e-ISSN (online): 2745-9497

Journal of Anesthesiology and Clinical Research (JACR)

Journal website: https://hmpublisher.com/index.php/jacr

Perioperative Anesthetic Management of Brain Abscess Evacuation in a Child with Double Outlet Right Ventricle: A Case Report

Rio Kharisma Putra[1]*, Buyung Hartiyo Laksono[1], Eko Nofiyanto[1], Fanniyah[1], Ruddi Hartono[1]

[1]Department of Aneshtesiology and Intensive Therapy, Faculty of Medicine, Universitas Brawijaya/Dr. Saiful Anwar Regional General Hospital, Malang, Indonesia

ARTICLE INFO

Keywords:
Brain abscess
Congenital heart disease
Craniectomy
Double outlet right ventricle
Pediatric anesthesia

***Corresponding author:**
Rio Kharisma Putra

E-mail address:
rkharisma1@ymail.com

All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/jacr.v6i1.668

A B S T R A C T

Introduction: Double outlet right ventricle (DORV) is a rare congenital heart defect where both the aorta and pulmonary artery arise from the right ventricle. This anomaly poses unique challenges for anesthetic management, especially during intracranial surgeries. **Case presentation:** We present the case of a 7-year-old female child diagnosed with a brain abscess and DORV, who underwent open evacuation and cranioplasty. Anesthetic management focuses on maintaining hemodynamic stability and ensuring adequate oxygenation. The patient was successfully extubated postoperatively and transferred to the intensive care unit (ICU) for close monitoring. **Conclusion:** Surgical interventions in patients with DORV require careful preoperative evaluation and close perioperative monitoring to minimize morbidity and mortality. This case highlights the importance of a multidisciplinary approach and meticulous anesthetic management in ensuring a successful outcome.

1. Introduction

Double outlet right ventricle (DORV) is a rare congenital heart defect characterized by the origin of both great arteries, the aorta, and the pulmonary artery, predominantly from the right ventricle. This anomaly represents a complex spectrum of cardiovascular malformations, accounting for 1-3% of all congenital heart diseases. The hallmark of DORV is the absence of a direct connection between the left ventricle and either of the great arteries. Instead, the aorta and pulmonary artery arise primarily from the right ventricle, leading to a mixing of oxygenated and deoxygenated blood. The pathophysiology of DORV is intricate and involves a combination of factors that contribute to abnormal circulation. The primary abnormality is the malalignment of the great arteries with the ventricular septum. This malalignment results in both arteries receiving blood from the right ventricle, disrupting the normal separation of oxygenated and deoxygenated blood. The degree of mixing and the direction of shunting depends on the associated cardiac defects, such as the size and position of the ventricular septal defect (VSD), the presence or absence of pulmonary stenosis, and the relationship of the great arteries to each other. In DORV, the aorta typically overrides the ventricular septum, meaning it sits above both the right and left ventricles. The degree of override is a crucial determinant of the clinical presentation and the complexity of surgical repair. The pulmonary artery can arise from the right ventricle in various positions, including anterior, posterior, or to the side of the aorta. The spatial relationship between the great arteries and the presence of additional cardiac defects, such as subaortic stenosis or coarctation of the aorta, further contribute to the complexity of DORV. The clinical presentation of DORV varies depending on the specific anatomy and the associated cardiac defects. Some infants may present with cyanosis, a bluish discoloration of the skin and mucous membranes, due to the mixing of oxygenated and deoxygenated blood. Others may exhibit symptoms of heart failure, such as shortness of breath, fatigue, and poor feeding, due to the increased workload on the heart. The severity of symptoms and the age of presentation depend on the degree of mixing, the presence of obstruction to blood flow, and the overall cardiac function.[1-3]

The diagnosis of DORV is typically made through a combination of clinical evaluation and imaging studies. Echocardiography is the primary diagnostic tool, providing detailed information about the heart's structure and function. It can identify the origin of the great arteries, the presence and size of a VSD, and any associated cardiac defects. Magnetic resonance imaging (MRI) or computed tomography (CT) scans may be used to further delineate the anatomy and assess the pulmonary and systemic circulations. The management of DORV typically involves surgical intervention to correct the abnormal circulation and improve cardiac function. The specific surgical approach depends on the individual anatomy and the associated defects. The goal of surgery is to create a pathway for oxygenated blood to flow from the left ventricle to the aorta and deoxygenated blood to flow from the right ventricle to the pulmonary artery. This may involve closing the VSD, creating a tunnel or baffle to redirect blood flow, or switching the great arteries to their normal positions. Brain abscess, a focal infection within the brain parenchyma, is a rare but serious complication in patients with DORV. The incidence of brain abscess in patients with DORV is estimated to be between 5-18%. The pathophysiology of brain abscess in DORV is multifactorial, involving a combination of paradoxical embolism, chronic hypoxia, and altered immune response. Paradoxical embolism occurs when an embolus, such as a blood clot or a clump of bacteria, bypasses the filtering mechanism of the lungs and enters the systemic circulation. In patients with DORV, the presence of a right-to-left shunt, such as a VSD or a patent foramen ovale, allows for the passage of emboli from the right side of the heart to the left side, potentially lodging in the brain and causing an abscess.[4-6]

