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Review

Pregnancy and pulmonary arterial hypertension: A clinical conundrum

Sonu Sahni [a], Atul V. Palkar [a], Burton L. Rochelson [b], Wiktor Kępa [c], Arunabh Talwar [a,*]

[a] North Shore – Long Island Jewish Health System, Department of Pulmonary, Critical Care and Sleep Medicine, 410 Lakeville Rd. Suite 107, New Hyde Park, NY 11040, United States

[b] North Shore University Hospital, Department of Obstetrics and Gynecology, Division of Maternal/Fetal Medicine, 300 Community Drive, Manhasset, NY 11030, United States

[c] Pabianice Medical Center, ul. Jana Pawła II 68, 95-200 Pabianice, Poland

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ABSTRACT

Pulmonary arterial hypertension (PAH) is a rare and devastating disease characterized by progressive increases in pulmonary arterial pressure and pulmonary vascular resistance which eventually leads to right ventricular failure and death. PAH inflicts most commonly women, majority of who are of childbearing age. Pregnancy in the setting of PAH is absolutely contraindicated due to high maternal fetal morbidity and guidelines do not exist for the management of such cases. A MEDLINE/PubMed search was performed identifying all relevant articles with "pulmonary arterial hypertension" and "pregnancy" in the title. Six case series were reviewed as well as our own center's experience outlined. Though there exists generalized treatment measures that are followed in such cases, management varies among different national centers as well an on an international level. At our center patients are managed using a multidisciplinary approach at a high risk obstetric center with preference for intravenous prostacyclin therapy. Women of child bearing age with possible signs and symptoms of PAH must be promptly diagnosed and managed expectantly with an emphasis on maternal–fetal safety.

Introduction

Pulmonary arterial hypertension (PAH) is a rare and devastating disease characterized by progressive increases in pulmonary arterial pressure and pulmonary vascular resistance which eventually leads to right ventricular failure and death [1]. It may be idiopathic in nature or associated with connective tissue diseases, congenital heart disease, portal hypertension, HIV or drug induced [2]. PAH affects mostly women, the majority of whom are of childbearing age [3]. Due to the high maternal fetal morbidity and mortality of pregnancy in PAH, the only guideline that exists is that it is absolutely contraindicated and has early termination [4].

Pregnancy in women with pulmonary vasculopathies is rare with an incidence estimated at 1.1 per 100,000 pregnancies [5]. There are a number of physiological changes that occur during pregnancy within the pulmonary and cardiovascular systems [6] that create an increased synergistic stress, further aggravating PAH, which may lead to maternal and fetal demise. However, with advances in diagnostic modalities and a greater understanding of this

* Corresponding author at: North Shore-LIJ Health System Pulmonary, Critical Care and Sleep Medicine, 410 Lakeville Rd., New Hyde Park, NY 11040, United States. Tel.: +1 (516) 465 5400; fax: +1 (516) 465 5454.

E-mail addresses: sahni.sonu@gmail.com (S. Sahni), apalkar@nshs.edu (A.V. Palkar), brochels@nshs.edu (B.L. Rochelson), wiktorkepa@gmail.com (W. Kępa), arunabh@nshs.edu (A. Talwar).

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disease, an increasing number of women are electing to continue with pregnancy. The aim of this article is to review PAH in pregnancy and discuss cases of pregnancy with PAH that we have handled at our center.

Methods and materials

A search was conducted of the National Library of Medicine's MEDLINE/PubMed with the objective of identifying all articles published in English language between January 1979 and May 2014 with "pregnancy" and "pulmonary hypertension" in the title. Combinations of medical subject heading terms including "pulmonary arterial hypertension," "pregnancy" and "management of pulmonary hypertension in pregnancy" were used. We mainly selected recent publications, but did not exclude any older works that were widely referenced. We also searched the reference lists of all articles identified by this search strategy and selected those we judged to be relevant. All pertinent reports were retrieved and the relative reference lists were systematically searched in order to identify any potential additional studies that could be included. All data were accessed between January and May 2014.

