

# Complications of Cardiac Catheterization in Children with Congenital Heart Disease with and without Ranitidine and Hydrocortisone

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## **Abstract**

**Background and Objective:** Cardiac catheterization constitutes an essential method for diagnosis in cardiology. In addition to diagnosis, it is largely applied in electrophysiological studies of the heart, post-surgical follow-up and cardiac interventions. Similar to any other aggressive diagnostic technique, cardiac catheterization may entail certain complications. The objective of the present study is to determine complications of cardiac catheterization in children with congenital heart diseases with and without ranitidine and hydrocortisone.

**Method:** This is a clinical trial study on 400 children with congenital heart diseases who underwent cardiac catheterization in Ali Asghar and Ali-ebne Abitaleb Hospitals of Zahedan from March 2005 to February 2012. The children were classified into two groups. All patients underwent routine tests and para clinical procedures (Electrocardiography, Chest X-Ray, and Echocardiography) before cardiac catheterization and received premedication one hour before the procedure. The premedication consisted of morphine or promethazine for cyanotic patients and promethazine and pethedine for all other patients. All patients underwent cardiac catheterization by a pediatric cardiologist. After the procedure, all children were admitted to the hospital for 48 hours to monitor complications. Data were obtained from medical records using a specifically devised questionnaire, and analyzed on SPSS software version 17.

**Results:** Complications occurred in 15.5% of our patients, with 5 patients (1.25% of total) experiencing a major, and 57 patients (14.25% of total) experiencing a minor complication. Vascular events (32 cases; 8%) and arrhythmia (8 cases; 2%) composed the majority of complications. Death occurred in two patients (0.5%). The major complications included death (2 cases), cardiac arrest with a successful resuscitation (1 case) and spell (2 cases). In the present study, we found no significant difference between the group receiving ranitidine and hydrocortisone and the group receiving neither to prefer one group over the other.

**Conclusion:** The findings of the present study showed that the complications of cardiac catheterization is more or similar to other studies, except for small changes in minor complications and the fact that we observed no event of rupture or tamponade two serious complications. Moreover, our study demonstrates no significant difference between the two groups to indicate superiority for those receiving ranitidine and hydrocortisone, except for reaction to contrast.



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**Introduction:**

Cardiac catheterization is one of the most important diagnostic skills in congenital heart diseases (1, 2). Pediatric cardiac catheterization in the last decade has been not only a diagnostic means for anatomic and hemodynamic evaluation of the heart, but has also assumed an immense therapeutic role in pediatric cardiology (1, 2, and 3). Indications of cardiac catheterization include: 1- evaluation of congenital heart disorders prior to surgery; 2- evaluation of pulmonary vascular resistance; 3- follow-up after cardiac surgery; 4- myocardial biopsy for identifying cardiomyopathy or screening for graft rejection in heart transplantation; 5- electrophysiological studies; 6- interventional cardiac catheterization has replaced heart surgery in many cases (e.g. obstruction of pulmonary and aortic valves, patent ductus arteriosus, etc). Cardiac catheterization may be performed on left or right heart, and is achieved under fluoroscopy guide via skin and femoral vein. It is conducted under sedation (1, 2).

Pediatric cardiac catheterization, whether conducted for diagnosis or treatment, entails certain complications, the most important of which include: Death, arrhythmia, vascular events (arterial thrombosis, venous thrombosis), hemorrhage, heart rupture, tamponade, vascular rupture (arterial, venous), and embolism of balloon head and balloon rupture (1, 2, 5, and 6).

Complications of cardiac catheterization may be classified as major or minor, with the major complications including: Death, severe hypotension, cardiac arrest, emboli caused by catheterization, anatomic or functional lesions caused by catheterization (e.g. arterial thrombosis, cardiovascular events, vascular rupture, and aneurysm).

The minor complications are often transient and resolved with treatment: transient arrhythmia; and transient arterial embolism (5, 6, and 7). In a Canadian study by Vitello et al spanning from 1987 to 1993, arrhythmia was found to be the most common complication (7.7%) followed by vascular events (2.9%) (5). Another study in India yielded similar results; i.e. 8.8% arrhythmia and 3.8% vascular events, most of which consisted of arterial and venous thrombosis and obstruction (5, 6). Also, an Iranian study in Shahid Rajayi Hospital by Davari et al reported 3.1% arrhythmia and 2.1% vascular events. Also, 2 cases of death were recorded (8).

Given the ever-increasing need for cardiac catheterization in children as a diagnostic, therapeutic and electrophysiologic study tool, as well as the potential complications of the procedure, we undertook the present study to investigate the prevalence of complications of catheterization in children with congenital heart disease with and without ranitidine and hydrocortisone admitted to pediatric cardiology wards of Ali Asghar and Ali Ebne Abitaleb Hospitals.