Chronic hypoxia, a state of reduced oxygen supply to the tissues, can also contribute to the development of brain abscesses in patients with DORV. The mixing of oxygenated and deoxygenated blood in DORV can lead to chronic hypoxemia, which can impair the brain's defense mechanisms and make it more susceptible to infection. The clinical presentation of brain abscess in patients with DORV is similar to that in other individuals, with symptoms such as headache, fever, seizures, and neurological deficits. However, the diagnosis of brain abscess in DORV can be challenging, as the symptoms may overlap with those of the underlying heart condition. Neuroimaging studies, such as CT or MRI scans, are crucial for confirming the diagnosis and guiding treatment. The management of brain abscesses in patients with DORV typically involves a combination of medical and surgical interventions. Medical management includes the administration of antibiotics to treat the infection and control its spread. Surgical intervention may be necessary to drain the abscess and relieve pressure on the brain. The timing and approach of surgery depend on the size and location of the abscess, the patient's clinical condition, and the presence of any associated complications. The combination of DORV and brain abscesses presents significant challenges for anesthesiologists. The anesthetic management of such cases requires a thorough understanding of the pathophysiology of both conditions, meticulous preoperative evaluation, and vigilant intraoperative and postoperative monitoring.[7,8]

The primary goals of anesthetic management in patients with DORV undergoing brain abscess surgery are to maintain hemodynamic stability, ensure adequate oxygenation, and prevent complications such as arrhythmias, bleeding, and hypertensive crisis. Achieving these goals requires careful consideration of the patient's specific anatomy, the associated cardiac defects, and the potential impact of the surgical procedure on the cardiovascular system. Preoperative evaluation should include a thorough assessment of the patient's cardiac function, oxygenation status, and coagulation profile. Any existing comorbidities should be optimized to minimize the risk of perioperative complications. The choice of anesthetic agents should be tailored to the patient's specific needs and comorbidities. Intraoperative monitoring should include continuous electrocardiography, invasive blood pressure monitoring, pulse oximetry, capnography, and temperature monitoring. Arterial blood gas analysis may be necessary to assess oxygenation and ventilation. Postoperative management should focus on maintaining hemodynamic stability, providing adequate analgesia, and preventing complications such as arrhythmias, bleeding, and infection. Close monitoring in the intensive care unit (ICU) is crucial to ensure early detection and management of any complications.[9,10] This case report aims to describe the perioperative management of a 7-year-old female child with DORV who underwent brain abscess evacuation and cranioplasty.

2. Case Presentation

This report details the perioperative management of a 7-year-old female child who presented for the surgical evacuation of a brain abscess. The patient had a complex medical history, notably a diagnosis of double outlet right ventricle (DORV), a rare congenital heart defect where both the aorta and pulmonary artery arise from the right ventricle. This underlying cardiac condition significantly influenced the anesthetic approach and perioperative care. The child's clinical presentation unfolded over several days, initially with progressive weakness experienced while waiting at a pharmacy after a routine cardiology check-up. This weakness was accompanied by an unquantified fever, which worsened over two days. Additionally, the patient experienced painful swelling in both lower legs, further impeding her mobility. Upon presentation, the fever had subsided, and there were no signs of respiratory infection such as cough or runny nose. Importantly, the patient had no history of allergies, diabetes mellitus, asthma, or seizures, and no prior surgical interventions or chemotherapy. Physical examination revealed an unwell-appearing child with adequate spontaneous breathing and a conscious state, reflected in a Glasgow Coma Scale (GCS) score of E4V5M6. Vital signs showed a blood pressure of 102/68 mmHg, a heart rate of 91 beats per minute, an axillary temperature of 36.8°C, a respiratory rate of 24 breaths per minute, and oxygen saturation levels that varied significantly across different locations: 94% in the left hand, 83% in the right hand, 75% in the left leg, and 77% in the right leg, all measured in room air. These disparities in oxygen saturation likely reflect the altered circulatory dynamics associated with DORV, where the mixing of oxygenated and deoxygenated blood occurs. Anthropometric measurements indicated a body weight of 19 kg and a height of 116 cm, resulting in a body mass index (BMI) of 14, which falls within the normal range for her age. Head and neck examination was unremarkable, with no signs of anemia, jaundice, cyanosis, or enlarged lymph nodes. Thoracic examination revealed a single S1-S2 heart sound, regular rhythm, a heart murmur, and a gallop rhythm, all indicative of underlying cardiac abnormalities. Abdominal examination was within normal limits. However, extremity examination revealed cyanosis and clubbing of the fingers, classic signs of chronic hypoxia often associated with cyanotic congenital heart diseases like DORV. Assessment for respiratory infection yielded negative results, while evaluation for VACTERL association (a set of congenital malformations that often occur together) was positive for cardiac defects, consistent with the patient's known DORV. A chest X-ray demonstrated cardiomegaly, specifically left atrial enlargement and right ventricular hypertrophy, along with pulmonary plethora, suggesting a possible left-to-right shunt. Dextrocardia with situs solitus was also observed, indicating that the heart was positioned on the right side of the chest but with the remaining organs in their usual positions. Echocardiography, a crucial imaging modality for evaluating cardiac structure and function, provided detailed insights into the patient's

