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Case Report

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A Case of Multidisciplinary Approach to Post-Radiotherapy Dilative Cardiomyopathy Undergoing Elective Cesarean Delivery: Anesthetic and Intensive Care Management

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Abstract

Background: Cardiovascular diseases are the most common non-obstetric cause of maternal death. These cases became more common thanks to the improvement in cardiovascular therapies. A multidisciplinary team is necessary to manage these pregnancies.

Case Report: A 32 years old women at the 25th week of gestation for acute heart failure in pre-existing left ventricular dysfunction induced by radio-chemotherapy admitted to the Coronary Unit of IRCCS Policlinico Universitario Agostino Gemelli for worsening of dyspneic symptoms and anuria not responding to diuretic therapy. At the echocardiogram: ejection fraction 30%, enlarged left atrium, systolic pulmonary arterial pressure 38 mmHg, bilateral pleural effusion, bilateral diffused pulmonary B lines. A multidisciplinary team composed by cardiologists, gynecologists, anesthesiologists, cardiac surgeons, neonatologists and bioethicists decided for an elective cesarean delivery at the 27th week of gestation in the hybrid cardio-thoracic operating theater. Anesthesia was provided by combined spinal-epidural technique under invasive continuous hemodynamic monitoring with the Edwards Lifesciences HemoSphere with Hypotension Prediction Index (HPI) and ForeSight technology (Edwards Lifesciences, Irvine, USA) through catheterization of the left radial artery. The femoral arteries were left available for extracorporeal circulation. Continuous norepinephrine infusion was started once liquor was collected in the spinal needle at a 0.1 mcg/kg/minute through a central line and was continued until the end of surgery. Fluid management consisted of a total of 200 ml of crystalloids. HPI values never reached alarm values (maximum value =10). The patient was discharged home on the 5th day after delivery with good hemodynamic compensation. The baby was intubated at birth and then gradually weaned from mechanical ventilation, then discharged.

Keywords: Cardiovascular Diseases; Coronary Unit; Hypotension Prediction Index; Radio-Chemotherapy

Introduction

Nowadays cardiovascular diseases are the most common non-obstetric cause of maternal death, affecting the 1-4% of all pregnancies [1,2]. Cardiologic treatments have improved over the years, making pregnancies in women with cardiovascular diseases more common. The management of these pregnancies should be carried out by a multidisciplinary team of cardiologists, obstetricians, neonatologists and anesthesiologists [2]. We

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report an example of multidisciplinary approach to a case of radiotherapy-induced dilative cardiomyopathy (DCM) with acute heart failure at the 25th week of gestation.

History of Presentation

A 32 years old women at the 25th week of gestation admitted to the Coronary Unit of IRCCS Policlinico Universitario Agostino Gemelli for acute heart failure in pre-existing iatrogenic left ventricular dysfunction.

Past Medical History

The patient was treated with chemotherapy (anthracyclines) and radiotherapy in 2009 for Hodgkin's lymphoma. She was incidentally diagnosed with left ventricular systolic dysfunction (Ejection Fraction, EF 35%) during a hospital admission for a sprained ankle in May 2018. She then ran a cardiac Magnetic Resonance imaging in July 2018 showing mild left ventricle dilation and an EF of 37%, mild mitral regurgitation and mild right ventricular systolic dysfunction in absence of fibrosis. She was then put on bisoprolol 3.75 mg/day and ramipril 1.25 mg/day with clinical and echographic benefit (EF 51% at an exam of October 2018). Following episodes of chest pain after moderate efforts, she also underwent a myocardial scintigraphy showing small reversible perfusion deficits and a following coronarography which was negative in June 2019. Once pregnant, her cardiologic symptoms were stable (dyspnea after moderate efforts), and her therapy was switched to bisoprolol 3.75 mg/day and metildopa 250 mg/day, then suspended for hypotension. She also had an Holter electrocardiogram: sinus rhythm between 54 and 134 bpm with rare ventricular extra systoles; and a transthoracic echocardiogram: EF 40%, mild mitral regurgitation, moderate aortic regurgitation, minimal tricuspid regurgitation, systolic pulmonary arterial pressure not determined. She was admitted to our coronary unit at the 24th week of gestation from San Carlo Hospital of Potenza for worsening of dyspnoeic symptoms and anuria not responding to diuretic therapy.