**Method:**

This is a clinical trial study with the study population consisting of all cardiac patients referring to the specialized pediatric heart clinic of Ali Asghar and Ali Ebne Abitaleb hospitals in Zahedan who underwent cardiac catheterization from 2005 to 2012. Sampling was accomplished through survey. The study spanned from January 2005 to February 2012. The cases were selected from patients with congenital heart disease who referred to the pediatric heart clinics of Ali Asghar and Ali Ebne Abitaleb hospitals of Zahedan, their disorder was diagnosed as congenital, they required cardiac catheterization, and all information regarding their catheterization and its possible complications were documented in their medical records. The patients were assigned to two equal groups and homogenized for age, sex, and weight. The second group received ranitidine and hydrocortisone for controlling complications.

We collected the data on specifically designed data sheets and analyzed them.

Prior to cardiac catheterization, all patients underwent physical examination, Chest X-Ray, Electrocardiography, and Echocardiography. In addition, necessary tests were performed for all patients, and in case of normality, the patients would be prepared for catheterization. All patients were kept NPO during the 6 hours leading to the procedure, and received premedication one hour before catheterization in the following manner: cyanotic patients were administered morphine (0.1 mg/Kg) or promethazine (0.5 cc/Kg); and the rest were administered pethidine (0.5-1 mg/Kg) with promethazine. During the procedure, the patients were given PRN midazolam (0.05 mg/Kg) and fentanyl (1-3 mic/Kg) for sedation and pain control. Data were gathered on data sheets using the information documented in patients' medical records. Data were then fed into SPSS software and analyzed in percentages and tables.

**Results:**

The objective of the present study is to determine complications of cardiac catheterizations in patients with congenital heart disease in pediatric cardiology clinics of Ali Asghar and Ali Ebne Abitaleb hospitals.

A total of 400 patients underwent catheterization from March 2005 to February 2012, consisting of 248 (62%) males and 152 (38%) females – Table 1. The patients had a mean age of 3.75 years (from two months to 16 years) and mean weight of 9.86 Kg (from 2.7 Kg to 37 Kg). The patients were assigned equally to two groups, and the second group was administered hydrocortisone and ranitidine for control of complications. Subsequently, the complications were compared between the two groups.

The complications included vascular events (thrombosis), arrhythmia (tachycardia, bradycardia, and supraventricular tachycardia), myocardial stain, death, seizure, spell, and cardiac arrest, presented separately in table -2. There were 32 cases of thrombosis among our patients (8%). This was, however, a transient complication which resolved with administration of thrombolytics and required no surgical management. 4 cases of hematoma occurred in our patients, including SVT (2%) and bradycardia (0.5%), with 2 cases of SVT patients requiring medical treatment and the rest resolving with basic measures in the catheterization room, thus, all of these were considered minor complications. Tachycardia is a relatively normal finding during the procedure and cannot be considered a complication. Other complications occurring in our patients included death (2 cases; 0.5%), myocardial stain (3 cases; 0.7%), cardiac arrest (1 case; 0.25% which was successfully resuscitated), seizure (2 cases; 0.5%), and spell (2 cases; 0.5%). Death occurred in one 8-year old and one 9-year old child which were attributed to the underlying disease. The first patient was diagnosed as common atrium with pulmonary hypertension and the second patient was a case of hypertrophic cardiomyopathy with severe dynamic left ventricular out-flow obstruction and severe anatomic right ventricular out-flow obstruction with unresponsive arrhythmia. Among these complications, 5 were considered major (2 deaths, 1 cardiac arrest, and 2 spells) and the rest were deemed minor

**complications.**

*Table 1: Prevalence of major complications in patients undergoing catheterization with and without ranitidine and hydrocortisone in Ali Asghar and Ali Ebne Abitaleb hospitals from 2005 to 2012*

Complication	First Group (200)	Second Group (200)	Total
Death	1	1	2
Spell	1	1	2
Cardiac Arrest	1	0	1

*Table 2: Prevalence of minor complications in patients undergoing catheterization with and without ranitidine and hydrocortisone in Ali Asghar and Ali Ebne Abitaleb hospitals from 2005 to 2012*

Complication	First Group (200)	Second Group (200)	Total
Arrhythmia	5	3	8
Tachyarrhythmia	4	2	6
Brady arrhythmia	1	1	2
Vascular thrombosis	17	15	32
Myocardial stain	2	1	3
Hematoma	2	2	4
Seizure	1	1	2
Reaction to contrast	4	1	5
Total	36	26	62

**Discussion:**

The present article is a descriptive, cross-sectional study on patients with congenital heart disease referring to the pediatric cardiology clinics of Ali Asghar and Ali Ebne Abitaleb hospitals, Zahedan who underwent cardiac catheterization. Cardiac catheterization constitutes one of the most important diagnostic skills in congenital heart disorders (1, 2). Pediatric cardiac catheterization in the last decade has been not only a diagnostic means for anatomic and hemodynamic evaluation of the heart, but has also assumed an immense therapeutic role in pediatric cardiology (1, 2, and 3). Despite its numerous benefits in diagnosis, treatment and electrophysiological studies of the heart, it entails certain complications (4).