DORV anatomy. The echocardiogram confirmed dextrocardia with situs solitus, with systemic and pulmonary venous drainage entering the right atrium and left atrium, respectively. Dilatation of the right atrium and right ventricle was noted, while left ventricular systolic and diastolic function were preserved. Right ventricular systolic function was also assessed as good. The coronary sinus was normal. Key findings included an overriding aorta exceeding 70%, a right aortic arch, pulmonary atresia, a large perimembranous ventricular septal defect (VSD) measuring 25 mm in diameter, an intact interatrial septum, a persistent ductus arteriosus, and no pericardial effusion. These findings collectively confirmed the diagnosis of DORV with pulmonary atresia and VSD. A head CT scan with contrast revealed multiple rim-enhancing lesions in the left temporoparietal lobe, a hallmark of brain abscesses. Additionally, there was evidence of subfalcine herniation to the right, measuring approximately 1.1 cm, and transtentorial herniation downward to the level of the midbrain. These herniations indicated increased intracranial pressure due to the space-occupying lesion and associated edema. The differential diagnosis included cystic glioblastoma, another potential cause of such lesions and herniation. Preoperatively, the patient was afebrile and had not experienced any acute respiratory infections or seizures in the 24 hours preceding the procedure. Her blood pressure was 112/74 mmHg, heart rate was 96 beats per minute, respiratory rate was 18 breaths per minute, and oxygen saturation was 79% in the right upper extremity. She had been receiving intravenous fluids (D5 1/2 NS at 40 cc/hour) while fasting, along with cloxacillin (3 x 300 mg), paracetamol (4 x 200 mg), metronidazole (3 x 150 mg), mannitol (3 x 50 cc), aspirin (1 x 80 mg orally), propranolol (3 x 10 mg orally), and amitriptyline (1 x 12.5 mg). The patient had fasted for 6 hours from solid food and formula milk and 2 hours from clear fluids before the scheduled procedure. This detailed timeline of the patient's clinical presentation, physical examination findings, laboratory results, and imaging studies provides a comprehensive overview of her condition prior to surgical intervention. It highlights the complex interplay between her underlying DORV and the development of a brain abscess, setting the stage for the challenges and considerations involved in her anesthetic management (Table 1).

Upon arrival in the operating room, the patient was connected to standard monitoring equipment, including electrocardiography (ECG), non-invasive blood pressure monitoring, and pulse oximetry. To facilitate closer hemodynamic monitoring and administration of medications, a central venous catheter (CVC) was placed. Following CVC insertion, the patient was transferred to the premedication room where 1 mg of midazolam was administered to alleviate anxiety and facilitate a smooth induction of anesthesia. General anesthesia was chosen for the procedure, with the goal of ensuring patient comfort, hemodynamic stability, and optimal surgical conditions. Endotracheal intubation was performed to secure the airway and control ventilation. The anesthetic induction involved a combination of agents: 8 mcg of sufentanil for analgesia, 1% sevoflurane for inhalational anesthesia, 10 mg of ketamine for its dissociative and analgesic properties, 20 mg of lidocaine to attenuate the cardiovascular response to intubation, and 20 mg of rocuronium to provide muscle relaxation for intubation. Maintenance of anesthesia was achieved with a continuous infusion of atracurium at 6 mg/hour to maintain neuromuscular blockade, sufentanil at 2 mcg/hour for ongoing analgesia, and sevoflurane at 0.8% to provide a stable plane of anesthesia. In addition, an inline infusion of norepinephrine (NE) was commenced to support blood pressure and maintain hemodynamic stability, a particularly crucial aspect given the patient's underlying DORV. Throughout the procedure, vital signs were meticulously monitored and recorded every 5 minutes to ensure early detection of any hemodynamic instability or other complications. The surgical procedure itself consisted of a left temporoparietal craniotomy to access and evacuate the brain abscess. Intraoperatively, the surgical team encountered a large left temporoparietal cerebral abscess with an estimated volume of 100 cc. This finding corroborated the preoperative imaging. In addition to the abscess, there was 75 cc of intraoperative bleeding. Meticulous hemostasis was achieved, and the total fluid balance at the end of the procedure was -265 cc, indicating a net fluid loss. This fluid balance was carefully managed throughout the surgery with intravenous fluids guided by the central venous pressure (CVP) and urine output. In addition to standard monitoring, invasive blood pressure monitoring was instituted to provide continuous and accurate blood pressure readings. Central venous pressure monitoring was also employed to assess the patient's fluid status and guide fluid management. Heart rate was continuously monitored for any arrhythmias or signs of inadequate cardiac output. Temperature management was also a priority, with a forced-air warming blanket used to prevent hypothermia, a common complication of anesthesia that can lead to adverse outcomes. Arterial and venous blood gas analyses were performed intraoperatively to assess the patient's acid-base balance, oxygenation, and ventilation. This information was crucial in guiding ventilator settings and ensuring adequate oxygen delivery to the tissues. Intraoperative blood gas analysis revealed a pH of 7.30, pCO_2 of 38.8 mmHg, and pO_2 of 44.6 mmHg, indicating mild acidosis and hypoxemia. These findings were addressed with adjustments to the ventilator settings and continued close monitoring. A complete blood count was also performed intraoperatively, which showed a hemoglobin level of 18.2 g/dL, consistent with the preoperative diagnosis of polycythemia. This elevated hemoglobin level is a common compensatory mechanism in patients with cyanotic heart disease like DORV, where the body increases red blood cell production to enhance oxygen-carrying capacity. The erythrocyte count was 6.78 million, and the leukocyte count was 4.44 x $10^3/mm^3$, which, while slightly low, may be within the normal range for this patient. The hematocrit was 60.7%, reflecting the polycythemia. The total duration of the surgical procedure was 3 hours. Throughout this period, the anesthesia team maintained a vigilant watch over the patient's vital signs, fluid balance, and overall physiological status, ensuring optimal conditions for the surgical team and minimizing the risk of complications related to anesthesia or the patient's underlying cardiac condition (Table 2).

