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Ventilator Weaning Through Spontaneous Breathing Trials in Children with Tetralogy of Fallot in the PICU: A Case Report

Megah Fitrian[1, 2], Kadek Ayu Erika[2], Muhammad Yunus[1]

1. PICU Department, Dr. Wahidin Sudirohusodo Hospital, Makassar, Sulawesi Selatan, Indonesia
2. Faculty of Nursing, Hasanuddin University, Makassar, Sulawesi Selatan, Indonesia

*E-mail: kadek20_uh@yahoo.com

Abstract

Tetralogy of Fallot (TOF) is a congenital heart defect that causes chronic low oxygen levels, increased right ventricular workload, and a higher risk of complications. Weaning mechanical ventilation in patients with TOF is particularly challenging due to right ventricular dysfunction, muscle weakness, and the risk of heart failure. This study evaluates the use of a spontaneous breathing trial (SBT) strategy with pressure support ventilation (PSV) mode for mechanical ventilation weaning in pediatric patients with TOF. An observational study was conducted on a six-year-old pediatric patient with TOF and a cerebral abscess who underwent mechanical ventilation weaning using the SBT technique with PSV mode. The patient's vital signs (heart rate and respiratory rate) and oxygen saturation were monitored 24 h before, during, and 24 h after the trial. Weaning was successfully completed within 11 h without signs of failure, such as hypoxemia or muscle fatigue. The rapid shallow breathing index measured prior to weaning was within an acceptable range. The patient's physiological parameters remained stable throughout the process, and no Tet spells were observed. These findings suggest that SBT combined with PSV mode is a viable weaning strategy in pediatric TOF cases, particularly when a longer trial duration is used. However, because this report is based on a single case, the results should be interpreted with caution and cannot be generalized to all patients with TOF.

Keywords: pediatrics, pressure support ventilation, spontaneous breathing trial, tetralogy of fallot, ventilator weaning

Abstrak

Penyapihan Ventilator dengan Teknik* Spontaneous Breathing Trial *pada Anak dengan* Tetralogy of Fallot *di Ruang PICU: Studi Kasus. Tetralogy of Fallot (TOF) *adalah kelainan jantung bawaan yang menyebabkan kadar oksigen rendah kronis, beban kerja pada ventrikel kanan meningkat, dan risiko komplikasi yang lebih tinggi. Penyapihan ventilasi mekanis pada pasien dengan* TOF *sangat menantang karena adanya disfungsi ventrikel kanan, kelemahan otot, dan risiko gagal jantung. Studi ini mengevaluasi penggunaan strategi* Spontaneous Breathing Trial (SBT) *dengan mode* Pressure Support Ventilation (PSV) *dalam proses penyapihan ventilasi mekanis pada pasien anak dengan* TOF. *Sebuah studi observasional dilakukan pada pasien anak berusia enam tahun dengan* TOF *dan* cerebral abscess *yang menjalani penghentian penggunaan ventilasi mekanis menggunakan teknik* SBT *dengan mode* PSV. *Tanda-tanda vital pasien (denyut jantung dan laju pernapasan) dan saturasi oksigen dipantau 24 jam sebelum, selama, dan 24 jam setelah uji coba. Penyapihan ventilasi mekanis berhasil diselesaikan dalam 11 jam tanpa tanda-tanda kegagalan, seperti hipoksemia atau kelelahan otot. Nilai* rapid shallow breathing index *yang diukur sebelum penyapihan berada dalam rentang yang dapat diterima. Selama proses penyapihan, prameter fisiologis pasien tetap stabil dan tidak ada* Tet spells *yang diamati. Temuan ini menunjukkan bahwa penggunaan* SBT *dengan mode* PSV *dapat menjadi strategi penyapihan ventilator yang layak pada kasus* TOF *pediatrik, terutama saat menggunakan durasi uji coba yang lebih lama. Namun, karena laporan ini hanya berdasarkan satu kasus, hasilnya harus ditafsirkan dengan hati-hati dan tidak dapat digeneralisasi untuk semua pasien dengan* TOF.

Kata Kunci: *pediatrik, penyapihan ventilator,* pressure support ventilation*,* spontaneous breathing trial*,* tetralogy of fallot

Introduction

Tetralogy of Fallot (TOF) is one of the most common congenital heart defects, accounting for approximately 7%–10% of all congenital heart diseases (CHDs) (Horenstein et al., 2024).

