

Modeling a Caring Approach towards Children with Fallot's Tetralogy Repair: A Focus on the Child's Profile

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Abstract:- Children with Tetralogy of Fallot (TOF) continue to be on the rise in Africa. More research is needed to improve caring approach towards children with surgically corrected TOF. The consequences of surgical correction of TOF remains an important area of research interest as children with TOF repair run the high risk of increase mortality resulting from acute cardiopulmonary problems. Yet little or no research published focused on investigating which clinical or para-clinical profile of children going in for surgical correction could be the cause of morbidity or mortality amongst children with TOF repair. The aim of the study was to determine the association between the profiles of children visiting the Surgical Heart Center for consultation with Tetralogy of Fallot (TOF) on the healing process after surgical repair. It was a descriptive quantitative study in which 303 nurses were issued questionnaires. Data was collected using convenient sampling technique and analyzed using multiple corresponding analysis in SPSS software version 21.0. The results showed that the clinical symptoms, clinical history, para-clinical characteristics, and postoperative complications identified three groups of children operated on for TOF: children with unstable hemodynamics; children who usually have symptoms such as systolic thrill, oppression in chest, tachycardia, and heart murmur; and finally children with symptoms of failure to thrive and heart murmur.

Keywords:- Tetralogy of Fallot, Caring Approach, Child Profile.

I. INTRODUCTION

Development of a normal heart runs through stages as embryonic foldings before resulting to a normal muscular four chambered organ that could be identified in a chest cavity around the left side of the chest and specifically around the fourth and fifth intercostal spaces. The aim of this organ is to pump blood round the body. According to Momah et al. (2023) a normal heart should have two atria and two ventricles that is separated by a septum, a substance that prevents the right side of the heart from joining with the left side so as to prevent mixture of blood components of the two sides. Due to causes unknown, some children do encounter abnormal developments such that a hole appears on the lower side or the ventricle creating an abnormal connection to permit mixture of the left and right side components of the blood (Callow, Rummell et Frederick, 2016)

Villafare et al. (2013) affirmed TOF as a common CHD, occurring in about 1 in 3500 births, TOF accounting for about 3 cases per 10000 live births worldwide, though considered rare, but good enough to increase infant mortality as appropriate care is not given timely (Llamosas-Falcon et al., 2019). According to retrospective study results, 67.2% of children after cardiac screening were found to have congenital heart diseases accounting for a prevalence rate of 9.8% in Cameroon, out of which Tetralogy of Fallot was one of the complex congenital heart defect (Momah et al., 2023). Many studies still need to be carried out so as to roll out the prevalence of children leaving with tetralogy of Fallot in Cameroon.

➤ *Poblem Statement*

Cameroon, as well as most African countries keep on suffering the consequences of having many children with TOF on the rise. This article articulates from the area of caring sciences in the domain of pediatric cardiology as more research is needed to improve caring approach towards children with surgically corrected TOF, given that children with TOF continue to be on the rise in Africa. Still in Africa, and precisely in Nigeria, Animasahun et al. (2016) remarked that based on one of the first cohort studies of children with TOF in West Africa, at the Lagos University Teaching Hospitals, the prevalence of TOF during the study period stood at 4.9 per 1000 while its prevalence among those with CHD was 16.9%. Many children are severely sick with severe dyspnea and cyanosis with difficulty getting access to a competent surgical cardiac center. The consequences of surgical correction of TOF remains an important area of research interest as children with TOF repair run the high risk of increase mortality resulting from acute cardiopulmonary problems. Yet little or no research published focused on investigating which clinical or para-clinical profile of children going in for surgical correction could be the cause of morbidity or mortality resulting from acute cardiopulmonary problems amongst children with TOF repair. Certainly a lot has been done as far as caring for children with a surgically corrected TOF is concerned but modeling a quality approach of care for this children still demands results of a substantial work on the profile of these children.

II. METHODOLOGY APPROACH

➤ *Design*

This was a quantitative descriptive study whereby the profiles of children living with a surgically corrected TOF were explored from the nurses' point of view.

➤ *Research Population*

The researcher worked with the 303 nurses who had received formation on cardiac care, assisted a child with Fallot repair on more than one occasion, accepted to be part of the study and were available to participate in the study. The researcher used a non-probability convenience sampling technique towards the nurses who fulfilled the inclusion criteria.

➤ *Data Instrument and Data Collection*

Questionnaires were issued to all the nurses who were available to take part in the study, in which 303 questionnaires were retained, collected and analyzed. The questionnaire focused on deriving the clinical (sign/symptoms), para-clinical characteristics, type of surgical repair, past medical history prior to surgical repair and notions on the potential complications from the point of view of the nurses who had cared for some of these children. The questionnaire was distributed early in the morning before 7:30 am that work was supposed to start for those who had night shift and later within the day during break for those for morning duty. Questions were answered as need be and room was given for them to fill the questionnaire and drop them after two days.

➤ *Data Analysis*

Data was displayed and interpreted to arrive at intelligible impressions that could be further explored through descriptive and inferential statistics, after which information was processed statistically. This was done using SPSS software version 21.0 in which exploratory factor analysis was done to analyse information gotten from the questionnaires.

