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Authors' Affiliation:

¹Department of Anesthesiology, King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia

²MD, FRCPC, DABIM, Advanced Heart Failure and Transplant Cardiologist, King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia

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Anesthetic management of a patient with a transplanted heart undergoing a cesarean section: A case report

Nasser Alabdulkarim¹, Abdullah AlRaffa¹, Usama Saleh¹, Rawan Alandas¹, Norah Almajed¹, Alanood Alsaleem¹, Nawaf Alkhudryi¹, Mosaad Alhussein²

ABSTRACT

Background: This study was aimed to evaluate the outcomes of anesthetic management in a pregnant patient post orthotopic heart transplant secondary to dilated cardiomyopathy with severe left ventricular systolic function. **Case Description:** This is 25-year-old pregnant women, primigravida, gestational age at 34 weeks and 5 days that was electively admitted for further investigation in King Faisal Specialist Hospital and Research Center (KFSH&RC), Riyadh, Saudi Arabia, for multidisciplinary meeting, to properly optimize the patient status and approach the best possible outcome. The patient underwent orthotopic heart transplant in September 2011 due to dilated cardiomyopathy with severe left ventricular systolic dysfunction. The initial plan for this patient was pure neuraxial anesthesia, utilizing a Epidural and spinal combined anaesthesia. This, however, was complicated by an accidental dural puncture with an 18-gauge Tuohy needle, causing post dural puncture headache which was then later treated by an epidural blood patch. **Conclusion:** The perioperative management of such cases requires an intricate plan by an experienced team in a multidisciplinary approach to optimize intra and post operative outcomes for both mother and neonate. Keeping in mind all cardiac considerations of a transplanted heart and pregnancy, that normally involve the physiological, anatomical, and pharmacological changes and their role in the perioperative period. Anesthetic approach whether General anesthesia or neuroaxial anesthesia depends heavily on cardiac reserve and function.

Keywords: Pregnancy, Dilated cardiomyopathy, Left ventricular systolic, Heart, Transplant

1. INTRODUCTION

There is a significant economic loss associated with over 60 million individuals suffering from heart failure globally due to its constant rise in prevalence (James et al., 2018; Cook et al., 2014). The first post-solid organ transplant pregnancy and delivery happened in 1958, in a kidney transplant patient (Cowan et al., 2012; Murray et al., 1963). In 1988, a female patient with a history of dilated cardiomyopathy who became pregnant less than two years after receiving a heart transplant was claimed to be the first post-transplant patient to conceive (Cowan et al., 2012; Löwenstein et al., 1988; Wu et al., 2007). Since heart transplantation (HTx) has a median survival period of more than ten years, it is acknowledged as the most successful destination treatment (Lund et al., 2017). In 2015, there were more than 5,000 HTx done globally, which is a record since the technique's inception in 1967 (Lund et al., 2017).

The gold standard for treating patients with end-stage heart disease is still orthotopic heart transplantation (OHT). For patients who are not responding to guideline directed medical therapy, cardiac transplantation can be a lifesaver. The median survival time has grown to 13 years, with an overall survival rate of 85–90% at one year and over 75% at seven years after transplantation. (Chambers et al., 2019; Taylor et al., 2007). Women make one-third of these heart transplant patients, and roughly 20% of them are of reproductive age (Alston et al., 2001). Women of reproductive age who have undergone heart transplantation often achieve a normal lifestyle. Such women often wish to procreate and expect to be able to do so. Thus, one can expect that knowledge of the effects and risks of heart transplantation on fertility and pregnancy, as well as the risks of pregnancy, will require detailed preconception counselling and appropriate obstetric care for these patients.

Anesthesiologists encounter difficult issues with the denervated heart's function and the intricate medication regimens of cardiac transplant patients. If coupled with pregnancy, the illness will become more complex and pregnancy associated changes should be considered. This study was aimed to investigate the results of anaesthesia for a pregnancy undergoing caesarean section years after cardiac transplantation for a dilated cardiomyopathy with severe left ventricular systolic function, status post orthotopic heart transplant. It was initially supposed to be done under Epidural and spinal combined anaesthesia, but an accidental dura puncture occurred with an 18 g tuohy needle, so we fixated the catheter intrathecally, and the patient complained of a dura puncture headache post operatively. We describe a pregnant patient who underwent a successful anaesthesia procedure for dilated cardiomyopathy 12 years after receiving a heart transplant. Throughout the procedure, we employed a combination of vasoconstrictor and intrathecal anaesthesia. Hemodynamics were steady and the route was uneventful.