It is defined by four primary cardiac anomalies: pulmonary stenosis, which narrows the pathway that carries blood from the right ventricle to the lungs; a ventricular septal defect (VSD), which allows mixing of oxygenated and deoxygenated blood; right ventricular hypertrophy caused by increased workload; and an overriding aorta, in which the aorta receives blood from both ventricles instead of just the left ventricle. Together, these defects lead to insufficient oxygenation of the blood (chronic hypoxemia), resulting in cyanosis, developmental delays, and an increased risk of long-term complications, including heart failure.

A primary challenge in managing patients with TOF in intensive care is the need for prolonged mechanical ventilation, often due to respiratory muscle weakness and residual pulmonary dysfunction (Hammett & Griksaitis, 2023). Their compromised cardiopulmonary function increases the risk of weaning failure, making the transition to spontaneous breathing particularly difficult. Premature weaning may lead to respiretory distress and hemodynamic instability, while delayed weaning raises the likelihood of ventilator-associated complications such as pneumonia, airway trauma, and prolonged ICU stay—all of which contribute to increased morbidity and mortality (Weinberger et al., 2021).

Discontinuing mechanical ventilation is a crucial step in the recovery process of critically ill patients, particularly those with CHD. In patients with TOF, the process is especially challenging, as any additional respiratory workload during weaning may compromise cardiac output, leading to hypoxemia, increased respiratory effort, and ultimately, weaning failure (Finkelstein et al., 2025). Successful ventilator weaning occurs when the pulmonary system can sustain spontaneous breathing. Both respiratory and non-respiratory factors influence this process, with oxygenation status serving as a key predictor of success. Optimizing cardiovascular function and psychological well-being further enhances the likelihood of successful liberation from ventilatory support (Elsehrawy & Saleh, 2024; Huang et al., 2025; Kaur & Vines, 2025).

Several strategies have been developed to improve the success of ventilator weaning. Spontaneous breathing trials (SBTs) are commonly used to assess a patient's readiness to breathe independently for 30–120 min with minimal ventilatory support (Butcher et al., 2018). Another widely used method is pressure support ventilation (PSV), in which a predetermined level of inspiratory pressure is applied to reduce respiratory effort and facilitate the transition to spontaneous breathing (Na et al., 2022). Other approaches—such as T-piece trials or gradual reductions in ventilatory support—are also employed depending on the patient's clinical condition. Research indicates that combining SBT with PSV is one of the most effective strategies for ventilator weaning, as it supports early extubation while minimizing the likelihood of reintubation (Na et al., 2022). However, in patients with TOF, the weaning process requires careful monitoring, with particular attention to respiratory effort, gas exchange, and hemodynamic stability to prevent complications.

The complexity of ventilator weaning increases when comorbid conditions, such as brain abscesses, are present. Brain abscesses in patients with TOF may arise from right-to-left shunting in uncorrected or partially corrected cases, which allows microorganisms to bypass pulmonary filtration. This can lead to neurological impairment, decreased consciousness, and reduced respiratory drive—factors that further contribute to weaning failure (Bodilsen et al., 2024; Cinotti et al., 2018). In patients with unoperated TOF, chronic hypoxemia may also result in polycythemia and hyper viscosity, predisposing them to brain abscess formation. Clinical manifestations typically include headaches, fever, seizures, altered mental status, focal neurological deficits, nausea, and vomiting (Lakhani et al., 2020). These conditions may impair the patient's ability to maintain airway patency, clear secretions, and coordinate respiratory efforts, thereby increasing the risk of complications such as aspiration and reintubation.

Optimal weaning in such complex cases requires a multidisciplinary approach involving intensivists, cardiologists, neurologists, and respiratory therapists. A structured weaning plan should account for the patient's neurological status, hemodynamic stability, pulmonary function, and infection control measures (Shahu et al., 2023). Ensuring that the patient is sufficiently alert to protect their airway, can maintain adequate perfusion without excessive right ventricular pressure, and has optimized pulmonary function is essential for achieving successful weaning.