➤ *Ethical Consideration*

Prior to the study, the researcher obtained a national ethical clearance that was presented to the president of the scientific committee of the surgical heart centre. Permission was given to move on with the study with reference to the inclusion/exclusion criteria of the population under study. The consent and information notice were presented to the respondents before data collection. The researcher assured and respected the consent, such that there was no risk, discomfort, inconveniences towards the nurse or the child receiving treatment. It was declared to the respondents that refusal to participate in the study was allowed, whether consent was given or not, and that it would not affect their recruitment status or financial obligations. That the respondent was entirely allowed freedom of choice to participate. All the information gotten was attributed full anonymity and confidential treatment. Verbal Consent was gotten too from the respondents.

III. RESULTS

The respondents under study had to answer questions with an aim to determine the association between the profiles of children visiting the surgical heart centre for consultation with Tetralogy of Fallot (TOF) and their healing process after surgical repair. Results related to clinical profile was centered on the signs and symptoms or clinical manifestations of TOF pathology, estimated days of stay at the intensive care unit, the past medical history, post-operative complications. Meanwhile results about the para-clinical profile were gotten by answering questions in the area of laboratory tests, chest x-ray, echocardiogram, and electrocardiogram. The results were presented in tables and figures as shown below.

➤ *Signs / Symptoms*

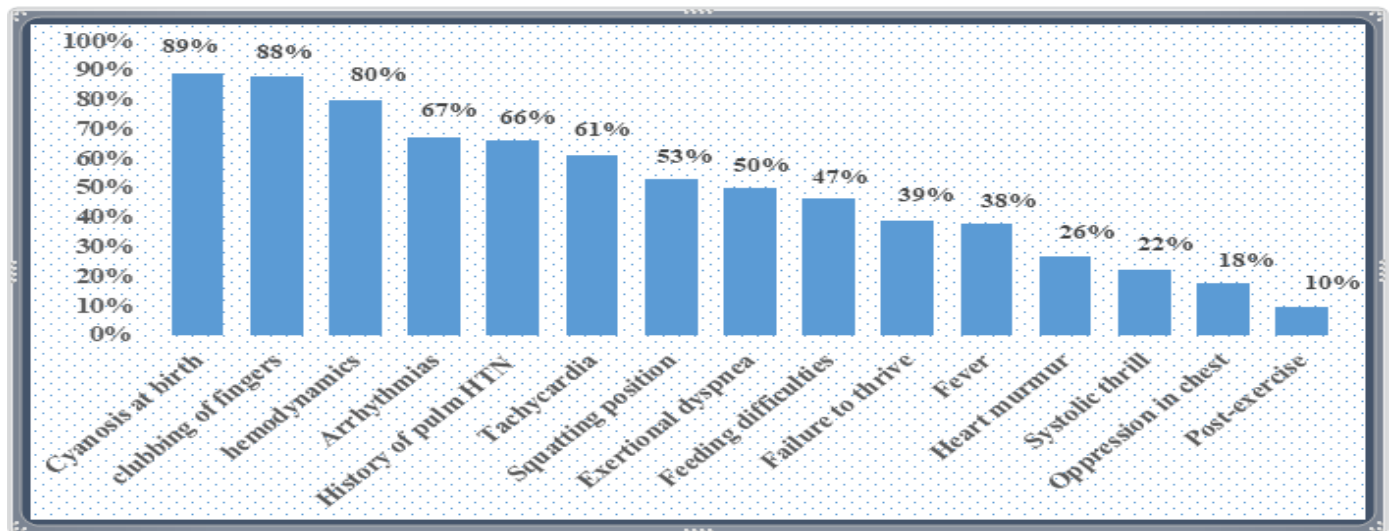


Fig 1 Percentage of Children Presenting Each of the Symptoms Identified
Source: Author Based on Survey Data

This figure revealed that cyanosis at birth, clubbing of fingers and hemodynamics are the most frequent symptoms in operated children with proportions of 89%, 88% and 80%, respectively. In particular, the hemodynamics are unstable in 8 out of 10 children. Arrhythmias and history of pulmonary HTN follow, which are observed in two-thirds (notably 67% and 66%) of children. Tachycardia, squatting

position and exertional dyspnea are moderately frequent symptoms (with proportions of 61%, 53% and 50% respectively) while heart murmur, systolic thrill, oppression in chest and post-exercise are the least frequent. (26%, 22%, 18% and 10% respectively).

➤ *Estimated Days ICU*

Table 1 Estimated Days ICU

Estimated days ICU	Total	Percentage (%)
[1-3]	123	41
[3-7]	173	57
[7-10]	7	2
Total	303	100

Source: Author Based on Survey Data

Analysis of this table showed that 41% of children undergoing surgery have between 1- and 3-days ICU stay and 57% of them do spend between 4 and 7 days at the ICU. In addition, only 2% of children operated on have between 8 and 10 days of stay at the ICU.

