Anaesthesia Perioperative Management in Laparotomy Procedure in Neonates with Tetralogy of Fallot (ToF): A Case Study

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ABSTRACT

Tetralogy of Fallot (ToF) is a congenital heart condition characterized by right ventricular hypertrophy, pulmonary stenosis, aortic overriding, and ventricular septal defect. Its presence raises mortality and perioperative risk. Noncardiac abnormalities associated with this condition include neurological, musculoskeletal, and ophthalmological defects, all of which were present in the index case. The complexity of the heart lesion, coupled with individuals’ potential to compensate, the urgency of the operation, and numerous concurrent conditions all present challenges for anesthesiologists when dealing with patients with cyanotic congenital heart disease (CHD) who require extracardiac surgery. The objectives of anaesthesia in patients with ToF are to minimize pulmonary vascular resistance (PVR), maintain or raise systemic vascular resistance (SVR), and prevent intraoperative hypercyanotic episodes. To investigate a case report in neonates with tetralogy of Fallot and discuss further anaesthesia perioperative management in laparotomy procedure in neonates with tetralogy of Fallot (ToF). A 20-days female neonate, weighing 1,9 kg, was referred to our hospital with the diagnosis of high-level bowel obstruction et causa suspect atresia duodenum dd duodenal stenosis, tetralogy of Fallot (ToF), and a Secundum Atrial Septal Defect (ASD) with ASA IV. The patient was planned to undergo general anaesthesia for explorative laparotomy surgery. There were hemodynamic changes during surgery, but they can be appropriately managed. Anaesthesia and surgery were successful, and the patient improved. Preoperative, Durante-operative, and postoperative management was shown. Tetralogy of Fallot (ToF) Children generally have congenital heart defects. Preoperative planning, managing anaesthesia during surgery, and typical postoperative problems in the critical care unit are all perioperative considerations. The procedure will be completed successfully with the help of careful planning and a solid understanding of physiological and pharmacological principles.

Keywords: case study, congenital heart disease, cyanotic, tetralogy of fallot.

I. INTRODUCTION

Tetralogy of Fallot (ToF) is a congenital heart condition that includes right ventricular hypertrophy, pulmonary stenosis, aortic overriding, and ventricular septal defect [1]. Its presence raises mortality and perioperative risk. Noncardiac abnormalities associated with this condition include neurological, musculoskeletal, and ophthalmological defects, all of which were present in the index case [2]. The most prevalent kind of cyanotic congenital heart disease (CHD), tetralogy of Fallot (ToF), was one of the first to be successfully treated by cardiac surgeons. Due to the early surgical success, there is now a sizable adult cohort of ToF survivors presenting with acquired adult issues such as coronary artery disease and the pathophysiology of previously corrected CHD [3].

The complexity of the heart lesion, individuals’ ability to compensate, the urgency of the surgery, and numerous concurrent conditions all present challenges for anesthesiologists when dealing with patients with CHD who require extracardiac surgery. A diagnosis of CHD raises the mortality risk for both minor and major surgery, regardless of whether mortality is determined in a few days or after a month, according to a clinical assessment of 191,261 patients under the age of 18 who had one or more non-cardiovascular surgeries. Additionally, neonates and babies with CHD had a twofold increased risk of dying from noncardiac surgery in the same clinical population [4]. A review found that 75% of children under the age of two had CHD and underwent noncardiac surgery experienced anaesthesia-related juvenile cardiac arrest [5].

The objectives of anaesthesia in patients with ToF are to minimize pulmonary vascular resistance (PVR), maintain or raise systemic vascular resistance (SVR), and prevent intraoperative hypercyanotic episodes.
When a neonate with a complex cardiac condition, such as unstable Tetralogy of Fallot (TOF), truncus arteriosus (TA), or hypoplastic left heart syndrome (HLHS), presents to us for treatment of a general surgical emergency, anaesthesia can still be administered to them with only minor problems [2]. In this article, a case report involving newborns with tetralogy of Fallot will be examined. Other anaesthetic perioperative treatments will be covered concerning laparotomy procedures in newborns with tetralogy of Fallot (ToF).

II. CASE STUDY

A 20-days female neonate, weighing 1.9 kg, was referred to our hospital with the diagnosis of high-level bowel obstruction et causa suspect atresia duodenum dd duodenal stenosis, tetralogy of Fallot (ToF), and a Secundum Atrial Septal Defect (ASD) with ASA IV. She presented with vomitus since the first day of birth and was disabled from drinking. The colour of vomit at the beginning was clear but became green. The mother did not perform routine antenatal check-ups during pregnancy. She was born 2.3 kg at 38-39 weeks of pregnancy. There was no history of seizure, icteric, cyanosis, oedema, or fever.