This study aims to evaluate the effectiveness of using SBTs combined with PSV in the weaning process for patients diagnosed with TOF and brain abscess. It assesses weaning success based on criteria including a PEEP requirement of <8 cmH_2O and FiO_2 <0.4, absence of increased work of breathing, and stable cardiovascular function. Additional parameters considered for weaning include a PaO_2/FiO_2 ratio of 150–300, hemoglobin levels >8–10 g/dL, absence of respiratory acidosis, normal electrolyte and acid–base balance, no fever (temperature <38°C), minimal use of hemodynamic support medications, and adequate cough strength. Key clinical outcomes in patients experiencing respiratory failure requiring invasive mechanical ventilation are also evaluated. By examining the effectiveness of these weaning strategies in complex clinical scenarios, this study can provide valuable insights into optimizing ventilatory management for high-risk patients. This approach aligns with the ethical principle of beneficence, which emphasizes the obligation to take actions that promote patient well-being and benefit.

Case Illustration

Patient Description. Patient M, a six-year-old boy born on August 18, 2018, was admitted to the Emergency Department on December 5, 2024, with sudden-onset shortness of breath that began approximately one hour prior to arrival. He experienced Tet spells accompanied by cyanosis of the fingers and toes. To support oxygenation, he was intubated and placed on mechanical ventilation before being transferred to the Pediatric Intensive Care Unit (PICU). A chest X-ray performed on December 7, 2024, revealed bilateral pneumonia, cardiomegaly consistent with TOF, an endotracheal tube positioned approximately 0.45 cm above the carina, and a gastric tube whose tip was not visible on imaging. These findings indicated significant pulmonary involvement, which could further compromise his already fragile cardiopulmonary status.

On December 8, 2024, the patient was somnolent, with a FOUR (Full Outline of UnResponsiveness) score of 7 (E1M1B4R1), indicating impaired neurological status. The FOUR score is a 17-point scale (ranging from 0 to 16), with lower scores reflecting a worsening level of consciousness. It evaluates four domains of neurological function: eye responses, motor responses, brainstem reflexes, and breathing patterns. The patient's vital signs included a blood pressure of 90/60 mmHg, pulse rate of 148 beats per minute (tachycardia) with a strong palpable pulse, respiratory rate of 32 breaths per minute (tachypnea) with regular chest breathing, body temperature of 36.5°C, and oxygen saturation (SpO_2) of 78% (which falls within the expected range for patients with TOF, normal value 60–80%). He remained on mechanical ventilation in PC-AC mode (RR: 15, PEEP: 5 cmH_2O, PS: 6 cmH_2O, FiO_2: 70%). Secretions were present in both the endotracheal tube (ETT) and oral cavity, and rhonchi were audible in both lung fields, suggesting ongoing pulmonary congestion. Capillary refill time was under 3s, indicating preserved peripheral perfusion despite his underlying cardiac condition.

Anthropometric measures revealed that the patient was 98 cm in height and weighed 11.2 kg. His nutritional status was classified as severe malnutrition (weight-for-age 53.33%), short stature (height-for-age 85.2%), and undernourished (weight-for-height 74.66%). Malnutrition is common in children with CHD, particularly TOF, due to increased metabolic demands and feeding difficulties. His compromised nutritional status may have contributed to increased susceptibility to infections and prolonged recovery, highlighting the need for targeted nutritional support to improve his overall condition.

During the assessment, the patient continued to have excessive secretions in the ETT, with persistent rhonchi audible in both lung fields. Although cyanosis was still present at the fingertips, no active Tet spells were observed. Management focused on optimizing oxygenation, reducing pulmonary congestion, and preventing further respiratory deterioration.

After four days in the PICU, on December 12, 2024, the patient was scheduled for extubation, with close monitoring of both respiratory and