This section details the multi-faceted management of the patient, encompassing the preoperative preparation, the intraoperative anesthetic technique, and the postoperative care provided. Each phase presented unique challenges and considerations due to the patient's underlying DORV and the nature of the surgical intervention. Recognizing the complexity of the case, the patient was admitted to the Pediatric Intensive Care Unit (PICU) for close monitoring and optimization before surgery. A multi-pronged approach was adopted to address the brain abscess and manage the potential implications of her DORV. Intravenous antibiotics, including cloxacillin and metronidazole, were initiated to combat the infection and prevent its spread. Antipyretics, specifically paracetamol, were administered to control any fever and improve the patient's overall comfort. Mannitol, an osmotic diuretic, was used to reduce brain edema and lower intracranial pressure, thereby mitigating the risk of herniation and associated complications. The patient's existing oral medications, aspirin, and propranolol, were continued. Aspirin, an antiplatelet agent, likely served to reduce the risk of thromboembolic events, a concern in patients with DORV. Propranolol, a beta-blocker, was presumably prescribed to control heart rate and potentially improve myocardial function. In preparation for the surgery, the patient was kept nil per os (NPO), meaning she was fasted. This involved withholding solid food and formula milk for 6 hours and clear liquids for 2 hours prior to the procedure. Fasting is a standard preoperative precaution to reduce the risk of aspiration during anesthesia induction. The anesthetic management aimed to provide a safe and stable anesthetic while considering the challenges posed by DORV. Upon arrival in the operating room, standard monitoring was established, including ECG, non-invasive blood pressure (NIBP) monitoring, pulse oximetry (SpO_2), and capnography to monitor end-tidal carbon dioxide (CO_2). A central venous catheter (CVC) was inserted to facilitate fluid and medication administration and allow for close monitoring of central venous pressure. Premedication with 1 mg of midazolam was administered to reduce anxiety and facilitate a smooth induction. Anesthesia was induced with a combination of sufentanil (8 mcg) for analgesia, sevoflurane (1%) for inhalational anesthesia, ketamine (10 mg) for its dissociative and analgesic properties, lidocaine (20 mg) to blunt the hemodynamic response to intubation and rocuronium (20 mg) for muscle relaxation to facilitate endotracheal intubation. Maintenance of anesthesia was achieved with sevoflurane (0.8%), sufentanil (2 mcg/hour), and atracurium (6 mg/hour) infusions. Importantly, an infusion of norepinephrine was initiated to provide cardiovascular support and maintain hemodynamic stability, a critical aspect in a patient with DORV. Ventilation was carefully controlled with a tidal volume (VT) of 200 ml, a respiratory rate (RR) of 20 breaths per minute, an inspiratory-to-expiratory ratio (I:E) of 1:2, and a positive end-expiratory pressure (PEEP) of 2 cmH_2O. These settings were chosen to ensure adequate ventilation and oxygenation while minimizing the impact on cardiovascular function. Following the surgical procedure, the patient was admitted to the PICU for close monitoring and continued care. Mechanical ventilation was maintained initially to support respiration and ensure adequate oxygenation. Intravenous antibiotics, ceftriaxone and metronidazole, were continued to combat the infection. Other medications administered included ranitidine for gastric protection, tranexamic acid to minimize bleeding, paracetamol for analgesia and antipyresis, and phenytoin for seizure prophylaxis. Norepinephrine and dexmedetomidine infusions were continued to provide cardiovascular support and sedation, respectively. Propranolol was also continued as per the preoperative regimen. Once the patient demonstrated adequate respiratory effort and oxygenation, she was extubated. Supplemental oxygen was provided as needed to maintain satisfactory oxygen saturation. A repeat head CT scan was performed to assess the surgical site and evaluate for any residual abscess or complications. The postoperative management focused on providing comprehensive care, including respiratory support, infection control, pain management, and hemodynamic stability. The PICU environment allowed for close monitoring and timely intervention should any complications arise (Table 3).

Table 1. Timeline of the disease, including anamnesis, clinical findings, laboratory and imaging findings, and the diagnosis.

Anamnesis	Clinical finding	Imaging	Laboratory	Diagnosis
Progressive weakness Fever for 3 days Lower extremity swelling No cough, runny nose, or seizures No history of allergies, diabetes, or asthma	Unwell appearance Alert and conscious (GCS E4V5M6) BP: 102/68 mmHg HR: 91 bpm RR: 24 breaths/min Temp: 36.8°C (axillary) SpO_2: 94% left hand, 83% right hand, 75% left leg, 77% right leg (room air) Single S1-S2, murmur, gallop rhythm Cyanosis and clubbing of fingers	Chest X-ray: Cardiomegaly (LAE, RVH) Pulmonary plethora Dextrocardia with situs solitus Head CT with Contrast: Multiple rim-enhancing lesions in left temporoparietal lobe Subfalcine herniation to the right (±1.1 cm) Transtentorial herniation downward to midbrain level	Echocardiography: DORV with pulmonary atresia (PA) and VSD Overriding aorta (>70%) Right aortic arch Persistent ductus arteriosus Good biventricular function	Complete Blood Count: Hemoglobin: 18.2 g/dL (polycythemia) Leukocytes: 12,000/µL (possible infection) Platelets: 350,000/µL Blood Gas Analysis: PaO_2: 60 mmHg (hypoxemia) $PaCO_2$: 40 mmHg pH: 7.35

Table 2. Surgical procedure, intraoperative finding, and intraoperative monitoring and management.

Surgical procedure	Intraoperative finding	Intraoperative monitoring and management	Laboratory findings
Left temporoparietal craniotomy. Evacuation of brain abscess.	Large left temporoparietal cerebral abscess (approximately 100 cc). Bleeding (75 cc). Fluid balance of -265 cc	Invasive blood pressure monitoring. Central venous pressure (CVP) monitoring. Heart rate monitoring. Fluid therapy guided by CVP and urine output. Temperature management (forced-air warming blanket). Arterial and venous blood gas analysis	Intraoperative blood gas analysis: pH 7.30 (arterial), pCO_2 38.8 mmHg (arterial), pO_2 44.6 mmHg (arterial), HCO_3 19.1 mmol/L (arterial), BE -7.6 (arterial). Complete blood count: Hemoglobin 18.2 g/dL, Erythrocytes 6.78 million, Leukocytes 4.44 $10^3/mm^3$, Hematocrit 60.7%.

Table 3. Preoperative management, anesthetic management, postoperative management.