The physical examination found spontaneous ventilation and patent airway, SpO2 68 %-77%, respiratory rate of 48 – 58/min, vesicular lung sound, and heart rate of 135-145 bpm with murmur sound. The neurology status, urinary status, and gastrointestinal status were normal. The blood test showed normal with mild leukocytosis (12.580 µL, Hb 11.3 g%, and platelet 234.000 mm3). Postnatal echocardiography revealed regurgitation tricuspid valve, pulmonary stenosis, subaortic ventricular septal defect (VSD), Secundum ASD, and overriding of the aorta. The babygram showed air fills the gaster and proximal duodenum, suggesting duodenal atresia. The planning was to administer IVFD D5 ¼ NS 0,9% 9 cc/hour, ampicillin sulbactam 3×130 mg E6, gentamicin 1×10 mg E6, propranolol 3×1 mg, pre-operation preparation (breastfeeding fasting for 4 hours, or 6 hours for formula milk consumption and clear water for 2 hours prior to the surgery), NICU care after surgery, preparation of 20cc baby pack PRC (packed red cell), and femoral CVC.

The patient was planned to receive general anaesthesia intubation using the endotracheal tube of ABF no. 4, WBF no 3,7, and uncuff ETTO 3/3,5/4 with a depth of 10-12 cm. The patient was monitored with electrocardiography, pulse oximetry, end-tidal carbon dioxide, and temperature preoperatively. Anaesthesia was induced with ketamine 2 mg/kg, fentanyl 8 mcg/kg, and atracurium 1.5 mg/kg IV. Anaesthesia was maintained with 1 MAC sevoflurane with 100% oxygen and in-line dobutamine, Milrinone, and epinephrine.

Intraoperative pulse readings varied between 58–110 bpm. SPO2 reading varied between 75% and 98% (see Fig. 1). Desaturation and bradycardia occurred (SpO2 56% and HR 60 bpm). This was treated by giving a Milrinone loading dose of 50 mcg/kg in 10 min, followed by 0.375 mcg/kg/min, and started administration of epinephrine at 0.03 mcg/kg/min. Inhalation anaesthesia was discontinued. Afterwards, hemodynamic improvement was obtained with HR 115x/min and SpO2 94%. Atresia duodenum was suspected, along with ToF and Secundum ASD. Therefore, exploratory laparotomy was performed with a blood loss of 5 ml. As much as 60 ml of Crystalloid solution was used for maintenance and replacement of loss. Besides blood loss, urine output was 1,34 ml/kg/hour and BC 25 ml. The blood sugar was maintained every hour (86 mg/dl in the first hour, 120 mg/dl for the second hour, and 150 mg/dl for the last hour).

Postoperatively, the endotracheal tube was still on, and the patient was shifted to NICU for further care. Patient received Ropivacaine 0,2%, Dexamethasone 0,4 mg, Clonidine 5 mg, Syringe Morphine 0,4 mg, Ketamine 2 mg with rate of 1 cc/jam. The presentation of neonates after surgery is shown in Fig. 2 and Fig. 3.
The capillary refill was < 2 seconds, HR 140-145 bpm on dobutamine 10 mcg/kg/min, and the heart sound was regular with a murmur. The GCS was 15 on fentanyl at 1 mcg/kg/hour. The orogastric tube was on. There was no distention on the abdomen, oedema, or cyanosis. The patient urinated in her diapers. To maintain energy intake, the patient was planned to receive 150-180 kcal, protein 4-5 g/day, fat 2 gram/day, GIR 14.4 gram/day, fluid intake 60 ml/day, sodium 4-12 mcg/day, potassium 4-6 mcg/day, and calcium 400-800 mg/day.

Neonatal Infant Pain Score (NIPS) to assess pain was two while the patient was on fentanyl at 1 mcg/kg/hour. The fluid balance was maintained using D5 ¼ NS + KCL 4 ml + NS 3% 10 ml + Ca gluconate 2 ml with the rate of 3 ml/hour. The patient also received Meropenem 3×40 mg, Paracetamol Syrup 4×20 mg, Erythromycin 3×4 mg, Propranolol 3×1 mg, and planned to fast five days postoperative.

The follow-up on day two after surgery found progress in the clinical condition. The patient was in NIV ST pins 10 peep 7 i.e 1:2 rate 60 FiO2 30% VT 10 ml, respiration rate 58-60 x/min, and SpO2 75-80%. The heart rate was still 140-145 bpm on dobutamine 10 mcg/kg/min, with a murmuring sound. There is progressivity in NIPS score (0 scores) on fentanyl at 0.5 mcg/kg/hour.