Pulmonary arterial hypertension and pregnancy

Two systematic reviews of the literature described the outcomes of pregnancies in women with PAH in the setting of Eisenmenger's syndrome to have a maternal mortality at rates of 36% and 28% respectively [7,8].

Pulmonary hypertension is defined hemodynamically as a mean pulmonary artery pressure (mPAP) greater than or equal 25 mmHg. Pulmonary arterial hypertension (PAH) has the added criteria of a pulmonary capillary wedge pressure (PCWP) less than or equal to 15 mmHg which must be confirmed by right heart catheterization (RHC) [9]. The World Health Organization (WHO) has proposed a classification system for pulmonary hypertension based on common clinical features (Table 1) [2].

The physiologic changes of pregnancy that are normally well tolerated in healthy individuals, in the setting of PAH, may further increase cardiopulmonary stress and expedite right sided heart failure. Pulmonary changes are both of the anatomical and functional nature (Table 2) [6] and cardiovascular changes are a physiologic response to improve oxygenation and nutritional flow to the fetus (Table 3) [6]. Under normal circumstances, during pregnancy there is an increase in cardiac output, blood volume and oxygen consumption with reductions in systemic vascular resistance [10]. These changes begin early in pregnancy, reach their peak during the second trimester, and then remain relatively constant until delivery. The pulmonary arterial systolic, diastolic and mean pressure remains unchanged during normal gestation despite the increase in cardiac output indicating a decline in pulmonary vascular resistance. This expected decrease in systemic vascular resistance in pregnancy could augment any present right to left shunt and exacerbate the cyanosis [11] in patients with the Eisenmenger's syndrome. Hemodynamics are also altered substantially during labor and delivery secondary to pain, anxiety, elevated catecholamine levels and uterine contractions. Oxygen consumption increases three folds

Table 1
World health organization's classification of pulmonary hypertension [2].

Group I – Pulmonary arterial hypertension (PAH)
Idiopathic PAH
Heritable PAH (BMPR2, ALK1, ENG, SMAD9, CAV1, KCNK3, unknown)
Drug and toxin induced
Associated with (i) Connective tissue disease, (ii) HIV infection, (iii) Portal hypertension, (iv) Congenital heart disease, (v) Schistosomiasis
Pulmonary veno-occlusive disease and/or pulmonary capillary hemangiomatosis
Persistent pulmonary hypertension of the newborn
Group II – Pulmonary hypertension due to left heart disease
Left ventricular systolic dysfunction
Left ventricular diastolic dysfunction
Valvular disease
Group III – Pulmonary hypertension due to lung diseases and/or hypoxia
Chronic obstructive pulmonary disease
Interstitial lung disease
Other pulmonary diseases with mixed restrictive and obstructive patterns
Sleep-disordered breathing
Alveolar hypoventilation disorders
Chronic exposure to high altitudes
Developmental lung disease
Group IV – Chronic thromboembolic pulmonary hypertension (CTEPH)
Group V – Pulmonary hypertension with unclear multifactorial mechanisms
Hematologic disorders: chronic hemolytic anemia, myeloproliferative disorders, splenectomy
Systemic disorders: sarcoidosis, pulmonary histiocytosis, lymphangioleiomyomatosis
Metabolic disorders: glycogen storage disease, Gaucher's disease, hypothyroidism
Others: tumoral obstruction, fibrosing mediastinitis, chronic renal failure, segmental pulmonary hypertension

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BMPR: Bone morphogenic protein receptor type II; CAV1: Caveolin-1; ENG: Endoglin; HIV: Human Immunodeficiency Virus.

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Table 2
Pulmonary changes in pregnancy.

Increased	Decreased
Vital capacity (VC)	Residual volume (RV)
Oxygen requirement	Total lung capacity (TLC)
Oxygen pressure	End respiratory volume (ERV)
Inspiratory capacity	Carbon dioxide pressure
Minute volume	PCO_2
Tidal volume (TV)	
Oxygen pressure (PO_2)	

Table 3
Cardiovascular changes in pregnancy.