Preoperative management	Anesthetic management	Postoperative management
Admitted to PICU: IV antibiotics (cloxacillin, metronidazole), Antipyretics (paracetamol), Mannitol Oral aspirin, and propranolol continued Fasting (6 hours solids, 2 hours clear liquids)	Standard monitoring (ECG, NIBP, SpO_2, capnography), Central venous catheter (CVC) insertion. Premedication: midazolam 1 mg Induction: sufentanil 8 mcg, sevoflurane 1%, ketamine 10 mg, lidocaine 20 mg, rocuronium 20 mg. Maintenance: sevoflurane 0.8%, sufentanil 2 mcg/hour, atracurium 6 mg/hour, norepinephrine infusion. Controlled ventilation (VT 200 mL, RR 20 breaths/min, I:E 1:2, PEEP 2 cmH_2O)	PICU admission Continued mechanical ventilation, IV antibiotics (ceftriaxone, metronidazole) Ranitidine, tranexamic acid, paracetamol Phenytoin, Norepinephrine and dexmedetomidine, infusions Propranolol, Extubation, Supplemental oxygen, Repeat head CT scan

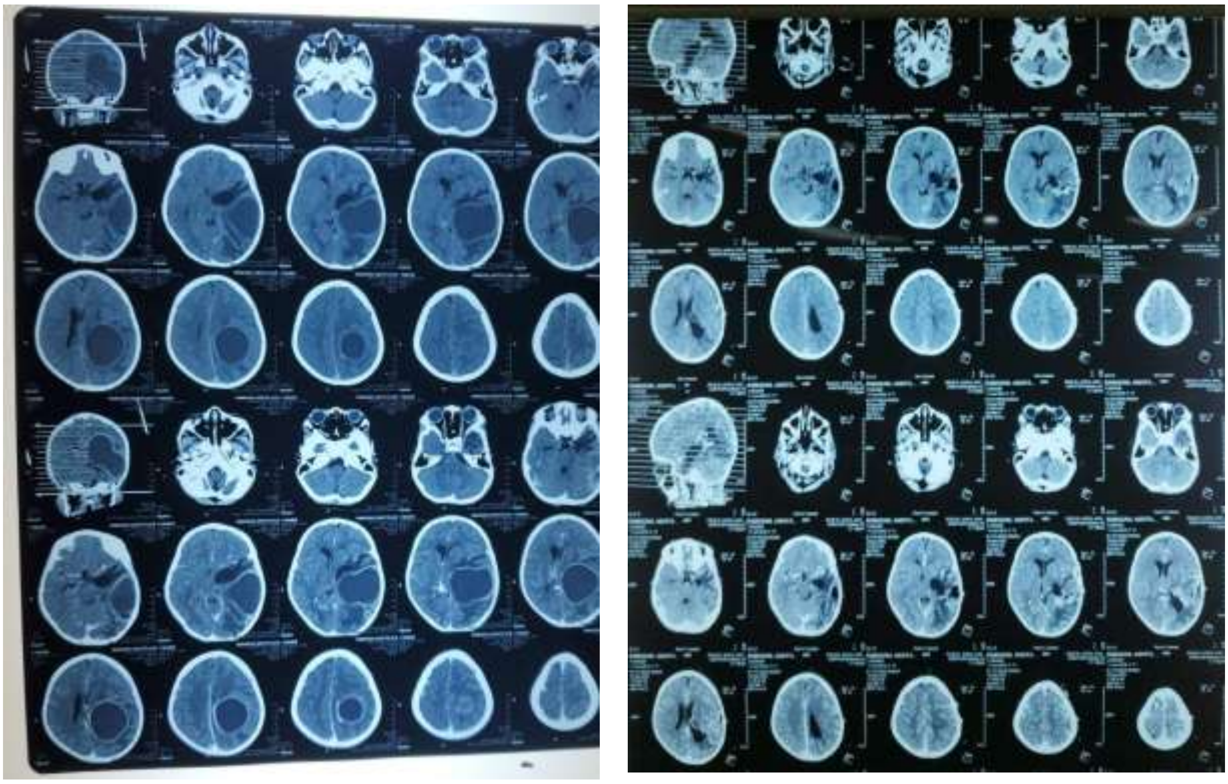

Figure 1. Head CT-Scan. A. Before B. After operation.

3. Discussion

Double outlet right ventricle (DORV) is a rare congenital heart defect where both the aorta and pulmonary artery arise predominantly from the right ventricle. This abnormal anatomy disrupts the normal segregation of oxygenated and deoxygenated blood, leading to a spectrum of physiological consequences. The pathophysiology of DORV involves a complex interplay of abnormal blood flow pathways, pressure and volume overload on the ventricles, and the potential for right-to-left shunting. These factors have profound implications for anesthetic management. In normal cardiac anatomy, the aorta arises from the left ventricle and carries oxygenated blood to the body, while the pulmonary artery arises from the right ventricle and carries deoxygenated blood to the lungs. In DORV, this separation is disrupted, and both great arteries receive blood from the right ventricle. The degree of mixing and the direction of shunting depends on the associated cardiac defects, such as the size and position of the ventricular septal defect (VSD), the presence or absence of pulmonary stenosis, and the relationship of the great arteries to each other. The abnormal blood flow pathways in DORV can lead to an increased workload on the heart and the potential for volume or pressure overload. This can result in ventricular hypertrophy, heart failure, and pulmonary hypertension. The potential for right-to-left shunting can lead to cyanosis, where deoxygenated blood bypasses the lungs and enters the systemic circulation. In patients with DORV, maintaining hemodynamic stability is of paramount importance. The heart is often working harder to compensate for the abnormal circulation, and any disruption to this delicate balance can have serious consequences. Anesthetic agents and techniques must be carefully chosen to avoid depressing cardiac function or causing significant changes in blood pressure or heart rate. The choice of anesthetic induction agent is crucial. Inhalational agents, such as sevoflurane or isoflurane, can cause vasodilation and decrease systemic vascular resistance, potentially leading to hypotension. This can be particularly problematic in patients with DORV, who may already have compromised cardiac function. Intravenous agents, such as propofol or etomidate, may be preferred due to their minimal effects on systemic vascular resistance.