Table 1. Patient Characteristics

Age /Date of Birth	6 years 3 months/08-18-2018
Gender	Male
Weight	11.2 kg
Medical Diagnosis	TOF+CEREBRAL ABSCESS POST CRANIECTOMY
Nursing Diagnosis	Impaired child ventilatory weaning response associated with airway hypersecretion (NANDA International, 2024).
Drug Therapy	Holliday Segar Fluid Requirements – Respiratory Distress (20%) – 211 (medicine) = 669 ml/24 hours Fentanyl 1mcg/kgbb/intravenous Midazolam 1mcg/kgbb/intravenous Ceftriaxone 1.2 grams/24 hours/intravenous Gentamicin 30 mg/12 hours/intravenous Epinephrine continuous/ 0.1 mcg/kgbb/intravenous
Medical Therapy	ETT + ventilator with PCV mode, PEEP 5, PS 6, FiO2 70% I:E Ratio 1:2, VT 102 ml. Urinary catheter NGT nutrition
Condition before Weaning	Vital signs were within normal limits. Pulse rate: 82 beats/minute Respiratory rate: 28 times/minute Temperature: 36.3°C
	Blood gas analysis results were within normal limits. pH 7.432 pO2 196.4 mmHg pCO2 35 mmHg HCO3 23.3 mmol/l
	Blood electrolyte lab results were within normal limits. Hb = 16.8 gr/dl Sodium = 133 mmol/l Potassium = 4.4 mmol/l Chloride = 104mmol/l PaO2/FiO = 196.4/0.7 = 280.5 (within normal limits)
Reasons to start weaning	The patient had met the weaning criteria, which include a PEEP of <8 cmH_2O and FiO_2 <0.4, with no signs of increased work of breathing and a stable cardiovascular system. Additional parameters considered for weaning include a PaO_2/FiO_2 ratio of 150–300, hemoglobin levels >8–10 g/dL, the absence of respiratory acidosis, normal electrolyte and acid–base balance, no fever (temperature <38°C), minimal use of hemodynamic support drugs, and adequate cough strength.

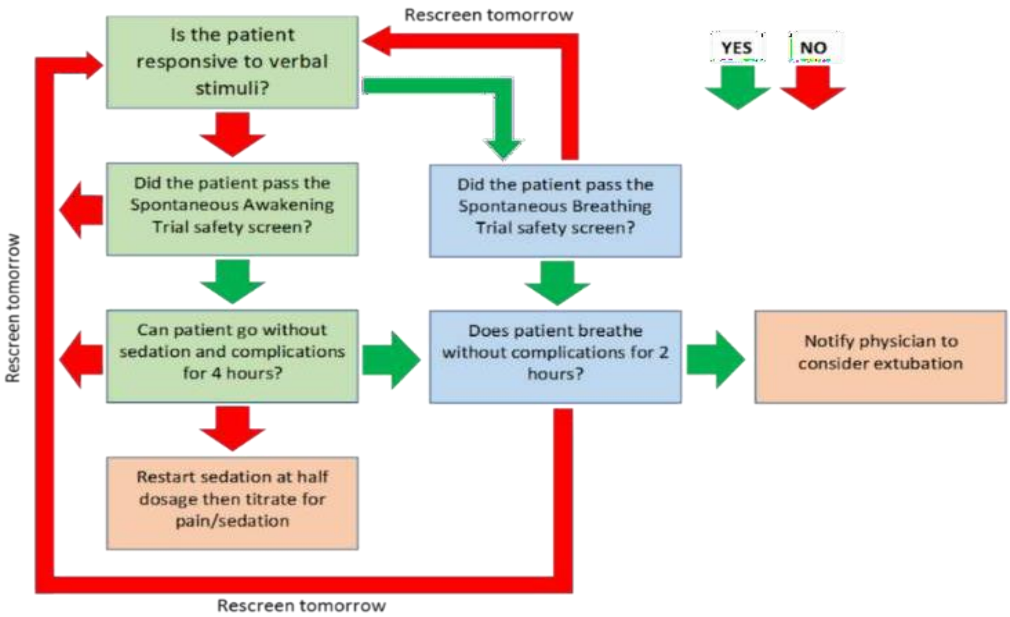

Figure 1. SBT Protocols (Agency for Healthcare Research and Quality [AHRQ], 2017)

hemodynamic status. Given his history of Tet spells, cardiomegaly, and pneumonia, a gradual weaning approach was employed to minimize the risk of post-extubation respiratory failure. Laboratory parameters—including hemoglobin levels, electrolytes, and arterial blood gases—were reviewed to ensure clinical stability prior to extubation. Nutritional supplementation and pulmonary physiotherapy were emphasized to support recovery following extubation. A multidisciplinary team, comprising pediatric cardiologists, pulmonologists, and critical care specialists, collaborated to optimize his care and prevent complications. Further details are provided in Table 1.