2. CASE DESCRIPTION

This is 25-year-old pregnant patient, G1P0, gestational age at 34 weeks and 5 days that was electively admitted for further investigation in King Faisal Specialist Hospital and Research Center (KFSH & RC), Riyadh, Saudi Arabia. For Multidisciplinary meeting, planning, and patient preparation prior to elective Caesarean section. The patient had undergone orthotopic heart transplant 12 years earlier due to severe left ventricular systolic dysfunction secondary to dilated cardiomyopathy. Her post-transplant course was uncomplicated with the 10-year routine angiography showing no evidence of cardiac allograft vasculopathy and an echocardiogram showing LV function. She has no history of severe cellular or antibody mediated rejection. During early January of 2023, the patient discovered that she was pregnant. Throughout pregnancy, antenatal care was optimized, and no obstetrical concerns were found. She also had frequent follow up with the transplant cardiologist. After a lengthy multidisciplinary team meeting comprising of obstetricians, transplant cardiologists, neonatologists, and anesthesiologists' elective C section was decided to be performed on the end of the 35th week of gestation (13th September 2023) due to her Heart Transplantation history.

3. CLINICAL EVALUATION

The patient was doing well with no active complaints or issues. She was asymptomatic from a cardiac point of view being in New York Heart Association (NYHA) class I. There was good fetal movement, no per-vaginal loss or bleeding, no urinary symptoms. On physical exam her vital signs were stable, no signs of DVT, abdomen was soft and lax with no contraction or tenderness and normal pH was recorded. Laboratory tests: Hb 13.2 g/l, serology was non-reactive. Coagulation profile values were within the normal reference range (Table 1).

Physical examination

Airway Mallampati classification II soft palate, portion of uvula, adequate distance, temporomandibular joint mobility was good, mouth and throat appeared normal with no signs of edema, Neck was full range of motion. The respiratory examination showed equal bilateral air entry with no added sounds. Cardiac Examination was unremarkable.

Radiological evaluation

Singleton pregnancy with gestation age of 35 weeks 5 days, Fetus presentation was cephalic, and placenta was anteriorly high. Normal umbilical growth and doppler appeared normal. The Fetus was shown to have ventricular septal defect (VSD) that will be evaluated after delivery.

Cardiological examination

Echocardiogram showed Left ventricular systolic function was normal while ejection fraction was more than 55%. The right ventricular systolic function was mildly reduced. No echocardiographic features of heart transplant rejection found. Mild to moderate mitral and tricuspid regurgitation was reported. No regional wall motion abnormalities were observed. Pulmonary artery pressure was normal while no pericardial effusion was seen.

Medication evaluation

The patient was on vitamin D 1000 mg unit OD, calcium carbonate 1200 mg BID, Prednisone 5 mg OD, Folic Acid 5 mg OD, Tacrolimus 1 mg BID, Imuran 50 mg OD, MG 400 mg BID, Aspirin 81 mg OD. After the multidisciplinary team meeting the patient continued taking aspirin till the day of surgery without any contraindication and Tacrolimus 1 mg BID until morning of the surgery, she was also on prophylactic anticoagulant from the day of present up until 12 hours before cesarean section. 100 mg of hydrocortisone IV was given as a stress dose and 2 g of cefazolin intraoperatively prior to induction.

Anesthetic procedure

The plan advised for this patient was Combined-Spinal- Epidural anesthesia approach. To start, the patient's vitals (temperature, respiratory rate, SPO₂, pulse rate, blood pressure and heart rate), ECG of the patients were continuously monitored. The patient was kept on oxygen (2-5 L/min) until the cesarean section was completed. Before spinal anaesthesia was administered, the patient had an intravenous catheter inserted and 500 millilitres of Lactated Ringer's Solution preloaded. A left radial arterial was inserted to measure invasive blood pressure and to withdraw arterial blood gas samples with ease if needed. Aseptic measures were taken (sterile gloves, mask, cap, gown) and chlorhexidine was used as an antiseptic for skin. Lidocaine 2% 3.5 ml was used for local infiltration. Combined spinal and epidural anesthesia was performed at the level of L3-L4 interspace with the patient awake in the sitting position.