Case Description

On admission to the Coronary Unit of our hospital the patient was alert and cooperative, eupnoic at rest, with forced semi-orthopneic decubitus, no chest pain. Her height and weight were, respectively, 160 cm and 103 kg. At physical examination she had bilateral wet sounds with reduced vesicular murmur of the right lung and bilateral lower limbs pitting edema. A bedside transthoracic echocardiogram showed left ventricle systolic impairment (EF 28%, stroke volume 37 ml, cardiac output 3.9 l/min) and dilation (end diastolic left ventricle volume 123 ml); right ventricle systolic impairment (tricuspid annular plane excursion 16mm, S' 10 cm/s); enlarged left atrium, moderate/severe mitral regurgitation, mild aortic regurgitation, mild tricuspid regurgitation, systolic pulmonary arterial pressure 38 mmHg, bilateral pleural effusion, bilateral diffused pulmonary B lines (Figure 1). Her hemodynamic variables were monitored by Edwards FloTrac by catheterization of the left femoral artery to titrate the inotropic therapy and fluid management. She was then treated with furosemide and continuous infusion of levosimendan, her fluid balance was kept negative, with evidence of clinical, hemodynamic and echocardiographic benefit after 11 days in the Coronary Unit. Fetal cardiac monitoring was daily, showing good fetal heart rates around 150 bpm. A multidisciplinary team composed by cardiologists, gynecologists, anesthesiologists, cardiac surgeons, neonatologists and bioethicists was then gathered to choose the best treatment for mother and child. We programmed an elective cesarean delivery at the 27th week of gestation in the hybrid cardio-thoracic operating theater before which the patient was thoroughly counseled by a bioethicist. Prenatal steroids were suspended and magnesium sulfate was administered to manage risks of endocranial hemorrhage. Fetal wellbeing has been then monitored by echo flowmetry. Anesthesia was provided under invasive continuous hemodynamic monitoring with the Edwards Lifesciences HemoSphere with Hypotension Prediction Index (HPI) and ForeSight technology (Edwards