Observation Steps

Preparations. Prior to data collection, formal approval for this case report was obtained from the Faculty of Nursing, Hasanuddin University, as documented in letter number 04754/UN4.18/TA.05.24/2024. Following institutional approval, informed consent was obtained from the patient's parents, allowing the study to proceed.

Determining the Appropriate Weaning Technique. Weaning involves gradually reducing ventilator support until the patient can breathe independently. A key indicator of successful weaning is the patient's ability to maintain adequate spontaneous breathing with minimal support for 1–2 h, after which they are typically considered ready for extubation (Malisie et al., 2024). Throughout the weaning process, the medical team closely monitors respiratory parameters, gas exchange, and hemodynamic stability to minimize the risk of extubation failure. Ventilator settings are adjusted based on the patient's condition, with a spontaneous breathing trial (SBT) conducted using PSV/SPN-CPAP mode (settings: PEEP 5 cmH_2O, PS 12 cmH_2O, FiO_2 45%) in accordance with the standardized weaning protocol outlined in Figure 1. Additional assessments—including cough strength, secretion clearance, and neurological status—are also performed to ensure that the patient is fully prepared for extubation and to reduce the likelihood of reintubation.

Monitoring Physiological Parameters. Physiological parameters, including vital signs and SpO_2, were continuously monitored for 24 h before weaning, throughout the 11-h weaning process, and for 24 h post-weaning (after extubation). During this period, airway patency was maintained, excessive secretions were managed,

Table 2. Observations Results

Parameters	Time		
	Before trial	During trial	After trial
Level of Consciousness (FOUR Score)	13 (E3M4B4R2)	14 (E4M4B4R2)	16 (E4M4B4R4)
Vital signs			
Pulse rate (beats/minutes)	124.2 ± 29.2	94.7 ± 20.1	75.5 ± 12.8
Respiratory rate (times/minutes)	40.9 ± 9.1	27.9 ± 7.2	25.1 ± 3.9
SpO_2	84.1 ± 7.3	83.1 ± 2.9	91.4 ± 6.4
Laboratory Results (Blood)			
Hemoglobin (gr/dL)	16.8	–	17.5
Hematocrit (%)	53		53
Sodium (mmol/l)	133		130
Potassium (mmol/l)	4.4		3.5
Chloride (mmol/l)	104		99
Tet Spell	None observed	None observed	None observed

and continuous assessments were conducted to detect any signs of respiratory distress or hemodynamic instability. Ventilatory support was adjusted as needed to ensure a smooth transition to spontaneous breathing.

Observations Results. Weaning was successfully completed over 11 h with minimal sedation. Throughout the process, the patient exhibited no signs of failure, such as hypoxemia or respiratory fatigue, which are typically indicative of weaning difficulties. Further details are provided in Table 2.

During the weaning trial, the patient was fully conscious and exhibited no signs of confusion, as reflected by a FOUR score of 14 (E4M4-B4R2), indicating intact neurological function. Laboratory findings demonstrated a slight increase in hemoglobin levels, consistent with persistent polycythemia—a common feature in uncorrected TOF due to chronic hypoxemia. Although hematocrit levels remained elevated, no further increase was observed during the trial. While these values fall outside the normal pediatric range, they are expected in patients with TOF and did not indicate any acute clinical deterioration, making the changes clinically tolerable during the weaning process. Electrolyte levels were within normal limits. Additionally, no Tet spells—sudden drops in oxygen saturation or episodes of respiratory distress commonly seen in patients with TOF —were observed.

The successful trial demonstrated that the patient tolerated the reduction in ventilatory support without signs of respiratory compromise, maintaining stable respiratory and neurological status throughout. Vital signs showed a progressive decline in both heart rate and respiratory rate, indicating improved hemodynamic stability and reduced work of breathing. Although SpO2 slightly decreased to 84.1% during the trial, it remained within an acceptable range for patients with TOF and improved significantly following extubation. These trends indicate favorable clinical responses, supporting the patient's readiness for ventilator liberation.

Successful weaning within this timeframe suggests that the patient was prepared to transition to spontaneous breathing. Complete data on vital signs—including pulse rate, respiratory rate, and SpO_2—are presented in Figure 2.