➤ *Past Medical History*

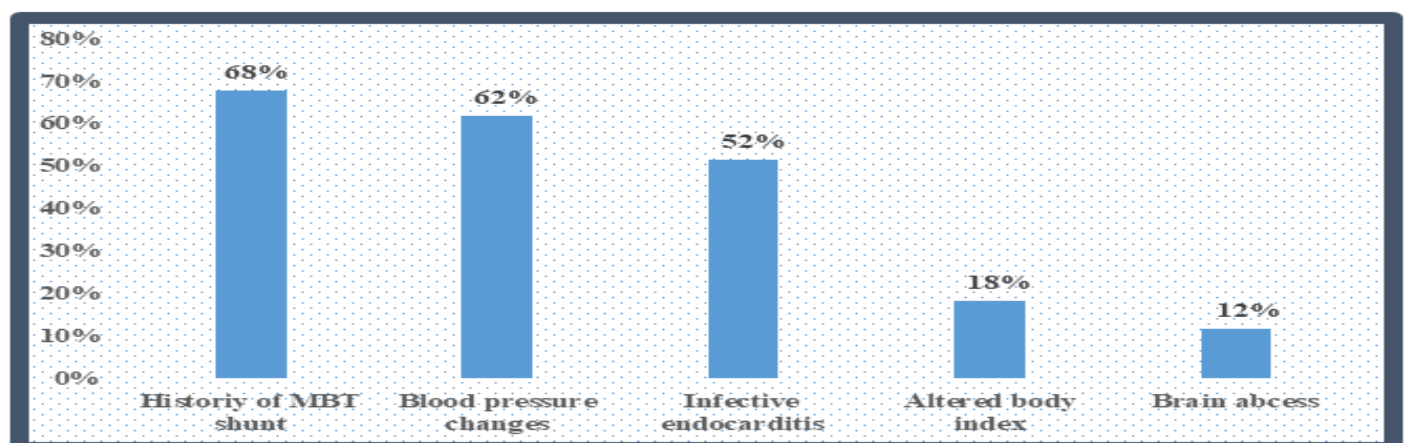


Fig 2 Distribution of Children According to Each Past Medical History
Source: Author Based on Survey Data

From this figure, the most common medical history in operated children is history of MBT shunt. In fact, more than two thirds, or 68% of children have had this antecedent. Blood pressure changes and infective endocarditis are moderately recorded medical histories in children with respectively 62% and 52% as proportions. With regard to

altered body index and brain abscess, these two antecedents are the least noted in children (with 18% and 12% respectively).

➤ *Post-OP Complications*

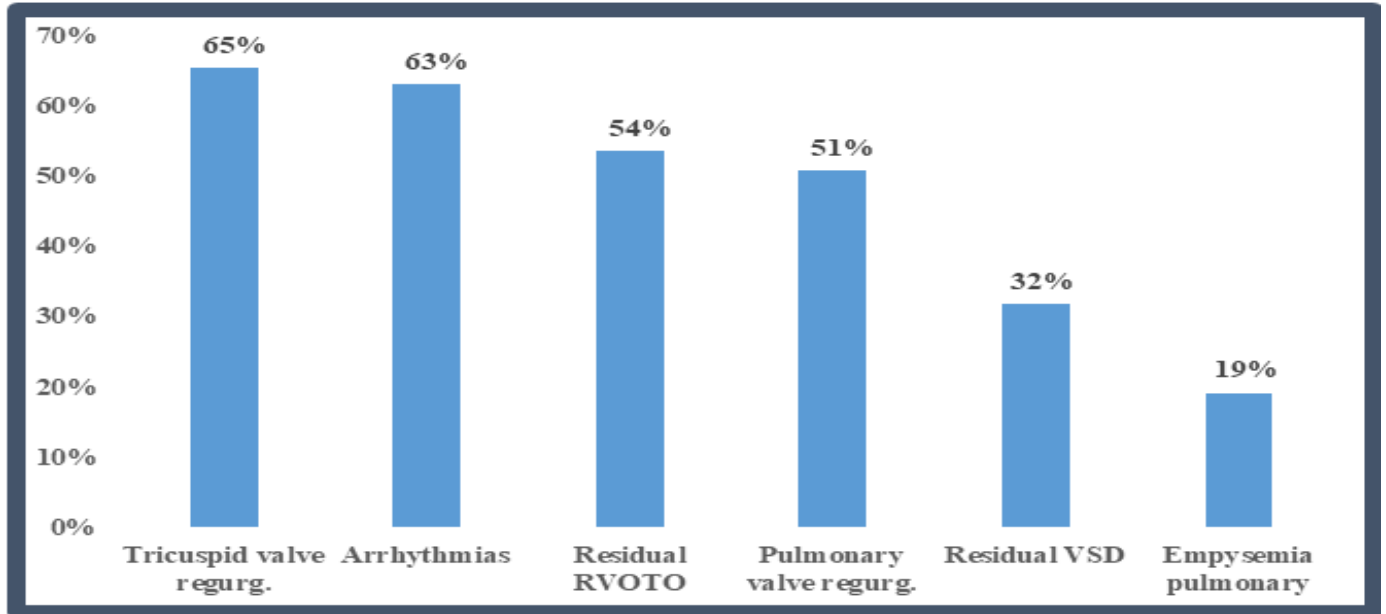


Fig 3 Distribution of Children According to Each Postoperative Complication
 Sources: Author Based on Survey Data

Analysis of this figure suggested that tricuspid valve regurgitation and arrhythmias are the most observed postoperative complications in operated children. In fact, more than 60% of children are concerned for each of these postoperative complications. Postoperative complications which are moderately frequent in children operated for TOF include residual RVOTO (54%) and pulmonary valve

regurgitation (51%) in particular. In addition, residual VSD and pulmonary emphysema are the least observed postoperative complications in children with respect to the proportions of 32% and 19%.

