

Anesthetic Strategies for Managing Childbirth in Women with Aortic Coarctation in A Low-Diagnosis Setting: Insights from Five Cases

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Abstract

Case Report

Background: The perioperative management of patients with congenital heart disease, such as aortic coarctation, presents significant challenges for anesthesiologists. The physiological and hormonal changes of pregnancy, particularly the increased hemodynamic load, are associated with a heightened risk of progressive aortic dilatation or dissection in these patients. Our study aims to delineate the anesthetic strategies employed to optimize maternal and foetal outcomes.

Methods: We conducted a cross-sectional study of women diagnosed with aortic coarctation who received care at the Monastir Maternity and Neonatal Center between March 1, 2013, and February 28, 2018. **Results:** The average maternal age was 27 years. Four women had pre-existing isthmic coarctation; one was diagnosed during pregnancy. Two had prior surgical repairs and one had undergone angioplasty. Comorbidities included rheumatic arthritis and hypertension. Common findings were hypertension (80%), murmurs (60%), and diminished femoral pulses (40%). Three patients had elective cesareans, one underwent an emergency cesarean, and one delivered vaginally. All received regional anesthesia, mainly combined spinal-epidural. Hemodynamics remained stable without vasoactive support. One case of uterine atony was managed effectively. All were monitored in ICU for 48 hours. Two infants were born prematurely, with APGAR scores of 8–10. No postpartum complications were observed. **Conclusions:** Regional anesthesia, especially combined spinal-epidural, was safe and effective for childbirth in women with aortic coarctation. Close multidisciplinary monitoring and individualized anesthetic planning contributed to stable maternal outcomes and favorable neonatal results. This study also suggests the potential underdiagnosis of aortic coarctation during pregnancy and underscores the need for routine cardiovascular screening in pregnant women with suggestive symptoms.

Keywords: Aortic coarctation in pregnancy, combined spinal-epidural anesthesia, multidisciplinary management, perioperative management, maternal and neonatal outcomes.

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INTRODUCTION

Coarctation of the aorta accounts for approximately 6% of congenital heart diseases, with an estimated prevalence of 1 in 2,500 live births [1]. This condition is characterized by a localized narrowing of the aortic isthmus, leading to significant hemodynamic consequences. Advances in diagnostic imaging have facilitated earlier detection, often allowing for surgical or catheter-based intervention during childhood. With continuous advancements in surgical techniques and the adoption of less invasive procedures, the morbidity and mortality associated with aortic coarctation have significantly declined, with survival rates reaching 99% at 30 years and 94% at 50 years. As a result, an increasing

number of women with aortic coarctation are now reaching childbearing age.

Pregnancy in women with aortic coarctation, whether native or previously treated, poses substantial maternal and foetal risks. The physiological and hormonal adaptations of pregnancy impose additional strain on the cardiovascular system, increasing the likelihood of progressive aortic dilatation, dissection, and rupture. These women are also at elevated risk for complications such as preeclampsia, embolism, cerebral hemorrhage, and aortic dissection. In most cases, cesarean delivery is preferred due to obstetric complications or the heightened cardiovascular risks associated with vaginal delivery [2].

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Perioperative anesthetic management in these patients is critical and requires meticulous planning, with a tailored approach based on the patient's cardiovascular status. The choice of anesthetic technique plays a pivotal role in minimizing perioperative morbidity and optimizing maternal and fetal outcomes. However, the literature lacks a clear consensus on the optimal anesthetic approach, and the most effective strategy remains a subject of ongoing debate [3].

However, we present the successful aesthetic management of five patients with aortic coarctation. This report provides a comprehensive analysis of the aesthetic techniques employed during childbirth and the perioperative strategies implemented, emphasizing the unique challenges associated with this high-risk population.

METHODS

This monocentric, cross-sectional, and descriptive study analyzed five pregnancies and deliveries in women diagnosed with aortic coarctation, managed at the Monastir Maternity and Neonatal Center (CMNM) over a five-year period, from March 1, 2013, to February 28, 2018.

Patient identification was conducted through the CMNM Anesthesia and Resuscitation Computerized Medical Record databases, as well as archived obstetrics and gynecology records. The inclusion criteria encompassed pregnant women with a confirmed diagnosis of aortic coarctation, regardless of whether the condition was diagnosed before or during pregnancy.

The study included patients irrespective of prior interventional treatment for aortic coarctation and accounted for the presence or absence of additional congenital cardiac anomalies. Women who delivered at term or preterm, under the care of either high- or low-risk obstetric teams, were included. The study also considered both live and stillbirths, with or without congenital anomalies. Written informed consent was obtained from all participants.

Exclusion criteria were limited to patients who declined participation in the study or refused analgesia or regional anesthesia during childbirth.