Increased	Decreased
Cardiac output (CO)	Systemic vascular resistance (SVR)
Stroke volume (SV)	Pulmonary vascular resistance (PVR)
Heart rate (HR)	End respiratory volume (ERV)
Mean arterial pressure (MAP)	
Left ventricular stroke work index	

and the cardiac output rises progressively during labor owing to an increase in both stroke volume and heart rate [12]. A temporary increase in venous return may occur immediately following delivery due to relief of inferior vena cava pressure which at times results in a substantial rise in ventricular filling pressures, stroke volume and cardiac output which may result in clinical deterioration and hemodynamic compromise leading to mortality. Hemodynamic adaptations to pregnancy persist post partum and gradually return to pre-pregnancy level within 12–24 weeks after delivery. These physiologic events place a great demand on the cardiovascular system, with the greatest incidence of mortality occurring during the first several postoperative days. Although the exact cause of death in patients with primary pulmonary hypertension is not clear, right ventricular ischemia and failure, cardiac arrhythmia and pulmonary embolism are likely mechanisms. Identification of the hemodynamic changes has led to the use of anticoagulants, oxygen, and vasodilators in the management of these patients.

Cases

Over the years we have successfully managed cases at our institution. No committee guidelines exist regarding the treatment of pregnancy in the PAH. Individual centers may have their own management algorithm, however we have outlined here the diagnosis and management of our center's cases (Table 4).

Case 1

A 32 year old G2P2 African American female presented during her 2nd trimester at 21 weeks gestation with a complaint of slight exertional dyspnea and dizziness. Her echocardiography showed an estimated RVSP of 45 mmHg. Patient refused any treatment until after delivery. She delivered a healthy baby via elective Cesarian section at 35 weeks gestation under epidural anesthesia. Patient underwent RHC two days post delivery which revealed mPAP of 49 mmHg. Postpartum she was initiated on oral anticoagulation, sildenafil and intravenous epoprostenol. Patient was followed at 3 month intervals and progressed to right heart failure and she eventually underwent lung transplant and is currently stable.

Case 2

A 39 year old G2P1 female presented to the emergency room with a complaint of dyspnea on exertion. She reported no past medical history except a 20 pack year history of smoking which she quit prior to her 1st pregnancy 4 years earlier. A transthoracic echocardiogram showed an estimated RVSP of 62 mmHg consistent with moderate to severe pulmonary hypertension. A RHC confirmed the diagnosis of PAH revealing a mPAP of 57 mmHg. The patient was hospitalized and initiated on intravenous epoprostenol and heparin anticoagulation. Patient was followed until delivery and maintained on intravenous epoprostenol. The patient successfully delivered a healthy baby via elective Cesarian section at 34 weeks gestation. She was followed post delivery and was continued on intravenous epoprostenol therapy. She was started on bosentan and inhaled iloprost and eventually weaned off of IV prostacyclin.

Case 3

A 44 year old G2P0 Cambodian female with a past medical history of uncorrected atrial septal defect (ASD) presented during her eighth month of pregnancy with shortness of breath. An echocardiography by primary care physician showed an estimated RVSP of 110 mmHg. RHC revealed a mPAP of 68 mmHg and intravenous epoprostenol was initiated. Within the high risk pregnancy unit elective Cesarian section was performed at 34 weeks gestation and patient delivered a healthy baby. Postpartum she was monitored closely and remained stable with no complications. She was started on bosentan, warfarin and continuous oxygen in addition to epoprostenol. Repeat RHC one year after delivery showed an mPAP of 56 mmHg and a PCWP of 13. She remains stable without complaints and has transitioned to inhaled prostacyclin and bosentan. 3 years post partum she remains well.