However, these agents can also depress cardiac function, particularly in patients with pre-existing ventricular dysfunction. The choice of induction agent should be individualized based on the patient's specific needs and comorbidities. The maintenance of anesthesia should also be tailored to the individual patient. Inhalational agents can be titrated to achieve the desired depth of anesthesia while minimizing cardiovascular depression. Opioids, such as fentanyl or sufentanil, can provide analgesia and reduce the required dose of inhalational agents. However, opioids can also cause respiratory depression and bradycardia, which may be particularly problematic in patients with DORV. Careful monitoring of respiratory rate and heart rate is essential when using opioids in these patients. Another key consideration in patients with DORV is the potential for hypoxemia. The mixing of oxygenated and deoxygenated blood can lead to lower-than-normal blood oxygen levels. This hypoxemia can be exacerbated by anesthesia, particularly if ventilation is not carefully managed. Ensuring adequate oxygenation throughout the perioperative period is crucial to prevent complications such as brain injury or cardiac arrest. Preoxygenation with 100% oxygen is essential prior to induction of anesthesia. This helps to create an oxygen reserve in the lungs and blood, which can be crucial during periods of apnea or hypoventilation. During the maintenance of anesthesia, the fraction of inspired oxygen (FiO_2) should be adjusted to maintain adequate oxygen saturation. Arterial blood gas analysis may be necessary to accurately assess oxygenation and ventilation. Positive pressure ventilation can also impact the circulation in patients with DORV. Positive end-expiratory pressure (PEEP) can increase intrathoracic pressure, which can decrease venous return and cardiac output. This can be detrimental in patients with DORV, who may already have compromised cardiac function. Tidal volumes should be kept within a normal range to avoid overdistension of the lungs and potential barotrauma. In addition to standard monitoring, such as ECG, non-invasive blood pressure, and pulse oximetry, invasive monitoring may be necessary in patients with DORV. Arterial blood pressure monitoring provides continuous and accurate blood pressure readings, which is particularly important in patients with labile hemodynamics. Central venous pressure monitoring can help assess fluid status and guide fluid management. In some cases, pulmonary artery catheterization may be considered to provide more detailed information about cardiac function and pulmonary vascular resistance. However, this is an invasive procedure with potential complications and should only be used when the benefits outweigh the risks. Patients with DORV may have other associated cardiac defects, such as ventricular septal defect (VSD), pulmonary stenosis, or subaortic stenosis. These defects can further complicate anesthetic management and require careful consideration. The presence of a VSD can lead to left-to-right shunting, which can increase pulmonary blood flow and potentially cause pulmonary hypertension. Anesthetic agents and techniques should be chosen to minimize increases in pulmonary vascular resistance. Pulmonary stenosis can obstruct blood flow from the right ventricle to the lungs, leading to right ventricular hypertrophy and potential heart failure. Anesthetic agents that decrease systemic vascular resistance may worsen right ventricular outflow obstruction and should be used with caution. Subaortic stenosis can obstruct blood flow from the left ventricle to the aorta, leading to left ventricular hypertrophy and potential heart failure. Anesthetic agents that increase systemic vascular resistance may worsen left ventricular outflow obstruction and should be avoided. The choice of anesthetic agents in patients with DORV should be guided by their potential effects on the cardiovascular system. Some agents, such as ketamine, can increase systemic vascular resistance and may be beneficial in patients with hypotension or low cardiac output. Other agents, such as volatile anesthetics, can decrease systemic vascular resistance and may be detrimental in patients with compromised cardiac function. The use of vasoactive drugs, such as inotropes or vasopressors, may be necessary to support hemodynamic stability in patients with DORV. These drugs should be titrated carefully to achieve the desired effect while minimizing potential side effects. Fluid management is a critical aspect of anesthetic care in patients with DORV. Excessive fluid administration can lead to volume overload and heart failure, while inadequate fluid administration can lead to dehydration and hypotension. The goal is to maintain normovolemia, which can be challenging in patients with complex cardiac anatomy. Central venous pressure monitoring can be helpful in assessing fluid status and guiding fluid management. Urine output should also be closely monitored as an indicator of renal perfusion and overall fluid balance. Maintaining normothermia is important in all patients undergoing anesthesia, but it is particularly crucial in patients with DORV. Hypothermia can lead to vasoconstriction and increased pulmonary vascular resistance, which can worsen right-to-left shunting and hypoxemia. Active warming measures, such as forced-air warming blankets, should be used to maintain normothermia throughout the perioperative period. Postoperative care for patients with DORV should focus on maintaining hemodynamic stability, ensuring adequate oxygenation, and managing pain. Close monitoring in the intensive care unit (ICU) is often necessary to ensure early detection and management of any complications.[11-15]