Discussion

The results of this observation indicate that the 11-h SBT contributed to successful ventilator weaning in patient M. The SBT protocol, using

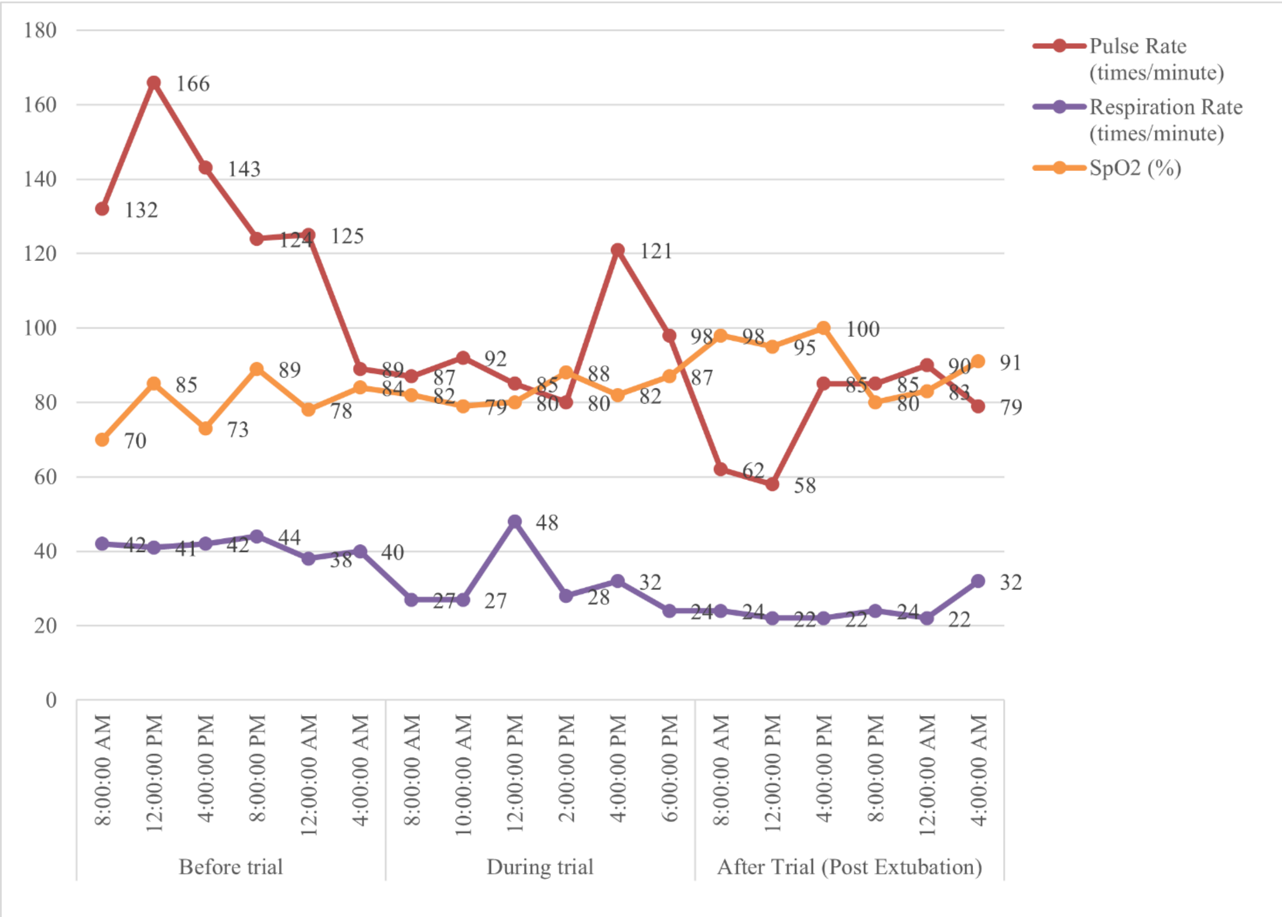

Figure 2. Vital Signs (Pulse Rate and Respiration Rate) and SpO_2, 24 Hours Before Weaning, 11 Hours During Weaning, and 24 Hours After Weaning (Post Extubation)

PSV in SPN-CPAP mode, proved effective in facilitating the transition from mechanical ventilation to spontaneous breathing. Successful weaning is influenced by several factors, including a PaO_2/FiO_2 ratio of 150–300, hemoglobin levels above 8 g/dL, and stable electrolyte and hemodynamic conditions (Malisie et al., 2024). All of these parameters were confirmed prior to initiating the weaning process, and continuous clinical assessments were performed throughout to minimize the risk of failure.