Case 4

A 23 year old Hispanic female G2P0 presented to our clinic with a history of uncorrected ventricular septal defect (VSD), Eisenmenger's syndrome and established history of PAH. She had a past medical history of spontaneous abortion at 12 weeks gestation. When pregnancy was confirmed the patient was on bosentan. She was transitioned to intravenous epoprostenol for worsening PAH. She was admitted to the hospital during her 2nd trimester, initiated on heparin and followed by the high risk pregnancy unit. She remained on intravenous epoprostenol and delivered

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Table 4
Summary of cases presented.

Case	Age/parity	Estimated (ECHO)	RHC measurement (mPAP/ PCWP) (RHC)	Anticoagulation	Therapy during pregnancy
1	32 G2P2	45 mmHg	49/23 mmHg	Warfarin (post partum)	Nil (patient request)
2	39 G2P1	62 mmHg	57/16 mmHg	Heparin	IV epoprostenol
3	44 G2P0	110 mmHg	68/27 mmHg	Heparin	IV epoprostenol
4	23 G2P0	102 mmHg	74/17 mmHg	Heparin	IV epoprostenol

a baby via elective Cesarean section. Postpartum bosentan was reinitiated as well as warfarin. She was referred for lung transplant evaluation and transitioned to inhaled iloprost. She remains well 10 years post partum.

Symptoms and clinical presentation

Pulmonary arterial hypertension in an indolent condition at first and its diagnosis is often overlooked. Initial symptoms such as dyspnea on exertion, fatigue, dizziness/lightheadedness and peripheral edema may all be disregarded as physiological especially in the setting of pregnancy. However as this disease progresses pulmonary vascular resistance increases in the setting of decreased cardiac output, which is further exacerbated by the changes of pregnancy. Symptomatic deterioration usually occurs during the second trimester and is manifested by fatigue, exertional dyspnea, chest pain, palpitations, and hemoptysis and leg edema.

Echocardiography is the most useful imaging modality for screening for pulmonary hypertension [13] and excluding underlying cardiac disease. The gold standard for diagnosis for PAH is a RHC and must be eventually performed [8]. In pregnant patients with suspected pulmonary hypertension echocardiography may significantly overestimate pulmonary artery pressures compared with catheterization. Patients with structural cardiac defects appear to have a significantly greater difference in pulmonary artery pressures. Thirty-two percent of pregnant patients in one study with normal pulmonary artery pressures were misclassified as having PH when measured by echocardiography alone [14]. Though some clinicians may feel RHC is over-invasive, we believe that it is absolutely essential to guide therapy.

Management of PAH in pregnancy

With advancements in diagnostic and treatment modalities a greater number of women of childbearing age are being found to have PAH. Though our therapeutic algorithm may be specific to our center a generalized consensus of care that we follow has been presented (Table 5). All PAH patients of child bearing age should be advised against pregnancy and be initiated on some form of birth control. In the case of 1st trimester pregnancy early termination is recommended [10].

For those patients with PAH who become pregnant and do not wish to terminate, must be referred to a high risk pregnancy facility where a multidisciplinary approach may be taken to manage PAH during parturition. The treatment of PAH in pregnancy is complex and an increased maternal–fetal survival has been attributed to a multidisciplinary approach taken by obstetricians, anesthesiologists, cardiologists, intensivists and pulmonary hypertension specialists. An early case series reported a 50% mortality rate associated with pregnancy and PAH [15]. A more recent account noted a 30% mortality rate and partly attributed the decline rate to earlier recognition, better understanding of the pathophysiology of pulmonary hypertension, along with improvements in medical therapy and critical-care obstetrics [8]. In patients with Eisenmenger's syndrome premature delivery occurs in at least 50% of cases, and only 15–25% of pregnancies progress to term [16]. Spontaneous abortion is common and there is appreciable neonatal mortality associated with prematurity. In addition a number of cases are reported in which the symptoms first developed during pregnancy or in the post partum period [17]. To date there has been no standardized treatment consensus established for management of pregnancy in the setting of PAH. However successful outcomes are dependent on an individualized approach and multidisciplinary team collaboration.