RESULTS

This descriptive, cross-sectional study reviewed the records of women admitted to the CMNM for childbirth with aortic coarctation over a five-year period, identifying a prevalence of 1 in 10,000. The average maternal age was 27 years, with a mean of two pregnancies and 1.5 births per patient, along with a history of one prior abortion per patient.

Aortic coarctation was pre-existing and isthmic in four of the five women. Two had undergone surgical correction (one following her first pregnancy), and one had undergone angioplasty. Figures 1 and 2 illustrate MRI scans of a patient before and after surgical intervention. Additionally, one woman had acute rheumatic arthritis, while another presented with multiple arterial stenosis and hypertension.

Figure 1: Cardiac MRI before correction of aortic coarctation.

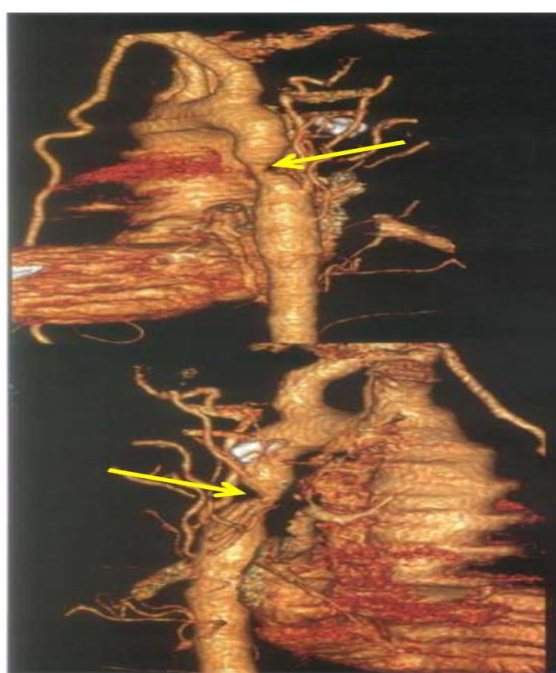


Figure 1: MRI scan of a patient with aortic coarctation before surgery

Figure 2: Cardiac MRI after correction of aortic coarctation.

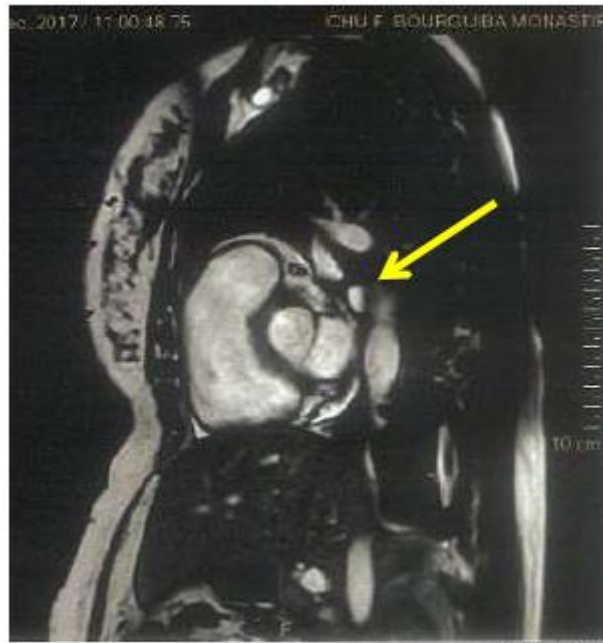


Figure 2: MRI scan of a patient with aortic coarctation After surgery

Overall, the pregnancies were well-monitored and uneventful, except in one case where aortic coarctation was first diagnosed during pregnancy. This patient developed severe preeclampsia, which was challenging to manage and accompanied by decreased foetal movements. Upon admission, the predominant

clinical findings included hypertension in 80% of cases (Figure 3), diminished or abnormal femoral pulses in 40%, and heart murmurs in 60%.

Figure 3: Histogram showing the hemodynamic stability of patients with aortic coarctation