➤ *Para-Clinical Characteristics*

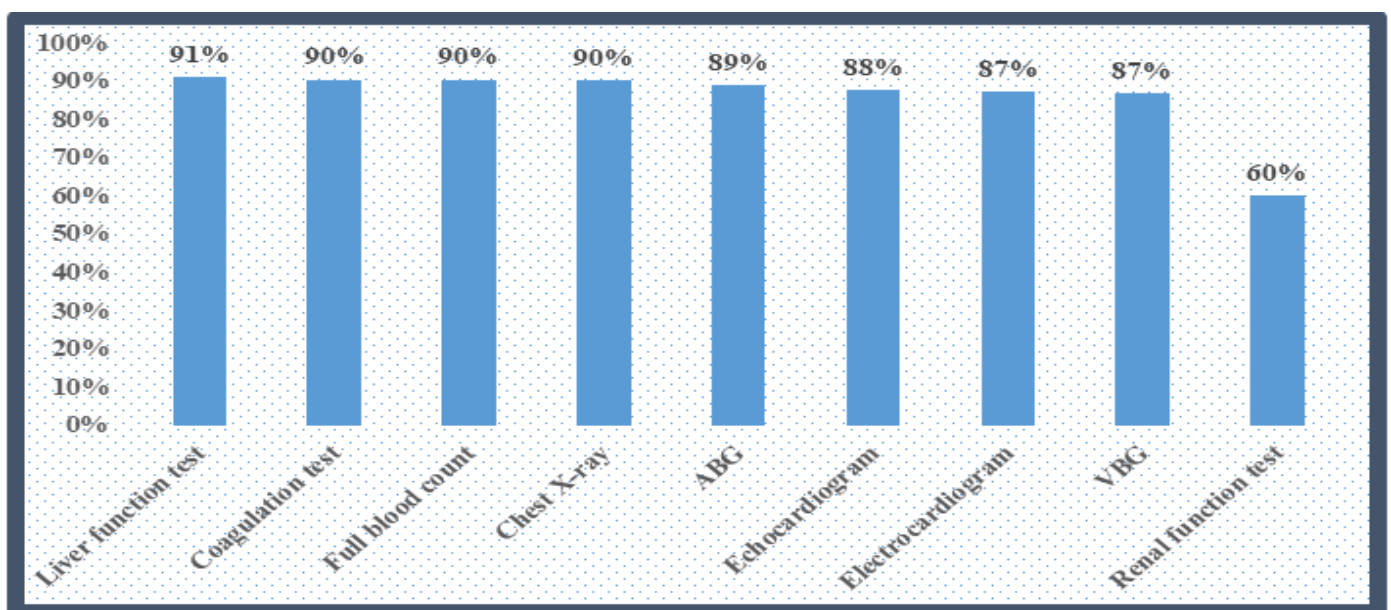


Fig 4 Distribution of Children According to Each Para-Clinical Characteristic
 Source: Author Based on Survey Data

This figure revealed that almost all para-clinical characteristics liver function test (91%), coagulation test (90%), full blood count (90%), chest X-ray (90%), ABG (89%), echocardiogram (88 %), electrocardiogram (87%) and VBG (87%) are very common than in operated children. Only renal function test is less observed in children with a proportion of 60%.

Table 2 Distribution of Children Operated on According to the Symptom History of MBT and Estimated Days in the ICU

HISTORY OF MBT	ESTIMATED DAYS ICU		Total
	[1-3]	[3-10]	
No	38	58	96
Yes	85	122	207
Total	123	180	303

Among the 207 children operated on with a clinical history of MBT, 85 or 41% have an estimated number of ICU days between 1 and 3 while 122 or 59% have an estimated number of ICU days between 4 and 10. An independence Chi-square test performed on these two variables reveals that at the 5% confidence interval level, there is no link in them. Indeed, the p-value of this test is equal to $0.807 > 0.05$.