The stability of the patient's vital signs further supported readiness for ventilator weaning. A gradual decline in heart rate and respiratory rate was observed throughout the weaning period, reflecting improved autonomic balance and reduced work of breathing. Notably, SpO2 remained within the expected range for patients with TOF during the trial and improved significantly after extubation, indicating effective gas exchange and adequate pulmonary adaptation to spontaneous breathing. These physiological trends are consistent with favorable cardiopulmonary responses during weaning and represent key predictors of extubation success (Napolitano et al., 2024).

In parallel, laboratory parameters corroborated the patient's clinical stability. Hemoglobin levels increased slightly from 16.8 to 17.5 g/dL, reflecting persistent polycythemia—a compensatory response to chronic hypoxemia commonly observed in uncorrected TOF. Hematocrit remained stable at 53%, and electrolyte levels (sodium, potassium, chloride) were within normal limits, indicating appropriate fluid and metabolic regulation. Blood gas analysis prior to weaning demonstrated normal pH, pCO_2, and PaO_2/FiO_2 ratio, confirming adequate oxygenation and ventilation without evidence of respiratory acidosis. Collectively, these laboratory findings provided further assurance of physiological resilience during weaning and supported the clinical decision to proceed with extubation safely (Malisie et al., 2024).

Successful weaning with a prolonged SBT is supported by the use of PSV, which provides optimal respiratory assistance while minimizing the risk of sudden hypoxemia or cardiovascular instability. These findings are consistent with previous studies demonstrating that SBT supported by PSV effectively increases weaning success (Burns et al., 2024; Na et al., 2022). Employing a standardized approach to SBT—including appropriate timing and ventilator adjustments based on the patient's condition—was crucial in enhancing the likelihood of successful weaning (Roberts et al., 2024). Additionally, a gradual weaning strategy has been shown to reduce the risk of weaning failure and complications associated with prolonged mechanical ventilation (Fadila et al., 2022). Implementing individualized weaning protocols based on the patient's clinical status is particularly important in pediatric patients with CHD, whose cardiopulmonary function is highly sensitive to abrupt changes in ventilatory support.

The duration of SBT is a critical factor in weaning success. Several studies have shown that a 30-min SBT with PSV improves extubation success rates compared to a 120-min trial using a T-piece (Knox et al., 2023; Subirà et al., 2019). However, for patients at high risk of reintubation, longer SBT durations of 120 min or more are recommended (Yi et al., 2021). In patients with TOF, the need for a prolonged SBT is likely related to their elevated risk of hypoxia and right ventricular dysfunction, both of which can significantly affect breathing endurance (Hammett & Griksaitis, 2023). Extended SBT duration allows for better physiological adaptation to spontaneous breathing while preventing excessive respiratory muscle fatigue, a benefit that is particularly important for pediatric patients with pre-existing cardiopulmonary conditions.

This case study provides new insights into the use of prolonged SBT with PSV mode in pediatric patients with TOF. Patients with special conditions such as TOF may require longer SBT durations due to their increased susceptibility to chronic hypoxemia, right ventricular dysfunction, and higher risk of respiratory fatigue. While previous studies have suggested that an SBT duration of 30–120 min is generally sufficient to assess extubation readiness (Na et al., 2022; Subirà et al., 2019), and a one-hour trial has been proposed as a reasonable alter-native to a two-hour trial to balance extubation success with minimizing invasive ventilation time (Loberger et al., 2023), the findings of this study indicate that extended SBT can offer additional benefits for patients at higher risk of complications. A prolonged trial may enhance cardiopulmonary adaptation, improving the patient's capacity to tolerate spontaneous breathing following extubation.