The blockade consisted of performing a spinal block via a 25-G spinal needle that was introduced through an 18-G Tuohy needle, which was oriented cranially in the epidural space. During the CSE insertion, the procedure was complicated by an accidental dural puncture with an 18-gauge tuohy needle, catheter was fixated intrathecally and the spinal block using the catheter. 100 mcg of intrathecal Morphine, 15 mcg of Fentanyl and 8.5 mg (1.8 ml) of 0.5% heavy Marcaine were used for the block. The level of the resulting sensory blockade was tested using a bag of ice. The block was tested to be at the level of T4. When a satisfactory anesthesia level was achieved, surgery began. Under spinal anesthesia, the patient was in supine position, she was prepped and draped in the usual sterile manner. A Pfannenstiel incision was applied using scalpel and carried through the underlying layers until reaching the rectus sheath. The rectus sheath was incised in the middle by scalpel.

Using mayo scissors, the incision was expanded laterally. The midline was used to divide the rectus muscles, and the peritoneum was located, stretched upward, and entered. The bladder was dissected and retracted from the uterus using doyen retractor. The uterus was in central position. A transverse incision was applied on the lower segment of the uterus. The baby boy was delivered in a cephalic presentation by forceps with clear liquor, handed to NICU team. Immediately after, Carbietocin 20 mcg intravenously, the uterus was contracting well. Cord blood was sampled then the placenta was delivered completely by continuous cord traction. The uterus was then cleaned from inside and closed in two layers using 0 polysorb suture. Intercede and Tachosi were applied. Hemostasis was achieved. Paracolic gutters were seen. Both tube and ovaries were normal. The rectus sheath was closed in one layer using Stratafix

suture in a continuous manner. Subcutaneous fat was approximated then the skin was closed in subcuticular manner. Vaginal drain was done, and it showed normal lochia.

During the surgery, good hemodynamics was achieved with a urine output of 300ml and a estimated blood loss of 500 ml. Patient was transferred to the Cardiac Care Unit (CCU) postoperatively for observation with good hemodynamics, with no inotropic support on room air. Breast feeding was completely restricted due to immunosuppressant risk transfer to baby. PDPH headache was developed on day 1, the patient complained of a headache that was characterized as 7/10 in terms of pain, throbbing in nature, aggravated by standing and walking and relieved by laying down, no fever or photophobia were present. Patient was on 600 mg of ibuprofen q 6 for 3 days orally, 1000 mg of oral paracetamol q 6 for 3 days. However, her headache did not subside, so, a blood patch was performed on day 2 post-op which yielded almost instantaneous recovery. Four days after delivery, the patient and her infant were released from the hospital, both in good health.

Table 1 Laboratory investigation results

CBC and Differential		
Parameter	Result	Measurement unit
WBC	H 16.45	109/L
RBC	4.07	Million/mm3
Hemoglobin	128	g/dl
Hematocrit	0.366	Percent
MCV	89.9	Femtoliters
MCH	H 31.4	Picograms per cell
MCHC	350	g/dl
RDW	13.6	Femtoliters
Platelet	185	109/L
MPV	10.6	Femtoliters
Coagulation		
PT	H 14.4	Seconds
INR	1.1	Seconds
PTT	31.5	Seconds
PTT Ratio	0.9	Ratio
Chemistry		
Urea	L 3.0	mg/dL
Creatinine	58.0	mg/dL
e-GFR	>60	mL/min
K	4.2	mmol/L
Na	135	mmol/L
Cl	106.0	mEq/L
CO2	L 18	CO2parts per million
Ca Level	2.27	mg/dL
PO4	1.06	mg/L
Mg	L 0.55	mg/dL
Albumin	L 34	g/dl
Abbreviation: WBC: White blood cells, RBC: Red blood cell, MCV: Mean corpuscular volume, MCH: Mean corpuscular hemoglobin, MCHC: Mean corpuscular hemoglobin concentration, RDW: Red cell distribution width, MPV: Mean platelet volume, PT: Prothrombin time, INR: International normalised ratio, PTT: Partial thromboplastin time, e-GFR: estimated glomerular filtration rate		