A brain abscess, a localized collection of pus within the brain parenchyma, is a serious and potentially life-threatening condition. It arises from the intricate interplay of infectious agents, host immune responses, and the unique anatomical and physiological characteristics of the brain. In the context of a child with double outlet right ventricle (DORV), a complex congenital heart defect, the presence of a brain abscess introduces additional layers of complexity. This detailed exploration delves into the pathophysiology, clinical presentation, diagnosis, and management of brain abscess, with particular emphasis on the implications for a child with DORV. The development of a brain abscess in a child with DORV is often attributed to a phenomenon known as paradoxical embolism. This occurs when an embolus, typically originating from a distant site of infection, bypasses the filtering mechanisms of the lungs and gains access to the systemic circulation. In individuals with DORV, the presence of a right-to-left shunt, such as a ventricular septal defect (VSD) or a patent foramen ovale, facilitates this process. These shunts allow deoxygenated blood from the right side of the heart to mix with oxygenated blood in the left side, creating a pathway for emboli to travel directly to the brain. The emboli, often laden with bacteria or other infectious agents, can lodge in the intricate network of cerebral blood vessels. Once lodged, they initiate a cascade of inflammatory responses, leading to the formation of a localized abscess. The brain, with its unique immune environment and limited regenerative capacity, is particularly vulnerable to the damaging effects of infection. Chronic hypoxia, a state of reduced oxygen supply to the brain, further contributes to the susceptibility of children with DORV to brain abscesses. The mixing of oxygenated and deoxygenated blood in DORV can result in chronic hypoxemia, compromising the brain's defense mechanisms and rendering it more vulnerable to infection. The clinical manifestations of a brain abscess are diverse and depend on several factors, including the location, size, and virulence of the abscess, as well as the patient's overall health and immune status. Often the most prominent symptom, headache can range from mild and intermittent to severe and persistent. A systemic sign of infection, fever may be present but is not always a reliable indicator, especially in immunocompromised individuals. These symptoms may arise due to increased intracranial pressure or irritation of the brainstem's vomiting center. Seizures, either focal or generalized, can occur due to disruption of normal brain activity by the abscess. A wide range of neurological deficits may manifest, including weakness, numbness, sensory disturbances, speech difficulties, visual disturbances, and cognitive impairment. These deficits often reflect the location of the abscess and the specific brain regions affected. In children with DORV, the symptoms of a brain abscess may overlap with those of the underlying cardiac condition, making diagnosis more challenging. Careful clinical assessment and a high index of suspicion are crucial in these cases. Neuroimaging studies, particularly computed tomography (CT) and magnetic resonance imaging (MRI) scans, are essential for confirming the diagnosis of a brain abscess. These imaging modalities provide detailed visualization of the brain's structure, allowing for the identification of the abscess, its size, location, and characteristics. CT scans, readily available and relatively quick to perform, can detect the presence of an abscess as a well-defined, ring-enhancing lesion. MRI scans, with their superior soft tissue contrast, offer more detailed information about the abscess's internal structure and surrounding edema. In some cases, lumbar puncture may be considered to analyze cerebrospinal fluid (CSF) for signs of infection. However, this procedure carries the risk of herniation in patients with increased intracranial pressure and should be performed with caution. The management of a brain abscess involves a multidisciplinary approach, encompassing medical and surgical interventions tailored to the individual patient's needs. Intravenous antibiotics are the cornerstone of medical management for brain abscess. The choice of antibiotics depends on the suspected causative organism, but broad-spectrum antibiotics are often used initially until the results of culture and sensitivity testing are available. The duration of antibiotic therapy typically ranges from several weeks to months, depending on the severity of the infection and the patient's response to treatment. Anticonvulsants may be prescribed to prevent or control seizures, a common complication of brain abscess. The choice of anticonvulsant depends on the type of seizures and the patient's individual needs. Corticosteroids, such as dexamethasone, may be used to reduce brain swelling and inflammation. However, their use is controversial due to potential side effects, including immunosuppression and increased risk of gastrointestinal bleeding. Surgical intervention may be necessary to evacuate the abscess and relieve pressure on the brain. The specific surgical approach depends on several factors, including the size and location of the abscess, the patient's neurological status, and the presence of any associated complications. Aspiration involves inserting a needle into the abscess cavity to drain the pus. This minimally invasive procedure is typically reserved for smaller, well-defined abscesses that are accessible and do not pose a significant risk of bleeding or damage to surrounding brain tissue. Craniotomy, a more invasive procedure, involves creating a surgical opening in the skull to access the abscess directly. This approach is often necessary for larger or more complex abscesses, those located in deep or critical brain regions, or those associated with significant mass effect or complications. The anesthetic management of patients with brain abscess, particularly those with underlying cardiac conditions like DORV, requires meticulous planning and execution. The patient's blood pressure and heart rate must be closely monitored and controlled throughout the perioperative period. Fluctuations in blood pressure can compromise cerebral blood flow and oxygen delivery, potentially exacerbating brain injury. Maintaining optimal blood oxygen levels is crucial to prevent further brain injury. Hypoxemia can worsen neurological deficits and increase the risk of complications. Measures to reduce brain swelling and prevent increases in intracranial pressure are essential to avoid complications such as herniation, a life-threatening condition where brain tissue is displaced from its normal position. The choice of anesthetic agents and techniques should be tailored to the individual patient's needs and comorbidities. Close monitoring, including invasive blood pressure monitoring and arterial blood gas analysis, is crucial to guide anesthetic management. Postoperative care for patients with brain abscess focuses on monitoring for complications, continuing antibiotic therapy, and providing supportive care. Close observation in the intensive care unit (ICU) is often necessary to ensure early detection and management of any neurological deterioration, infection, or other complications. Continued intravenous antibiotic therapy is essential to eradicate the infection and prevent recurrence. The duration of antibiotic treatment depends on the specific organism, the severity of the infection, and the patient's clinical response. Rehabilitation may be necessary to help patients regain lost function and improve their quality of life. This may involve physical therapy, occupational therapy, speech therapy, and psychological support. The prognosis for patients with brain abscess depends on several factors, including the size and location of the abscess, the patient's overall health and immune status, the causative organism, and the promptness of treatment. With appropriate medical and surgical management, most patients can make a full recovery. However, some patients may experience long-term neurological deficits, such as weakness, sensory disturbances, or cognitive impairment.[16-20]

4. Conclusion

This case report describes the successful perioperative management of a 7-year-old child with DORV undergoing brain abscess evacuation. The presence of DORV presented unique challenges for anesthetic management, requiring careful consideration of the patient's hemodynamic status, oxygenation, and ventilation. Meticulous planning, close monitoring, and individualized anesthetic care were essential to ensure the patient's safety and facilitate a successful surgical outcome. This case highlights the importance of a multidisciplinary approach in managing complex patients with DORV undergoing intracranial procedures. The collaboration between anesthesiologists, surgeons, intensivists, and other healthcare professionals was crucial in providing comprehensive care and optimizing patient outcomes.