The primary challenges in implementing SBT in pediatric patients include respiratory muscle fatigue and the need for close monitoring to detect early signs of weaning failure. Comprehensive monitoring, along with support for critically ill pediatric patients and their families, is essential for optimizing recovery outcomes (Apriyanti & Adawiyah, 2018). Additionally, the use of advanced weaning indices—such as diaphragm excursion and thickening fraction assessed via ultrasound—may improve clinical decision-making and reduce unnecessary extubation failures.

In the PICU, continuous assessment of the patient's condition, effective communication with families, and individualized care planning are critical for enhancing ventilator weaning success. Appropriate medical interventions, combined with emotional support for the patient's family, help stabilize the patient during the transition from mechanical ventilation to spontaneous breathing. By integrating structured monitoring with a comprehensive support system, healthcare providers can improve patient safety, accelerate recovery, and enhance overall quality of care. Family involvement and education on post-extubation management are also essential for ensuring long-term respiratory stability in pediatric patients (Alqahtani et al., 2024; Moura et al., 2021; van den Hoogen & Ketelaar, 2022).

A critical aspect of weaning TOF patients is the prevention of Tet spells, which are sudden cyanotic episodes that can be life-threatening. The absence of Tet spells in this case suggests that careful adjustment of ventilatory support, combined with strict monitoring, can effectively prevent these complications. This contrasts with previous reports in which abrupt weaning or inadequate respiratory support often triggered hypoxic crises (Hammett & Griksaitis, 2023). These findings highlight the importance of maintaining optimal oxygenation and avoiding rapid fluctuations in pulmonary blood flow during the weaning process.

Furthermore, this study underscores the importance of structured monitoring during ventilator weaning. The approach employed integrated a 24-h pre-weaning assessment, continuous real-time monitoring during the 11-h SBT, and a 24-h post-extubation evaluation. This strategy ensured stable oxygenation, heart rate, and respiratory effort throughout the weaning process. Given the elevated risk of cardiovascular decompensation in patients with TOF, such extended monitoring may represent a viable weaning strategy in pediatric cases. However, as this report is based on a single patient, the findings should be interpreted with caution and cannot be generalized to all patients with TOF.

The complexity of this case was further heightened by the presence of a brain abscess, which made ventilator weaning more challenging. Factors such as neurological impairment, fluctuations in intracranial pressure, and alterations in respiratory drive required careful sedation adjustments and strict hemodynamic monitoring. Most studies on TOF weaning have focused on patients without neurological complications, making this case a rare documented example of successful ventilator weaning in a TOF patient with a brain abscess. This success emphasizes multidisciplinary coordination and a personalized approach to care. Future research should investigate the long-term outcomes of patients with TOF undergoing prolonged SBTs, particularly in the presence of neurological comorbidities, to refine best practices and optimize patient management strategies.

This study has several limitations, primarily its single-subject, observational design, which restricts the ability to generalize the findings. The absence of a control group and standardized intervention introduces potential bias and confounding factors—such as nutritional intake, nutritional status, comorbidities, and the psychological state of the patient and caregivers—that could not be systematically assessed or controlled. Ventilator weaning was a clinical decision fully managed by the attending physicians; as observers, we did not influence or intervene in the clinical process. The complexity of this case, involving a pediatric patient with both TOF and a cerebral abscess, emphasizes the need for individualized and cautious approaches in similar high-risk settings. Future studies should include larger cohorts, employ controlled or randomized designs, and evaluate long-term outcomes following extubation to better understand the determinants of successful ventilator weaning in pediatric patients with TOF.

Conclusion

The findings of this case suggest that SBT with PSV mode is a viable strategy for ventilator weaning in selected pediatric patients with TOF, particularly when an extended trial duration is employed. In this patient, structured monitoring and an individualized care approach facilitated successful ventilator liberation without major complications. The presence of a comorbid cerebral abscess added clinical complexity, making the positive outcome particularly noteworthy. These insights may inform PICU management strategies in similar high-risk cases and underscore the need for further research on extended SBT protocols in pediatric patients with complex cardiopulmonary and neurological conditions.

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Artificial intelligence tools were used solely to assist with language editing and improving the clarity of the manuscript. The authors take full responsibility for the content, interpretation, and conclusions presented in this article.

Data Availability Statement

The data supporting the findings of this case report are not publicly available due to ethical considerations and patient confidentiality. Anonymized data may be made available from the corresponding author upon reasonable request and with appropriate ethical approval.

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