4. DISCUSSION

The care for heart transplanted patients undergoing non cardiac surgery requires meticulous and intricate planning because of their aberrant cardiac physiology. In this case, the cardiac and obstetric considerations, risks, complications require detailed discussion by experienced Cardiac Anesthesiologists, Obstetric Anesthesiologists, Cardiologists, Neonatologists, and Obstetricians. Patient pre-operative evaluation is key for planning, their cardiac condition and functional status can change multiple aspects of the plan, in our patient, the cardiac reserve was excellent, and her functional status was practically normal. However, in other patients with similar history there could be some degree of limited cardiac capacity or signs of rejection on ECHO. Furthermore, it is important to consider neonatal complications and postpartum monitoring and disposition for the mother as well as the baby.

Cesarean sections are performed in about 30% of heart transplanted recipients (Cowan et al., 2012; Wielgos et al., 2009). This case study cesarean section was performed on patients with dilated cardiomyopathy with severe left ventricular systolic function, status post orthotopic heart transplant. Maintaining hemodynamic stability, protecting heart function, taking precautions to prevent infections, and ensuring the safety of both the mother and baby are important objectives no matter what type of anesthesia method is used. Both general and neuraxial anesthetic were successfully administered to heart transplant recipients (Allard et al., 2004; Valerio et al., 2014; Movva and Taksande, 2023). However, compared to general anesthesia, neuraxial is a better option for pregnant women as it has less an impact on the baby. This patient had good cardiac function, a normal coagulation, and no other severe complications, so for that reason neuraxial anesthesia was administered.

According to the case report of Knight and Morris, (2007), a pregnant woman, 33 years old, was admitted to the hospital with a 34-week 3-day pregnancy. Due to her dilated cardiomyopathy, she had an orthotopic heart transplant in September of 2005. She was given tacrolimus and mycophenolate as prescribed for the next ten years, during which time she experienced no rejection episodes (Knight and Morris, 2007). Similar finding is reported in our case report, the patient is a 25-year-old pregnant lady who presented to the Emergency Department with age of gestation at 34 weeks and 5 days. The patients underwent orthotopic heart transplant in September 2011 for a dilated cardiomyopathy with severe left ventricular systolic function. We maintained anesthesia level at T4 and got satisfactory results and hemodynamic stability. Control of the proper level of block during neuraxial blockade; is essential as too high a level of blockade can inhibit sympathetic nerves and cause significant vasodilatation, which could be detrimental for a heart transplant patient; Furthermore, too low a level of blockade could also be an issue because the resultant pain will activate sympathetic responses and may increase acute blood pressure fluctuations during labor and increase myocardial oxygen demand (Cowan et al., 2012).

Maintaining preload strictly is essential as the heart is pre-load dependent in these patients. However, it's important to remember that overfilling can harm a debilitated heart by increasing the risk of heart failure. Urine output must also be measured frequently and the color of urine to be assessed to evaluate the fluid administration rate. Immunosuppressant drugs are an important aspect to consider when dealing with such patients as there is an increased risk of infections peri-operatively and precautions should be taken to reduce the risk of infections, strict aseptic techniques should be followed, Reduce the amount of time that indwelling catheters are used, and remove invasive lines as soon as possible. In this patient, tacrolimus was used postoperatively as Knight and Morris, (2007) suggested.

5. CONCLUSION

Optimizing intra- and post-operative outcomes for both mother and neonate necessitates a complex strategy developed by a skilled team using a multidisciplinary approach for the perioperative treatment of these patients. Considering all cardiac aspects of a heart transplant and pregnancy, which often entail modifications to physiology, anatomy, and pharmacology as well as their significance during the postoperative phase Anesthetic approach whether General anesthesia or neuraxial anesthesia depends heavily on cardiac reserve and function.

Ethical approval

Not applicable.

Informed consent

Written & Oral informed consent was obtained from individual participant included in the study.

Author's contribution

Nasser Alabdulkarim, Abdullah AlRaffa, Usama Saleh: Participated in writing introduction and discussion.

Rawan Alandas, Norah Almajed, Alanood Alsaleem: Participated in writing discussion and case description.

Nawaf Alkhudry, Mosaad Alhussein: Participated in writing discussion, case description, abstract and conclusion.

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Conflict of interest: The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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