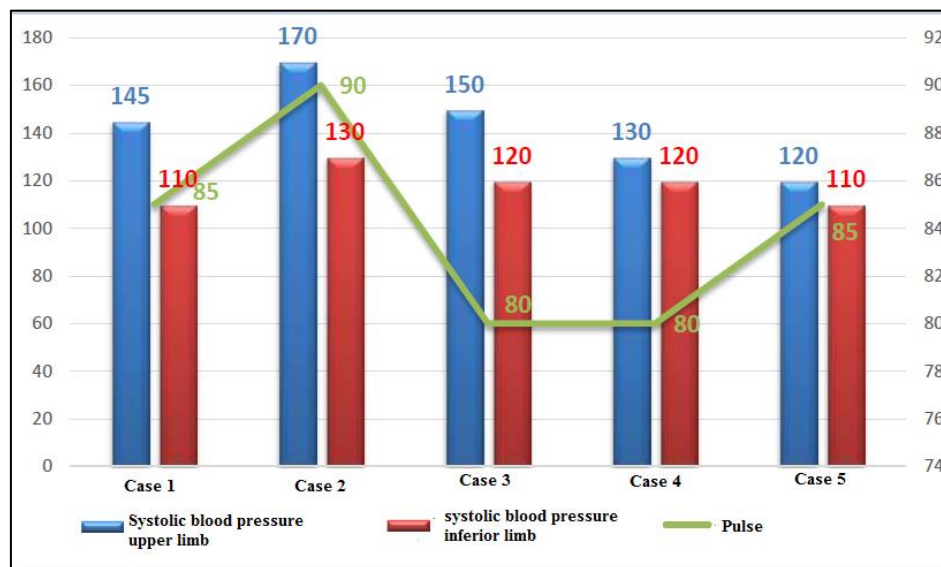


Figure 3: Histogram showing the hemodynamic stability of patients with aortic coarctation

Delivery methods varied among the cases: three patients underwent elective cesarean sections, one required an emergency cesarean section due to premature rupture of membranes, and one had a vaginal delivery.

Pre-anesthetic evaluations revealed no significant abnormalities, and radiological findings were unremarkable. All women received regional anesthesia;

four underwent combined spinal-epidural anesthesia, including the patient who had a vaginal delivery.

For cesarean sections, anesthesia was induced with 5 mg of 0.5% hyperbaric bupivacaine and 5 µg of sufentanil. Non-invasive monitoring was used for all patients, and no vasoactive drugs were required. Hemodynamic stability was maintained throughout the procedures (Figure 3).

One case was complicated by uterine atony, which was promptly managed with oxytocin and uterine revision. In this patient, the epidural catheter remained in place for 12 hours, while in the remaining cases; it was removed after two hours.

Morphine analgesia was administered via the catheter before removal. All patients were monitored in the ICU for 48 hours, with no reported complications. Postpartum monitoring included blood pressure, arterial gradients, oxygen saturation, ECG, and blood loss assessment. The postpartum period was uneventful for all women.

Two of the five newborns were delivered prematurely (between 34 and 37 weeks of gestation). The mean APGAR score was 8 at one minute, improving to 10 at ten minutes.

While this study is exploratory and limited by a small sample size and some missing data, it provides valuable insights into current anesthesia practices for this high-risk population and contributes to refining perioperative management strategies.

DISCUSSION

Coarctation of the aorta accounts for approximately 7% of congenital cardiac malformations, with a prevalence of 1 in 10,000 live births in our study—significantly lower than the reported 1 in 2,500 live births in the literature [1]. This discrepancy may reflect local underdiagnosis, possibly due to limited access to advanced imaging or delayed postnatal detection. While no specific incidence rate has been established for pregnancy complicated by aortic coarctation, this condition is not typically associated with infertility, except when it occurs as part of Turner syndrome [4]. However, given the specific characteristics of our sample, we cannot conclusively determine whether this anomaly is less prevalent in our population.

The observed abortion rate in our study (40%) exceeds that reported in previous studies, such as 17% in a Dutch cohort and 9% in a U.S. study involving 50 women with aortic coarctation [5]. Although the direct relationship between aortic coarctation and spontaneous abortion remains unclear, a theoretical risk exists due to the associated hemodynamic burden such as reduced perfusion to the lower part of the body, including the uterus and placenta, which may compromise foetal development and viability.

Aortic coarctation is typically diagnosed in early childhood, as symptoms often emerge following the closure of the arterial duct [6]. Intervention is recommended primarily to mitigate the risk of aortic dissection during pregnancy, particularly when the diameter of the ascending aorta exceeds 4.5 cm. While isolated congenital coarctation carries a minimal risk of

dissection [7], the presence of syndromic conditions such as Marfan syndrome, Ehlers-Danlos vasculitis, Loeys-Dietz syndrome, or Turner syndrome significantly amplifies this risk, necessitating individualized risk stratification and tailored management [8]. If left untreated, coarctation is fatal in 80% of cases by the age of 35 due to complications such as severe hypertension, cerebral haemorrhage, aortic aneurysm, and heart failure.

Early intervention is the cornerstone of optimal outcomes, with surgical correction being the preferred approach in neonates under three months of age, as angioplasty in this population carries a high risk of restenosis [10]. In adults, angioplasty with or without stenting is the preferred intervention due to its minimally invasive nature, lower complication rates, and comparable efficacy to surgery [10,11].