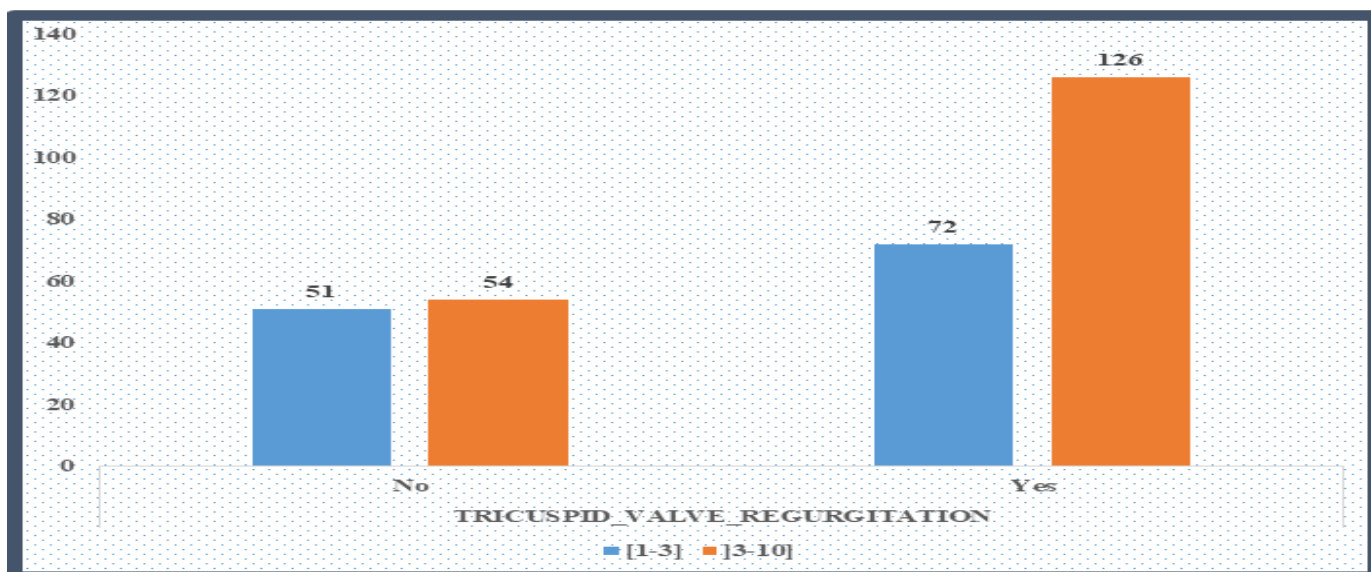


Fig 5 Distribution of Children Operated on According to Estimated Days at the ICU and Tricuspid Valve Regurgitation
 Source: Author Based on Survey Data

This figure showed that for 72 children operated upon, out of the 198 who had the tricuspid valve regurgitation complication, had an estimated number of ICU days between 1 and 3. While 126, or 64% of these children, had

an estimated number of ICU days between 4 and 10. A chi-square test of independence carried out on these two variables reveals they have no connection at the 5% level. Indeed, the p-value of this test is equal to $0.036 < 0.05$.

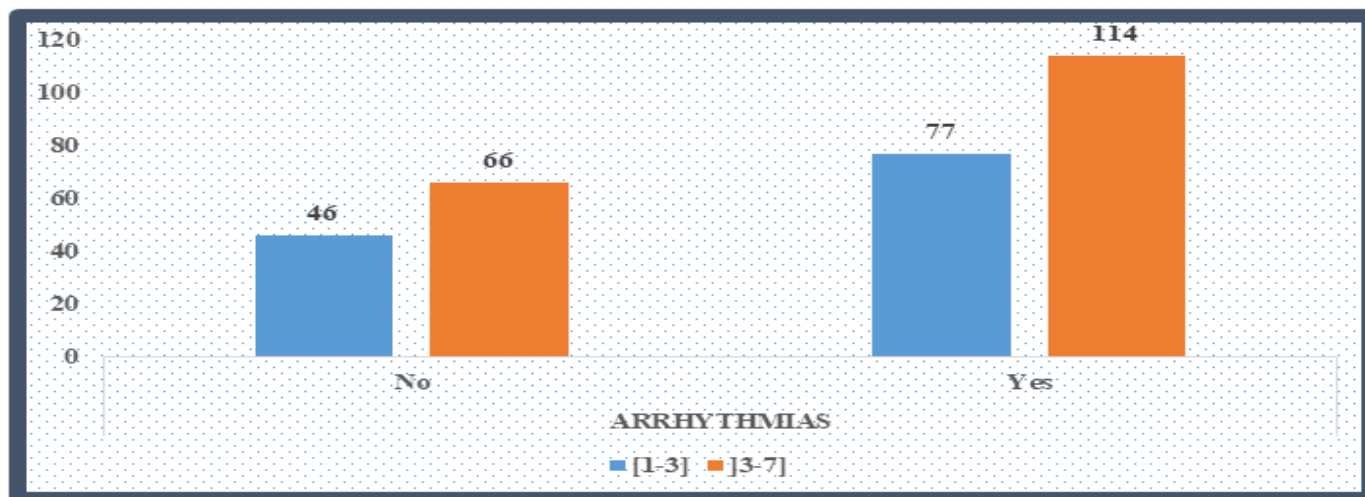


Fig 6 Distribution of Children Operated on According to Estimated Days ICU and Arrhythmias
 Source: Author Based on Survey Data

Analysis of this figure revealed that 77 children operated on out of the 191 having had the arrhythmia as a complication have had an estimated number of ICU days at between 1 and 3. While 114, or 60% of these children have an estimated ICU number of days included between 4 and 10. A chi-square test of independence carried out on these two variables reveals they have no connection at the 5% confidence interval level. Indeed, the p-value of this test is equal to $0.897 > 0.05$.