For the patients who choose to continue with pregnancy hospitalization at 20 weeks close monitoring is advisable. Certain basic principles can be applied to all PAH cases, and these include avoiding high altitude travel, tobacco exposure. Women should also limit physical activity and avoid the supine position, especially late in the pregnancy. Arterial blood gas analysis should be performed to exclude hypoxemia and acidosis as contributors to pulmonary hypertension. Obstructive sleep apnea should be ruled out and aggressively treated. A low-salt diet and judicious use of diuretics can be helpful in reducing volume overload in patients with pulmonary hypertension and right ventricular failure. As the right heart is dependent on preload, care should be taken to avoid excessive diuresis and further reduction of cardiac output. Excessive use of diuretics may also enhance the risk for thrombotic events in patients with Eisenmenger's syndrome. Inotropic therapy with cardiac glycosides may be considered in the presence of excessive tachycardia [18]. Patients should also be anticoagulated due to the increased incidence of thromboembolism during pregnancy. Such therapy is recommended with heparin (Pregnancy category C – FDA safety information – Heparin) throughout gestation or at least during the third trimester and early postpartum period [10].

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Table 5
Summary of management options.

Pre-pregnancy
- Obstetrician and pulmonary hypertension specialist collaboration
- Discussion of maternal/fetal risks
- Discussion of effective/safe contraception
- Obtain update on clinical status
- Optimize medical management
- Vasodilator therapy
- Digoxin and diuretics for right ventricular dysfunction
- Prevention and treatment of respiratory infection
- Smoking cessation
- Treat obstructive sleep apnea
- Advise against pregnancy

Prenatal
- Reassess functional class of PAH
- Termination is an option
- Joint management with cardiologist
- Optimize medical management
- Avoid/minimize aggravating factors
- Anticoagulation (stop warfarin and change to heparin)
- Fetal surveillance:
  - Growth and umbilical artery doppler
  - Detailed fetal cardiac ultrasonography if maternal congenital heart disease

Labor/delivery
- Elective induction may be necessary
- Avoid mental and physical stress
- Labor in left lateral or upright position
- Monitor electrocardiogram
- Administer extra oxygen
- Consider vasodilator therapy with prostacyclin analogs, PDE-5/Nitric oxide
- Full resuscitation facilities available
- Continuous fetal heart rate monitoring

Postnatal
- Vigilance for right heart failure
- Avoid fluid overload
- Continued high-dependency care
- Discuss effective/safe contraception

Therapeutic goal is centered on optimization of right ventricular preload and systolic function, reduction in pulmonary vascular resistance and maintenance of aortic root pressure to allow sufficient right coronary artery filling of the right ventricle [19].

Pharmacological management

In pulmonary arterial hypertension (PAH), the pulmonary vasculature is the exclusive target of disease. The pathologic vasoconstriction associated with PAH is a prominent feature leading to the rationale for using pulmonary vasodilator therapies with the focus of therapy centered on vasodilation of the pulmonary arteries and now options are many (Table 6).

Calcium channel blockers

In patients who show evidence of an acute hemodynamic response during RHC, long-term treatment with calcium channel blockers, administered orally in high dosages, can produce a sustained hemodynamic response and increase survival [20]. In the setting of pregnancy it is recommended that this trial be performed initially when the patient is diagnosed much before a scenario of pregnancy is faced though successful use of calcium channel blockers in pregnancy has been reported [21]. The use of calcium channel during the first trimester of pregnancy seems not to represent a major teratogenic risk [22].

Prostacyclin pathway

Released by the platelets, prostacyclin I2 (PGI2) is a potent pulmonary vasodilator, exerting its effects via adenylate cyclase. Epoprostenol is a PGI2 derivative which has been shown to improve exercise capacity, quality of life, hemodynamics and long-term survival in PAH patients [23]. Since its advent there have been many cases in which this is the drug used in the setting of pregnancy [24–27]. At our center patients are weaned off of commonly prescribed phosphodiesterase-5 (PDE-5) inhibitors and endothelin receptor antagonists (ERAs) upon discovery of pregnancy and intravenous epoprostenol is initiated as the drug of choice.