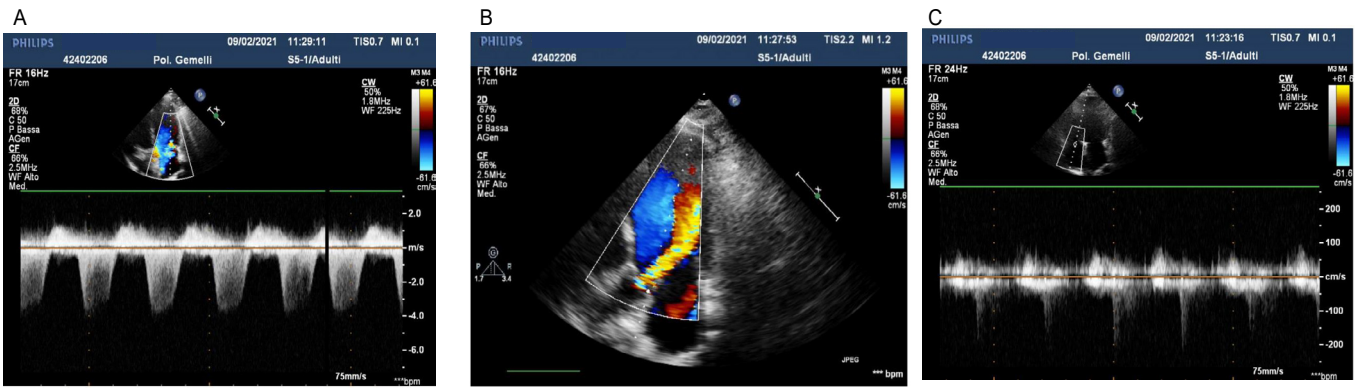

Figure 1 : Images of bedside trasthoracic echocardiocardgrafic exam. A: left ventricle systolic impairment (EF 28%, stroke volume 37 ml, cardiac output 3.9 l/min); B: aortic regurgitation; C: right ventricle systolic impairment (tricuspid annular plane excursion 16mm, S' 10 cm/s)

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Lifesciences, Irvine, USA) to predict hypotensive events and monitor cerebral oxygen saturation through catheterization of the left radial artery. Femoral arteries were left available if extracorporeal circulation would have been suddenly needed. Sensory anesthesia from T4 to S1 was achieved by combined spinal-epidural anesthesia with 7 mg of 0.5% hyperbaric bupivacaine and sufentanil 5 mcg in the subarachnoid space via a 27 G Whitacre spinal needle at L3-4 followed by lidocaine 2% 10 ml trough the epidural catheter. Continuous norepinephrine infusion was started once liquor was collected in the spinal needle at a 0.1 mcg/kg/minute through a central line and was continued until the end of surgery. Fluid management consisted of a total of 200 ml of crystalloids. After delivery, oxytocin 20 UI in SF 250 ml was administered as continuous infusion. Postoperative analgesia was achieved by 2,5 mg of morphine in the epidural catheter and by acetaminophen. Intraoperative hemodynamic variables were: cardiac output, cardiac index, stroke volume and stroke volume index, heart rate, systolic, diastolic and mean arterial pressure, dP/dt, dynamic elastance, and HPI. The mean values of these hemodynamic variables are reported in Table 1 at baseline (T0), after neuraxial anesthesia (T1) and after birth (T2). HPI values never reached alarm values (maximum value =10). The patient was then transferred to the coronary unit for postoperative observation which was uneventful. She was discharged to a regular cardiology unit on the 5th day after the delivery. The baby was intubated at birth and transferred to the neonatal intensive care unit.

Discussion

Advances in medical therapy are allowing more and more patients with cardiac failure to carry on pregnancies. Cardiovascular modifications during pregnancy lead to a delicate equilibrium that requires the management of a multidisciplinary team [1]. To meet the increased metabolic demand to the mother-and-fetus system, cardiac output increases in the first half of pregnancy as a consequence of an in increase in plasma volume (with plasma expansion not followed by an increased number of red blood cells with relative anemia) and stroke volume, and then as a consequence of increased heart rate (secondary to increased sympathetic tone). Atrial and ventricular chamber increase in diameter but not in function, with ventricular concentric remodeling and eccentric hypertrophy. At the end of second trimester systemic vascular resistances decrease as an effect of the release of vasodilatory agents such as progesterone, estrogen, prostaglandins, relaxin and nitric oxide, and of the placenta development which introduces a high-flow/low resistance shunt to the maternal circulation [3]. The maternal heart has to face an increase in preload and a decreased afterload. A lack of response in ventricular contractility may exacerbate heart failure, ensuing with tachycardia (to increase cardiac output and supply for the not-augmented stroke volume) and hypoxemia (to which contributes also the diminished oncotic pressure) [3]. Reports of DCM in pregnancy are rare, since pregnancies are discouraged in patients with EF<30%. Our patient had a well clinically tolerated reduction of EF which decompensated during pregnancy. This scenario was further worsened by the obliged suspension of ACE-inhibitors, which may have teratogenic effects. Our patient with DCM could bare the cardiovascular burden of pregnancy until the 24th week of gestation. At that point, functional reserve of the left ventricle was completely depleted, leading to a scenario of increased systemic vascular resistances to ensure an adequate preload to the left ventricl with contracted urinary function and lung edema, not responding to continuous furosemide infusions. Levosimendan administration favored a better left ventricle systolic performance and allowed to carry on the pregnancy until the 27th week of gestation. At this point the multidisciplinary team decided that the best option for mother and child was to program an elective cesarean delivery. We discussed the options available to support the heart function during the cesarean delivery and balance the risks of anticoagulation needed to implant an external left ventricle assistance device with the hemorrhagic risk related to the delivery and the hemodynamic impairment generated by a general anesthesia. Spinal anesthesia in cesarean delivery is accompanied by a high incidence of maternal hypotension. [4] This is due to the sympathetic motor block which the latest international recommendations advice to treat by preventive continuous vasopressors infusions and crystalloid co-load. [4] In our patient we decided to manage the hemodynamic alterations that accompany spinal anesthesia by the following strategies:

Table 1: Mean values of cardiac output (CO in L/min), cardiac index (CI in L/min/m^2), stroke volume (SV in ml/b) and stroke volume index (SVI in ml/b/m^2), heart rate (HR in bpm) systolic, diastolic and mean arterial pressure (respectively SAP, DAP and MAP in mmHg) dP/dt in mmHg/s, dynamic elastance (Ea_{dyn}), and Hypotension Prediction Index (HPI) at baseline (T0), after neuraxial anesthesia (T1) and after birth (T2).

	T0	T1	T2
CO	6.9	8.1	7.3
CI	3.4	3.9	3.6
SV	59	76	76
SVI	29	37	37
HR	117	105	95
SAP	165	136	132
DAP	100	72	71
MAP	122	94	93
dP/dt	1024	918	901
Ea_{dyn}	1.4	1.6	1.4
HPI	1	2	4

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- Slow titration of sensory block through combined spinal-epidural anesthesia. We delivered an initial small dose of subarachnoid hyperbaric bupivacaine and then reached a T4 sensory block by slowly administering 20 mg of lidocaine in 10 ml through the epidural catheter. Even if a metanalysis showed that doses of bupivacaine < 9 mg allow lower maternal side-effects at the cost of compromised anaesthetic efficacy [5]; Van de Velde demonstrated that adjunctive anesthetic doses through an epidural catheter are able to reinforce the block in case of longer procedures [6]. Combined spinal-epidural anesthesia has been successfully used for neuraxial anesthesia in patients with cardiac diseases [7].
- Fluid restriction and preventive norepinephrine continuous infusion. Medical interventions on hypotension recently shifted to a direct counteraction of arteriolar vasodilation and decreased systemic vascular resistance by preventive alpha-agonists administration. The vasopressor of choice is phenylephrine [4], which is associated with decreased maternal heart rate and, consequently, decreased cardiac output [8-10]. Ngan Kee et al. [11] showed that norepinephrine had similar effects on blood pressure with fewer effects on heart rate and higher values for cardiac output, possibly thanks to its weak beta-stimulation.
- Continuous minimally invasive hemodynamic monitoring by HPI and ForeSight technology to predict hypotensive events and monitor cerebral oxygen saturation. The HPI is an algorithm that predicts hypotensive events by the analysis of high-fidelity arterial pressure waveform which has been tested in surgical and intensive care unit patients [12]. HPI is a unitless number that ranges from 1 to 100, and as the number increases, the likelihood of a hypotensive event (defined as a mean arterial pressure (MAP) of <65 mmHg for more than 1 minute) occurring in the near future increases [12].

Our patient was relying on a subtle hemodynamic equilibrium. The advanced hemodynamic monitoring allowed us to predict and prevent any derangement of blood pressure, cardiac output and cerebral oxygenation.

Conclusions

A multidisciplinary team approach and an up-to-date anesthesiologic management with advanced hemodynamic technology allowed a successful delivery of a 27 weeks pregnant patient with post-radiotherapy DCM.

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