### III. DISCUSSION

The most prevalent kind of cyanotic congenital heart disease (CHD), the tetralogy of Fallot (ToF), was one of the first to be successfully treated by cardiac surgeons [3]. Etienne-Louis Arthur Fallot described the four anatomical traits that appeared in a specific group of cyanotic patients in a series of five studies published in the Marseille Medical magazine in 1888 [6]. He described the standard tetrad: (1) Right ventricular (RV) hypertrophy. (2) Pulmonary outflow tract obstruction (stenosis or atresia). (3) Ventricular septal defect (VSD). (4) Overriding aorta. 10% of children with CHD fall within the ToF category. With a male to female ratio of 1:1, the incidence is 1 in 3500 live births. Although the recurrence in siblings is just approximately 3%, cases are sporadic [7]. Twenty percent of the time, syndromes such VACTERL association (vertebral, anal, cardiac, tracheoesophageal fistula, println, and limb abnormalities) and CHARGE association are linked to ToF. (coloboma, heart anomaly, choanal atresia, retardation, and genital and ear anomalies). The management of restricted airways, the treatment of low calcium levels, and a contraindication to tranesophageal echocardiography (TEE) probe placement following prior tracheoesophageal fistula closure are just a few of the additional difficulties these syndromes may bring to the anesthesiologist [8].

An intracardiac right-left shunt and elevated right ventricle post load are linked to the pathogenesis of the tetralogy of Fallot. The consequences include chronic hypoxemia, hypercarbia, respiratory alkalosis and cyanosis, polycythemia, and hypertventilation. The complications include heart arrhythmias, right and left heart failure, artery and vein thrombosis, infections (endocarditis and brain abscess), and hypercyanotic spells. In the case described, the patient had vomitus and a lymphocytosis complication that was thought to be caused by an infection [1].

Children who need surgical palliation or repair for ToF should be looked after in a setting with experience treating children with congenital heart disease. Recent transcoronary echocardiography, a complete blood count, an EKG, a laboratory study of blood chemistry, and coagulation testing should all be part of the preoperative evaluation, along with a history and physical examination. The connection of coagulation problems in patients with cyanotic congenital cardiac malformations makes the latter research particularly significant. The pathophysiology of these coagulation abnormalities is probably heavily influenced by polycythemia and the accompanying hyperviscosity. Alterations in platelet function and low coagulation factor concentrations are other contributory variables [9].

Preventing a deteriorating right-left shunt is necessary for anaesthetic care of the patient with uncorrected TOF. In order to minimize dehydration, a reduction in systemic vascular resistance, and an increase in pulmonary vascular resistance, anaesthetic procedures should be used. General anaesthesia provides the benefit of allowing better maintenance of hemodynamic stability, airway control, and improved hemodynamic and respiratory monitoring when using safe anaesthetic agents and doses, as well as appropriate ventilation [1].

Because of the inadequate pulmonary blood flow, the presence of a right to left intracardiac shunt causes the inhalational induction to be prolonged; in contrast, an IV induction is quicker. The preferred induction drug is IV ketamine since it raises SVR [10]. A supplemental caudal block should be avoided as it may lead to low SVR. To avoid dynamic right ventricular outflow tract obstruction, euvolemia should be maintained. It is best to avoid infusion pump air bubbles since they can push emboli into the vascular system. Hypoxia, hypercapnia, and acidosis (metabolic and respiratory) should be avoided as they could enhance PVR. The hypertrophied pulmonary infundibulum's spasm during surgery may lead to the development of cyanotic spells [11]. It responds to an increase in volume and a rise in SVR by reducing infundibular spasm with beta-blockers and stopping it with alpha agonists like phenylephrine or ephedrine. The right to left shunting is reduced, and arterial oxygenation is improved with increased SVR. ABG analysis is helpful in these circumstances since pulse oximetry overestimates arterial oxygen saturation as saturation drops, end-tidal carbon dioxide readings underestimate PaCO₂, and the disparity worsens with hypoxemia [12].

### IV. CONCLUSION

Children who have Tetralogy of Fallot (TOF) commonly have congenital heart defects. Preoperative planning, managing anaesthesia during surgery, and typical postoperative problems in the critical care unit are all perioperative considerations. The procedure will be completed successfully with the help of careful planning and a solid understanding of physiological and pharmacological principles.
REFERENCES