Theoretically there is a concern with epoprostenol use in pregnancy because of concern over uterine blood flow. However several reports [28] have described the use of intravenous epoprostenol therapy during parturition and postpartum with good outcomes [29] both in PAH and in patients with Eisenmenger's syndrome [30]. As per packet insert epoprostenol has been rated a pregnancy category B and has shown minimal teratogenicity in the animal

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model. In the setting of PAH in pregnancy, as is obvious from our cases, intravenous epoprostenol is our center's drugs of choice.

Treprostinil is a prostacyclin analog that has also been successful in treating PAH by improving exercise capacity, functional class, hemodynamics and quality of life [31]. Reports of treprostinil use in the setting of pregnancy are sparse. As per packet insert treprostinil has been rated pregnancy category B and have shown variable toxicity in the animal model but no human evidence exists. More recently an oral form of treprostinil has been approved as a first line therapy for patients exhibiting functional class II or II symptoms [32]. There have been no studies or observation of this formulation used in the pregnancy population and thus should be avoided.

Inhaled iloprost has also been shown to induce vasodilatation lasting up to 60–120 min and has been shown to improve the dyspnea scores and hemodynamic variables but the major limitation was the repetitive inhalation 6–9 times daily [33]. Use in pregnancy has been demonstrated to be effective with minimal risk to fetal outcome [25,34–36]. As per packet insert iloprost has been rated a pregnancy category C and has shown shortening of thoracic digits as well as an increase in overall rate of fetal demise in the animal population. No evidence of human studies exists but risk cannot be ruled out.

Endothelin pathway

Endothelin1 (ET-1) is a potent vasoconstrictor and increased levels of ET-1 in vascular endothelial cells and in plasma has been demonstrated in patients with PAH which serves as the rationale for the ERAs. Bosentan was the first ERA approved by the Food and Drug Administration (FDA) for the management of PAH for use in patients with PAH associated with FC II–IV symptoms. [37,38].

Ambrisentan is a highly selective ET-A antagonist with a long half-life to allow once daily dosing. Data from two studies have shown that ambrisentan taken over 12 weeks significantly improved 6MWD in PAH patients. Associated extension study data also confirmed that continuation of treatment for two years was associated with sustained improvements in exercise capacity and a reduced risk of clinical worsening and death [39].

Macitentan is the newest FDA approved tissue-targeting ERA that has been shown to significantly decrease the risk of a morbidity and mortality event over the treatment period, and improved 6MWD and NYHA FC [40].

The use of ERAs in the setting of pregnancy is contraindicated due to the known teratogenicity of this class of drugs. As with all ERAs, bosentan ambrisentan and macitentan, a black box warning has been issued high lighting embryo-fetal toxicity. ERAs may cause fetal harm when administered to a pregnant woman. These drugs are contraindicated in females who are pregnant. They have consistently shown to have teratogenic effects when administered to animals. If a patient that is on ERA therapy is discovered to be pregnant therapy must be discontinued immediately.

Nitric oxide pathway

At the level of the endothelium nitric oxide indirectly acts as a potent vasodilator by upregulating the production of cyclic guanosine monophosphate (cGMP). Phosphodiesterase type 5 (PDE-5) is an enzyme that degrades cGMP leading to vasoconstriction. Sildenafil, the first PDE-5 approved for PAH is indicated for patients with FC II-III symptoms. Patients that are on this medication have shown improvement in symptoms, 6MWD as well s FC [41]. The use of sildenafil in pregnancy is well documented and is still the drug of choice in developing countries [42,43]. Tadalafil is not often used in pregnancy and in general due to its relative short half-life compared to sildenafil. The use of tadalafil in pregnancy may be considered if no other options exist. As per packet insert sildenafil and tadalafil have been rated pregnancy category B and have shown variable toxicity in the animal model. If the benefits outweigh the risks they may be used in the setting of pregnancy.