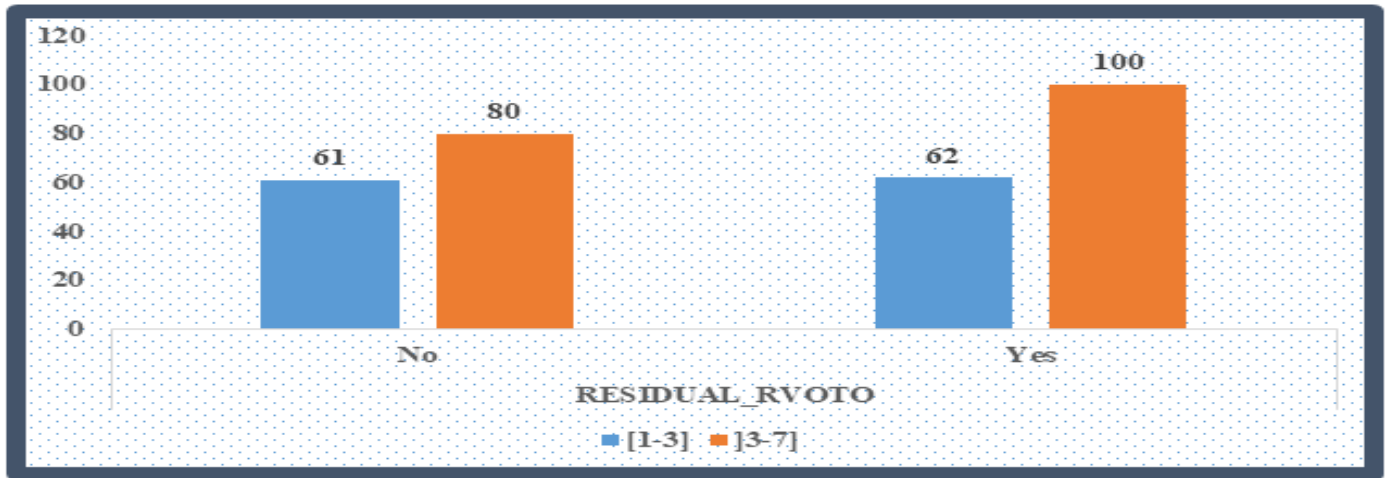


Fig 7 Distribution of Children Operated on According to the Estimated Number of Days in the ICU and Residual RVOTO
 Source: Author Based on Survey Data

The analysis of this figure revealed that out of 62 children operated upon, 162 had the residual RVOTO complication with an estimated number of ICU days between 1 and 3. While 100, or 62% of these children, have an estimated number of ICU days of between 4 and 10. A chi-square test of independence carried out on these two variables reveals that they have no connection at the 5% level. Indeed, the p-value of this test is equal to $0.378 > 0.05$.

Table 3 Distribution of Children Operated on According to Age at Repair and mBT History

Age at Repair	History of MBT Shunt		Total
	No	yes	
Less than 6months	26	59	85
More than 6 months	70	148	218
Total	96	207	303

Source: Author based on survey data

From this table, we note that 59 children operated on out of 207 presenting the history of MBT shunt symptoms have an age at repair of 6 months at most, while 148 have an age at repair of more than 6 months. A chi-square test of independence performed on these two variables reveals that at the 5% level. Indeed, the p-value of this test is equal to $0.798 > 0.05$.

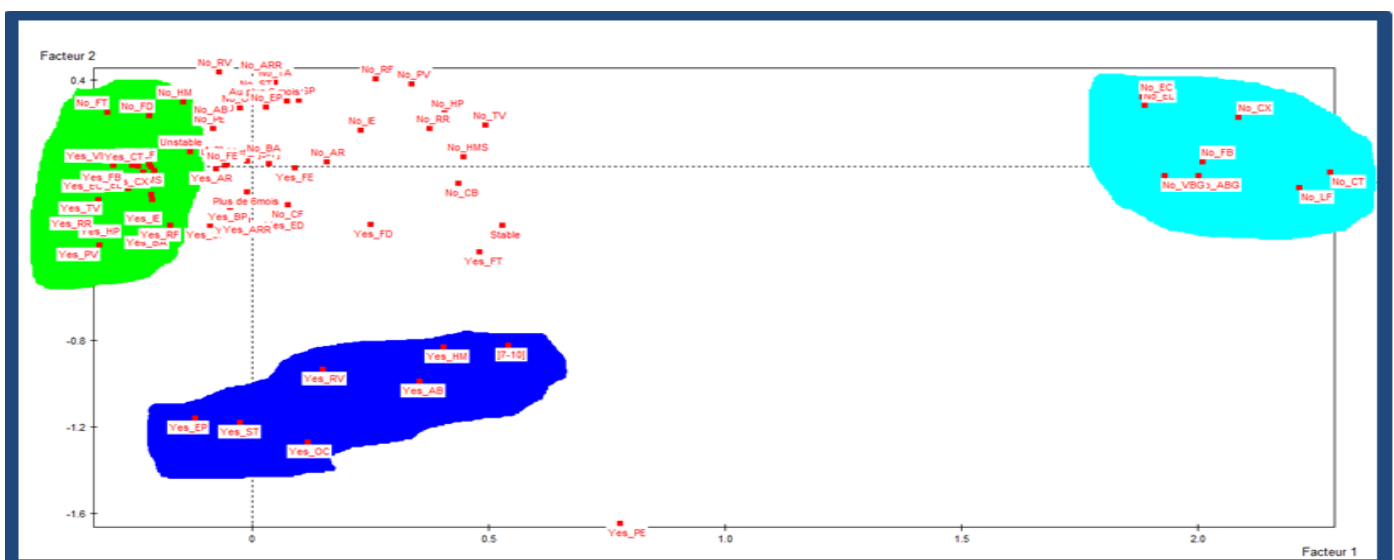


Fig 8 Global Clinical and Paraclinical Profile of Operated Children
 Source: Author Based on Survey Data

A multiple correspondence analysis performed on all clinical symptoms, clinical history, para-clinical characteristics, and postoperative complications identified three groups of children operated on for TOF. To better characterize these groups, a two-step classification method based on factors was carried out. The results of this classification made it possible to distinguish the three groups according to a few criteria of homogeneity and to characterize them using the modalities of the variables.

