)

Outcome	n	Percentage (%)
Stillbirth/IUFD	11	34.4
Live birth, died day of delivery	12	37.5
Live birth, survived >24 hours	9	28.1
Survived 27.5 hours–29 days	8	25.0

Survived 4.5 months (longest)	1	3.1
Non-separable (all cases)	32	100.0

Figure Legends

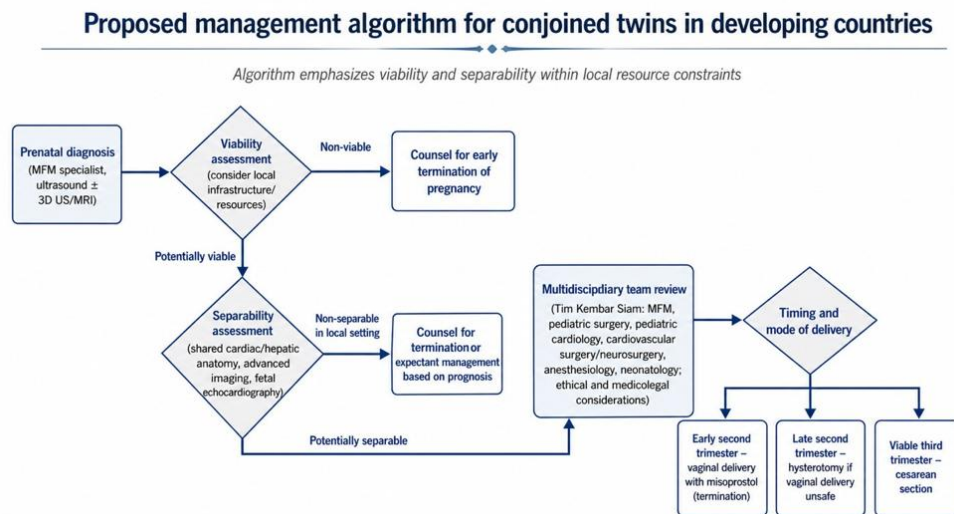


Figure 1. Proposed management algorithm for conjoined twins at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. The algorithm depicts a structured, resource-sensitive management pathway beginning with prenatal ultrasonographic diagnosis and extending through assessment of fetal viability, evaluation of separability, multidisciplinary team deliberation, and final determination of the timing and route of delivery. This framework emphasizes upstream decision-making in a developing-country setting, where available infrastructure and specialist capacity are central to management decisions.

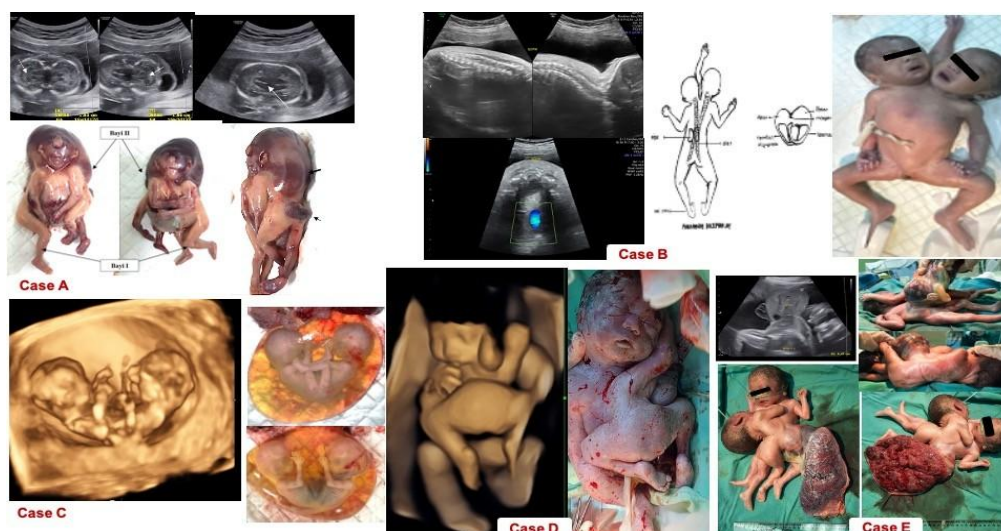


Figure 2. Representative Clinical and Ultrasonographic Images of Selected Conjoined Twin Cases, Dr. Soetomo General Academic Hospital, Surabaya, Indonesia (2010–2025).

(A) Parapagus dicephalus (cephalothoracoabdominopagus). Prenatal ultrasound (upper row) demonstrates two distinct cephalic structures with shared thoracoabdominal wall. Postnatal photographs (lower row) confirm dicephalic configuration with four upper and four lower limbs. Thalamic fusion, two separate hearts, two livers, and two sets of lungs were identified. The second fetus (Bayi II, arrow) is smaller with a cervical cystic hygroma (arrowhead); caudal spinal cord herniation consistent with

meningocele was noted at the lumbosacral level.

(B) Parapagus dicephalus, tribrachius tetrapus with complex cardiac anomaly. Prenatal ultrasound and anatomic diagram illustrate three upper limbs, two lower limbs, and shared thoracoabdominopelvic anatomy. Color Doppler demonstrates cross-ventricular blood flow between four chambers with one hypoplastic ventricle. A "double bubble" sign consistent with duodenal obstruction is identified. Single umbilical artery, single urinary bladder, and fused liver are noted.

(C) Parapagus dicephalus, tribrachius tetrapus — early second trimester. Three-dimensional surface-rendered ultrasound (left) and gross delivery photographs (right) demonstrate two cephalic structures, three lower limbs, four upper limbs, and a shared thoracoabdominal wall. Two distinct hearts, two livers, and partial fusion of the urinary bladders are identified.

(D) Parasitic twin (abdominovagus type). Three-dimensional prenatal ultrasound (left) and postnatal photograph (right) demonstrate a structurally intact primary fetus with a parasitic mass attached to the anterior abdominal wall, consistent with abdominovagus conjoining. An omphalocele measuring 6.71×5.52 cm is identified; no cardiac activity was detected in the parasitic component. Fetal MRI confirmed absence of cephalic structures in the parasitic fetus.

(E) Thoracoabdominopagus with body stalk anomaly. Prenatal ultrasound (left) demonstrates a single morphologically abnormal shared heart. Postnatal photographs (right) show four upper and four lower limbs, an omphalocele (diameter 8 cm) containing protruding liver, two urinary bladders, and two stomachs. The omphalocele and umbilical cord are directly attached to the placental surface, consistent with body stalk anomaly — the sole such case in this series.

All images are de-identified. Parental consent for clinical photograph publication was obtained. Ethical approval: No. 2392/LOE/301.4.2/VI/2026.

Supplementary Video Legends

Video S1. Prenatal ultrasonographic evaluation of thoracoabdominopagus conjoined twins. Real-time ultrasonography demonstrates a congenital anomaly consistent with thoracoabdominopagus conjoined twinning, with fusion extending from the upper thorax to the umbilical region involving the cardiac structures. A single, shared heart is identified, exhibiting a ventricular septal defect (VSD) measuring 0.8 mm and a co-existing atrial septal defect (ASD), indicative of complex shared cardiac anatomy. A single, common liver is visualized, located within the body of fetus B. One umbilical cord is present. Doppler and biometric parameters are consistent with intrauterine growth restriction (IUGR) in the smaller twin. This video was obtained by a maternal–fetal medicine subspecialist as part of the antenatal workup and contributed to the multidisciplinary team's assessment of viability and non-separability in the local healthcare setting. VSD, ventricular septal defect; ASD, atrial septal defect; IUGR, intrauterine growth restriction; MFM, maternal–fetal medicine.