Guanylate cyclase stimulator (sGC)

Riociguat, recently approved by the FDA is a stimulator of soluble guanylate cyclase (sGC) and works to increase levels of cGMP which results in vasodilation [44]. As per package insert riociguat may cause fetal harm when administered to a pregnant woman and has been rated

Table 6
Summary of currently available treatments for pulmonary arterial hypertension.

Drug class	Drug names	Route	Pregnancy category
Phosphodiesterase Type-5 inhibitor	Sildenafil	Oral	B
	Tadalafil	Oral	B
Endothelin receptor antagonists	Bosentan	Oral	X
	Ambrisentan	Oral	X
	Macitentan	Oral	X
Prostacyclin analogs	Epoprostenol	IV	B
	Iloprost	IV	C
	Iloprost	Inhaled	C
	Treprostinil	IV	B
	Treprostinil	Subq	B
	Treprostinil	Inhaled	B
sGC stimulator	Riociguat	Oral	X

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pregnancy category X. It is contraindicated in females who are pregnant as it was consistently shown to have teratogenic effects when administered to animals. If this drug is used during pregnancy, or if the patient becomes pregnant while taking this drug, the patient should be informed of the potential hazard to the fetus.

Mode of delivery/intrapartum care

An important component in the successful delivery of PAH patients involves a multidisciplinary team approach with an obstetrician, pulmonary hypertension specialist, anesthesiologist, and experienced supporting staff. The mode of delivery in patients with pregnancy and PAH is still deliberated as there is evidence of both vaginal deliveries [45] and Cesarian section [46] deliveries as the preferred route of delivery. Although vaginal delivery is associated with a decreased shift of fluids, risk of hemorrhage, thromboembolism and infection it can be associated with a prolonged second stage of labor. During partus, utilization of the Valsalva maneuver both increases heart rate and vascular resistances. This in itself may further complicate delivery and increase the right heart strain resulting in emergency Cesarian section and possible maternal demise. Uterine contractions, especially associated with forceps delivery, may also have adverse effects on pulmonary systemic circulation. Placement of a pulmonary artery catheter in preparation for labor and delivery may be helpful in assessing hemodynamic status, facilitate fluid administration during labor and may also help monitor vasodilator therapy [47]. Oxygen should be provided during labor to prevent hypoxemia and efforts made to prevent or immediately correct blood loss. Postpartum patients should continue to be monitored hemodynamically for 24–48 h to prevent potential deterioration due to postpartum increase in venous return to the heart.

Delivery via Cesarian section has the advantage of being scheduled and performed at a suitable time with a multidisciplinary staff on hand. In addition elective Cesarian section deliveries allow urgent deliveries in maternal hemodynamic instability and fetal distress. Several factors have been implicated as potential risk factors for maternal death, including mode of delivery, type and technique of anesthesia, and manner of maternal monitoring. All of our patients were delivered via elective Cesarian section. Planned delivery is preferred to allow for presence and coordination of all services involved in the patient's care. Epidural anesthesia provides excellent analgesia with minimal hemodynamic changes [48].

Conclusions

Pregnancy in the setting of PAH has become more commonplace as our diagnostics and medical therapies have advanced and it is known that many patients with PAH are of child-bearing age. Pregnancy in PAH presents a clinical conundrum and recent data indicate that the outcome of pregnancy in PAH has improved. Post-partum complications still remain an issue however with adequate pharmacological therapy and a multidisciplinary approach maternal fetal outcome may be positive. Based on our clinical observation initiation of intravenous epoprostenol upon diagnosis of PAH and delivery via elective Cesarian section produced favorable outcomes. As physicians become more aware of PAH, correct and early diagnosis in a child-bearing age in populations is imperative. Multidisciplinary centers must recognize the dangers involved to mother and fetus in the setting of PAH. An institutional algorithm must be followed and patients must be managed expectantly on a case by case basis until a community wide consensus is reached.

Ethics statement

The work described has been conducted in accordance with The Code of Ethics of the World Medical Association.

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Conflict of interest

The authors have declared that no competing interests exist.

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