The first group are children with unstable hemodynamics. These children present as a symptom of history of pulmonary HTN and generally have a medical history of history of MBT shunt for more than 6 months. The para-clinical characteristics observed in these children are mainly chest X-ray, renal function test, liver function test, full blood count, coagulation test, ABG, VBG, electrocardiogram, and echocardiogram. Regarding postoperative complications, overall residual RVOTO and pulmonary valve regurgitation are observed in operated children in this group.

The second group is made up of children who usually have symptoms such as systolic thrill, oppression in chest, tachycardia, and heart murmur. These children have a general history of blood pressure changes and infective endocarditis. We observe in them several paraclinical characteristics through echocardiogram, electrocardiogram, coagulation test, liver function test, renal function test, chest X-ray and full blood count. As for post-operative complications, we find residual VSD, arrhythmias, emphysema pulmonary and tricuspid valve regurgitation.

The final group is made up of children with symptoms of failure to thrive, heart murmur, and unstable hemodynamics. These children mainly have the liver function test as a paraclinical feature.

IV. DISCUSSION

The present study focused on TOF, one of the congenital heart diseases or lesions found to be real for neonates, infants, children, and even adults, depending on the age at which this condition is diagnosed in developed and underdeveloped countries. The findings of this study revealed that respiratory and cardiovascular signs were the main reasons for hospitalization. Basse et al. findings revealed that out of 156 files under study, 131 (82%) had dyspnea, 116 (73%) had respiratory distress, 77 (48%) had heart murmur, 53 (33%) had hepatomegaly, dysmorphia 52 (32%), cyanosis 30 (19%), oedeme 24 (15%), clinical anemia 22 (14%), digital hippocratism 09 (06%), thoracic deformity 04 (03%). In a study on the origins, management, and outcomes of TOF in children, aimed at considering the pathophysiology of TOF and current approaches to managing the plethora of disease states, this compass, together with the long-term sequelae, attested that the typical symptoms of TOF develop months after birth and do characterize by decreased exercise tolerance and hyper cyanotic spells (Worku & Allen, 2020) and others like systolic thrill at the lower left sternal border due to

ventricular septal defect, systolic ejection murmur resulting from pulmonary stenosis, and decreases during hypercyanotic periods, and clubbing of fingers and toes. Basse et al. (2020) in a retrospective study of 156 cases of congenital heart disease, confirmed that CHD is still a public health problem in developing countries. Basse et al. traced the epidemiological, clinical, paraclinical, and therapeutic profile of CHD including TOF in a university in Dakar but did not see cyanotic spells and cyanosis as being frequent, however they affirmed that saturation was above 96% in about 78 patients (49.05%), between 80 and 95% in 52 patients (32%), between 60 and 80% in 15 patients (9.4%), and below 60% in 14 patients (8.85%). Talwar et al. (2017) had similar findings with that of the present study as the authors presented that out of seventy-three patients under study, most patients did manifest clinically with shortness of breath in 40 patients (54.8%), cyanosis in 20 patients (27.4%), palpitation in 25 patients (34.2%), and failure to thrive in 10 patients (13.7%). Shortness of breath was more frequent in their study than in the present one. Hemodynamics also featured as part of the results of the present study that supported the fact that hemodynamic monitoring was vital.

The length of stay of a child during the immediate postoperative period in the intensive care unit or in the hospital as a whole could vary, either due to the age of the child before surgery, type of surgical correction done to the child, duration on mechanical ventilation, prolonged extubation or delayed weaning, or even be related to some intraoperative activities like cardiopulmonary bypass and clamping time. Talwar et al. (2017), in their study on mid-term results of correction of Tetralogy of Fallot with absent pulmonary valve, recorded immediate postoperative mortality and morbidity concerning length of ICU stay, hospital stay, use of extracorporeal membrane oxygenator support and ICU-associated complications based on duration on mechanical ventilation and ionotropes. Their results fit part of the present study's results as 57% of the respondents proved that some children with TOF repair spent between 4 and 7 days at the ICU. This matched with the view of Elassal et al. (2022) in their study on contemporary outcomes and risk profiles in neonatal congenital heart surgery with a focus on the primary outcome of operative mortality related to in-hospital deaths and secondary outcome related to hospital length of stay, ICU stay, and the duration of mechanical ventilation.

About the past medical history, the symptomatology of TOF seen so far could begin at birth, even though the condition might go unnoticed depending on the level of knowledge of the personnel consulting the child or the available means or resources to detect the lesion during birth or at birth. The results of this study with palliation as the most prevalent part of the medical history of most children operated upon at the data collection site was affirmed by Waqar et al. (2017) who had similar results that declared to have received 4 patients (1.3%) with a history of previous primary MBT shunt out of 307 patients who had to go for surgical repair of TOF.

With post-operative complications, Lecho (2022) stated that the postoperative course varies depending on multiple factors like the child's age at repair, duration of the cardiopulmonary bypass (CPB), the type of the TOF repair, and other comorbidities. The present work highlighted arrhythmias as most frequent in 60% of the operated children. Lecho 2022 reported the same findings and added that most arrhythmias affect hemodynamic functioning and included junctional ectopic tachycardia (JET), ectopic arterial tachycardia, re-entry supraventricular tachycardia (SVT), right bundle branch block (RBBB)/left bundle branch block (LBBB), complete branch block which to her could be rare and require temporal pacing.