Our study addresses the prevalence of complications of cardiac catheterization in children with congenital heart conditions who underwent the diagnostic procedure from March

2005 to February 2012 in Ali Asghar and Ali Ebne Abitaleb hospitals, Zahedan. Our patients consisted of 400 children, equally divided between two groups, and the second group received one dose of ranitidine and hydrocortisone before contrast infusion.

In a study by Casidy et al, comprising 85.3% diagnostic catheterization and 14.7% diagnostic-interventional catheterization, the rates of major and minor complications were 2.4% and 8.6%, respectively (9). They also reported two cases of death related to catheterization (0.19% mortality) and two cases of death shortly after catheterization attributed to the underlying disease (0.38% mortality), which is consistent with our findings.

Ino et al reported lack of pulse or weak pulse in 8.6% of cases (10), which is in line with our results. In an Iranian study conducted in the pediatric cardiology ward of Rajaei hospital, Tehran, 480 patients underwent cardiac catheterization, consisting of 90% diagnostic and 10% diagnostic-interventional procedures (8), resulting in 1.25% major complications and 8.3% minor complications. Compared to these findings, we had less major complications and more minor complications, which is due to the inappropriate arterio-venous cannula in younger children with less weight. However, Wessel Bulbul et al state that vascular obstructive and thromboembolic events tend to be more stable in younger children (11, 12).

A study by Yun Ching et al indicates that interventional repair of ventricular septal defect (VSD) is associated with 8.6% serious events, most notably 2nd or 3rd degree atrioventricular block which occurs 2 hours after device implantation. They also reported one case of perihepatic hemorrhage following device implantation which required blood transfusion. Similarly, we found one case of hemolysis requiring transfusion following PDA repair (13).

In another study, Jacek Bialkowski et al demonstrated that repairing PAD, ASD and foramen ovale using the interventional method or Cardio-O-Fix occluders is acceptable, at least in short term (14).

Taozhou et al indicated that complete atrioventricular block is the most serious complication of repairing membranous VSD using the interventional method, and ultimately they concluded that complete atrioventricular block is a major complication of repairing membranous VSD using catheterization. They recommended multicentric studies to mon-

itor this complication, and observed it in one patient (15).

In another study, Reyntjeis et al indicated remifentanyl sevoflurane to be a good and convenient anesthetic for pediatric cardiac catheterization, but may entail bradycardia and hypotension. They also demonstrated that intravenous administration of 1-6 mg/Kg glycopyrrolate during anesthesia may prevent bradycardia but not hypotension. We do not use this agent in our center (16).

Anne Marievalente et al reported that long term complications of coronary artery fistula include thrombosis, myocardial infarction and cardiomyopathy. Opening of CAF into coronary sinuses is associated with high risk over long term (17).

In another study, Yip WCL et al reported complete atrioventricular block after 2-4 days of repairing a membranous VSD with device through catheterization with Amplatzer in two patients. Interestingly, both patients responded to high dose intravenous steroid and aspirin. Similarly, we observed good responses to steroid in our patients and in some cases permanent pacemaker had to be extracted (18).

Walsh et al reported re-admission of three patients 10 days after PSVD repair with transcatheterization, whose complete atrioventricular block resolved rapidly with intravenous steroid. It must be noted, however, that confirming these findings requires multicenter studies (19).

In another study, Butea Gianfranco et al demonstrated that 1%-5% of patients undergoing interventional catheterization for VSD repair may experience complete atrioventricular block. Some researchers have reported successful management with steroid and aspirin in reversing the block resulting from interventional repair of perimembranous VSD. They used permanent pacemakers in patients whose atrioventricular block recurred after steroid therapy. One of our patients developed complete atrioventricular block unresponsive to steroid, and was administered permanent pacemaker (20).

Yang et al demonstrated that although VSD closure with symmetric or asymmetric occluder is a convenient method, it may result in complete atrioventricular block with either approach (21).

Liu et al reported that treatment with fibrinolytics, including urokinase, is beneficial in children developing femoral artery thrombosis after left heart catheterization. In the study conducted in this center, streptokinase proved useful

for management of femoral artery thrombosis (22).

Tavli et al evaluated 230 patients undergoing catheterization (204 for diagnosis and the rest for intervention) to report 3.4% complications, most notably atrial flutter, ventricular tachycardia, hypercyanotic spell, seizure, transient complete atrioventricular block, transient pulselessness, and peripheral vascular injury leading to femoral artery pseudoaneurysm that may require surgical intervention (23). This is very much similar to our findings.

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