5. References

1. Bedforth NM, Aitkenhead AR, Hardman JG. Hematoma and abscess after epidural analgesia. Obstet Anesth Dig. 2009; 29(2): 63–4.
2. Broalet E, N'dri Oka D, Eholie S, Guillao-Lasme E, Varlet G, Bazeze V. Cerebral Abcess and Intracranial Empyemas in Children (Francais). Afr J Neurol Sci. 2002; 21(1).
3. Auyong DB, Tokeshi J, Joshi S, Anderson CTM. Recognition of an incidental abscess and a hematoma during ultrasound-guided femoral nerve block. Reg Anesth Pain Med. 2011; 36(4): 406–9.
4. Subramanian H, Sudhakar B, Vyapaka P, Venu GB. Anesthetic challenges of decompressive craniotomy for the right frontal lobe abscess in a patient with Ebstein's anomaly: a rare case report. Anesth Essays Res. 2012; 6(1): 84–6.
5. Koroki M, Tanigawa Y, Uemura Y, Hirakawa N, Sakaguchi Y. Study of 12 cases of epidural abscess that occurred after epidural puncture. J Jpn Soc Clin Anesth. 2017; 37(3): 289–94.
6. Nagpal G, Flaherty JP, Benzon HT. Diskitis, osteomyelitis, spinal epidural abscess, meningitis, and endocarditis following sacroiliac joint injection for the treatment of low-back pain in a patient on therapy for hepatitis C virus. Reg Anesth Pain Med. 2017; 42(4): 517–20.
7. Perioperative management of uncorrected D-TGA with brain abscess: a case report. J Anesth Crit Care. 2017; 7(1).
8. Kupersztych-Hagege E, Dubuisson E, Szekely B, Michel-Cherqui M, François Dreyfus J, Fischler M, et al. Epidural hematoma and abscess related to thoracic epidural analgesia: a single-center study of 2,907 patients who underwent lung surgery. J Cardiothorac Vasc Anesth. 2017; 31(2): 446–52.
9. Kupersztych-Hagege E, Dubuisson E, Szekely B, Michel-Cherqui M, François Dreyfus J, Fischler M, et al. Epidural hematoma and abscess related to thoracic epidural analgesia: a single-center study of 2,907 patients who underwent lung surgery. J Cardiothorac Vasc Anesth. 2017; 31(2): 446–52.
10. Mohammad Ali W, Ali I, Saa R, Az R, Ahmed M. Recent trends in the epidemiology of liver abscess in western region ofUttar pradesh: a retrospective study. J Surg Anesth. 2018; 02(02).
11. Nagpal G, Flaherty JP, Benzon HT. Diskitis, osteomyelitis, spinal epidural abscess, meningitis, and endocarditis following sacroiliac joint injection for the treatment of low-back pain in a patient on therapy for hepatitis C virus. Reg Anesth Pain Med. 2017; 42(4): 517–20.
12. Um B-K, Ku J-K, Kim Y-S. Diagnosis and treatment of obstructive atelectasis after general anesthesia in a patient with abscess in the maxillofacial area: a case report. J Dent Anesth Pain Med. 2018; 18(4): 271–5.
13. Prasad A, Nag T. Scalp block for drainage of cerebral abscess in a patient with tetralogy of Fallot. J Clin Anesth. 2018; 49: 87.
14. Makito K, Mouri H, Matsui H, Michihata N, Fushimi K, Yasunaga H. Spinal epidural hematoma and abscess after neuraxial anesthesia: a historical cohort study using the Japanese diagnosis procedure combination

database. Obstet Anesth Dig. 2021; 41(4): 175–7.

15. Chandran R, Kiew ASC, Zheng JX, Singh PA, Lim JKT, Koo SH, et al. Experiential learning in simulated parapharyngeal abscess in breathing cadavers. J Anesth. 2021; 35(2): 232–8.
16. Bos EM, van der Lee K, Haumann J, de Quelerij M, Vandertop WP, Kalkman CJ, et al. Intracranial hematoma and abscess after neuraxial analgesia and anesthesia: a review of the literature describing 297 cases. Reg Anesth Pain Med. 2021; 46(4): 337–43.
17. Bos EM sE, Posner KL, Domino KB, de Quelerij M, Kalkman Cor J, Hollmann MW, et al. Haematoma, abscess or meningitis after neuraxial anesthesia in the USA and the Netherlands: a closed claims analysis. Obstet Anesth Dig. 2021; 41(2): 78–9.
18. Bos EM, van der Lee K, Haumann J, de Quelerij M, Vandertop WP, Kalkman CJ, et al. Intracranial hematoma and abscess after neuraxial analgesia and anesthesia: A review of the literature describing 297 cases. Obstet Anesth Dig. 2022; 42(1): 46–8.
19. Crain MA, Fazi A, Hayanga HK, Cook CC, Ellison MB, Sloyer DA. Intraoperative three-dimensional transesophageal echocardiography: Reconstruction of mitral valve ring abscess. J Cardiothorac Vasc Anesth. 2022; 36(8 Pt A): 2563–7.
20. Cheong I. Recognition of bronchopleural fistula after lung abscess rupture using lung ultrasound. J Cardiothorac Vasc Anesth. 2023; 37(10): 2171–2.