In area of para-clinical profile, Bedair and Iriart (2019) conveyed that imaging of preoperative TOF could be done via echocardiography as fetal echocardiography performed from 13 to 14 weeks of gestation to view a large VSD with overriding of the aorta and antero-cephalad deviation of the outlet septum and small pulmonary arteries, and transthoracic echocardiography for follow-up of TOF.

In addition, with regards to history of MBT and estimated days in the ICU. Waqar et al. (2017) reported that the late repair of TOF results is comparable to early surgery but that late repair remains associated with increased intensive care unit stay, mechanical ventilation time, and inotropic requirements. Waqar et al. reported a mean duration of ICU stay of 44.12 ± 29.85 hours, falling within the range of the duration recorded in our study.

Bedair et Iriart (2019) reported tricuspid regurgitation as a long-term outcome or complication seen with progressive right ventricular enlargement that leads to annular dilatation or leaflet abnormalities related to the tethering in the region of the VSD patch. Kirsch et al. (2014) added that tricuspid regurgitation is a postoperative complication following TOF repair and increased hospital length of stay is obvious, even though out of 242 patients under their cohort had a relatively short length of stay as those with no complications were discharged by 7 days after surgery. Paluszek et al. (2019) added that for their study on the risk factors and outcome of post-operative Fallot repair arrhythmias, especially junctional ectopic tachycardia, JET, the occurrence of JET remains an important complication during the initial postoperative period following TOF repair found to increase mechanical ventilation time, need for inotropic support, and prolonging the length of ICU and hospital stay, with both time to rate control and time to return to sinus rhythm having a crucial impact on the length of stay.

Kirsch et al. (2014) in their retrospective study to report the practice and outcomes in infants undergoing elective repair at 6 months of TOF, noted that for 277 patients in their cohort, hospital mortality rate was zero. In addition, 87.4% were discharged home within 7 days of repair, 21.6% discharged home before postoperative third day, and that the postoperative course was uncomplicated in 245 patients (88.4%). longer support time, younger age, chromosomal abnormality, and presence of a complication

were associated independently with a longer hospital stay ($p < 0.001$), concluding that elective repair of asymptomatic infants with TOF should be advocated as well as symptomatic infants in early infancy, since data obtained in their retrospective study approved that repair at age 3 to 6 months was associated with improved outcome for asymptomatic patients. Ali et al. (2019) atrial arrhythmias feature as the main adverse cardiac event during the follow-up of patients with TOF repair and are associated with higher biventricular volumes and lower biventricular ejection fraction (EF).

In the global clinical and paraclinical profile of operated children, Rajput et al. (2014) attested that atrial and junctional tachyarrhythmia that occurs frequently after TOF or congenital cardiac surgery as rhythmic disturbances often cause significant hemodynamic instability. Cools et Missant (2014) expressed that no one can predict the exact time that the arrhythmia could resolve. Therefore, Cools and Missant advised the intensive cardiac care nurses that for every congenital cardiac surgery, the patient's hemodynamic status should be adequately monitored using invasive arterial blood pressure, assessment of serum lactate levels, urine output and mixed venous oxygen saturation. Similarly, Ismail et al. (2018) included TOF repaired patients with stable or unstable hemodynamic states and realized that younger age was significantly associated with increased risk of JET population, supported by heart rate variability due to smaller size of their hearts of younger age patient that are difficult to manipulate during surgery.

V. CONCLUSION

The aim of this study was to determine the association between the profiles of children visiting the surgical heart center for consultation with Tetralogy of Fallot (TOF) on the healing process after surgical repair. The study showed that cyanosis at birth, clubbing of fingers and hemodynamics are the most frequent symptoms in operated children with proportions of 89%, 88% and 80%. Moreover, that 41% of children undergoing surgery have between 1- and 3-days ICU stay and 57% of them do spend between 4 and 7 days at the ICU, and that the most common medical history in operated children is history of MBT shunt, with moderate ones including Blood pressure changes and infective endocarditis. Tricuspid valve regurgitation and arrhythmias were the most observed postoperative complications in operated children, meanwhile almost all para-clinical characteristics liver function test (91%), coagulation test (90%), full blood count (90%), chest X-ray (90%), ABG (89%), echocardiogram (88 %), electrocardiogram (87%) and VBG (87%) were very common. Therefore in global terms, multiple correspondence analysis performed on all clinical symptoms, clinical history, para-clinical characteristics, and postoperative complications identified three groups of children operated on for TOF: children with unstable hemodynamics; children who usually have symptoms such as systolic thrill, oppression in chest, tachycardia, and heart murmur; and finally children with symptoms of failure to thrive and heart murmur.

➤ *Implications for Nursing and Health Policy*

The study was to determine the association between the profiles of children visiting the Surgical Heart Center for consultation with Tetralogy of Fallot (TOF) on the healing process after surgical repair. The results of this work serve as a pre-requisite for modeling a caring approach for children living with a surgically corrected tetralogy of Fallot.

LIMITATIONS

The study was carried out in one African country and in one surgical heart center in an ethnocentric region. The researcher suggest that a large study be carried out which could embrace a diversity of cultures and varied experiences.

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