Pregnancy Management and Delivery Considerations

During pregnancy, close monitoring is essential. The American Society of Cardiology (ASC) recommends monthly echocardiographic surveillance to assess the ascending aortic diameter, aortic wall integrity, valve function and aneurysm formation as progressive dilation or dissection may occur in response to the dynamic hemodynamic changes of pregnancy [9], including increased blood volume, cardiac output, and arterial wall stress. Additionally, a prospective observational study involving 303 pregnancies in women with aortic coarctation reported a 3.3% incidence of CHD in their offspring. This rate is within the expected recurrence risk range of 4%–6.5% for non-syndromic maternal coarctation and higher for syndromic cases [21], highlighting the importance of preconception counselling and prenatal ultrasound screening for fetal cardiac anomalies [12].

Given the increased risk of hypertension and preeclampsia in pregnant women with aortic coarctation, antihypertensive therapy is recommended throughout gestation [11]. β -blockers and angiotensin II receptor antagonists (ARBs) have been shown to slow the progression of ascending aortic dilation, which can increase by up to 5% in normal pregnancies. However, due to the teratogenic potential of ARBs, β -blockers remain the preferred option [12]. The role of anticoagulant therapy and endocarditis prophylaxis in these patients remains a subject of debate, with inconclusive findings in the literature [13].

Regarding the mode of delivery, European cardiology guidelines no longer systematically recommend cesarean sections for congenital heart disease cases [14]. Reported vaginal delivery rates range from 60% to 87% [5].

In our study, non-invasive blood pressure monitoring was performed on both upper and lower limbs during labor. Some cases in the literature have

employed invasive monitoring, as recommended by Barcellos *et al.*, [15], to facilitate early detection of aortic rupture. However, over the past 30 years, only one case of thoracic aortic dissection during pregnancy has been reported [16].

ANESTHETIC MANAGEMENT

Oxygen therapy (2 L/min via nasal cannula) was administered to all patients, as per standard practice in the literature. A single 18G peripheral venous line was secured due to the potential risk of hemorrhage; the placement of multiple lines or central venous access was deemed unnecessary. Patients did not receive premedication but were administered oral antacids to minimize the risk of Mendelson's syndrome [17].

For cesarean sections, combined spinal-epidural anesthesia remains the preferred approach, as it allows for lower doses of local anesthetics, thereby minimizing hemodynamic fluctuations [18].

In a study by Vriend *et al.*, which analyzed 54 women with aortic coarctation and 126 pregnancies, 98 (39%) delivered vaginally, most without anesthesia [7]. The double-segment technique was previously used for sensory block, but since the 1980s, the single-segment approach has become more popular due to its efficiency and improved patient comfort [19].

A test dose of 3 mL of 2% lidocaine without adrenaline was administered to confirm epidural catheter placement. The American Society of Regional Anesthesia recommends fentanyl and epinephrine for detecting intravascular injection, while NICE guidelines advocate for 2% lidocaine with epinephrine as the anesthetic of choice [20].

For neuraxial anesthesia, we administered an intrathecal injection of 5 to 7.5 mg of 0.5% hyperbaric bupivacaine combined with 5 µg of sufentanil. This combination, supplemented with lipophilic morphine, enabled dose reduction while minimizing hemodynamic instability.

The NICE 2004 guidelines discourage routine crystalloid preloading before spinal anesthesia in cesarean sections, instead recommending ephedrine for the prevention of hypotension. Oxytocin administration was carefully titrated to mitigate the risks of peripheral vasodilation, hypotension, and tachycardia.

Two patients received antibiotic prophylaxis to prevent infective endocarditis. However, current guidelines no longer recommend routine antibiotic prophylaxis for pregnant women with aortic coarctation [20].

CONCLUSION

Despite the reduced sample size, this study provides valuable insights into the perioperative

management of patients with aortic coarctation. We aimed to establish criteria for pre-anesthetic evaluation and perioperative management while outlining the various anesthesia techniques employed in these patients. Although our findings are encouraging with regard to the feasibility and safety of tailored anesthetic strategies, they highlight the need for larger, multicenter studies with longer follow-up periods to further validate these observations

List of abbreviations

- APGAR – Appearance, Pulse, Grimace, Activity, Respiration
- ARBs – Angiotensin II Receptor Blockers
- ASC – American Society of Cardiology
- ASRA – American Society of Regional Anesthesia
- CHD – Congenital Heart Disease
- CMNM – Monastir Maternity and Neonatal Center
- CSE – Combined Spinal-Epidural
- ECG – Electrocardiogram
- ICU – Intensive Care Unit
- NICE – National Institute for Health and Care Excellence

Competing interests

Declare any competing interests here. If there are no competing interests to declare use the mention: The authors declare no competing interest.

Authors' contributions

All the authors have read and agreed to the final manuscript.

“The authors declare that they have no conflicts of interest to disclose.”

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