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CASE SERIES AND REVIEW

Peripartum anesthetic management of patients with aortic valve stenosis: a retrospective study and literature review

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ABSTRACT
Background: Anesthetic management of parturients with aortic stenosis is controversial. Early studies suggest maternal mortality was related to cardiac condition and anesthetic care. In this report, management of parturients with moderate or severe aortic stenosis in two institutions is compared, and published cases are reviewed.
Methods: Peripartum anesthetic management of all parturients with moderate or severe aortic stenosis who gave birth between 1990 and 2005 at our institutions, is described. Patients with mild or non-valvular aortic stenosis were excluded.
Results: There were 12 parturients, six with moderate and six with severe aortic stenosis. Two patients with moderate aortic stenosis were New York Heart Association (NYHA) classification II, the others were asymptomatic. Five patients with severe aortic stenosis were symptomatic (NYHA classification II or III). Two patients with moderate and three with severe aortic stenosis underwent cesarean delivery; epidural anesthesia was used for two. Two patients with moderate and all with serious aortic stenosis were observed postpartum for 24 to 48 h in a high-dependency unit. There were no severe maternal or neonatal complications.
Conclusions: Carefully titrated regional analgesia is usually well tolerated in patients undergoing vaginal or cesarean delivery even in the presence of severe aortic stenosis. Standard monitoring is usually adequate for vaginal delivery, but invasive monitoring may facilitate management in some patients. An arterial line allows close monitoring of systemic blood pressure. Facilities for close 24-48-h post-partum observation should be available. A multidisciplinary approach is needed.

Keywords: Pregnancy; Aortic stenosis; Anesthesia; Peripartum

Introduction

Aortic stenosis (AS) in young women is usually the result of a stenotic bicuspid aortic valve. Bicuspid aortic valves are among the most common congenital cardiac anomalies, occurring in 1-2% of the population.[1] Severe AS carries a high risk of maternal morbidity and mortality and therefore requires advanced planning and a comprehensive team approach.[2] Anesthetic management of the parturient with AS has been discussed in several case reports.[3–17] In our report, the peripartum anesthetic management of patients with moderate and severe AS, is discussed in context with a systematic review of previously reported cases.

Methods

The peripartum records of parturients with the diagnosis of AS who delivered between January 1990 and October 2005 were reviewed in two university hospitals (Shaare Zedek Medical Center, Jerusalem, Israel and Mount Sinai Hospital, Toronto, Canada) with approximately 17 000 deliveries annually. The hospital databases and records of parturients with the diagnosis of 'aortic stenosis and pregnancy' meeting these criteria were reviewed. The severity of AS: moderate (peak pressure gradient 36-63 mmHg) or severe (peak pressure gradient >63 mmHg), was determined by echocardiography.[3] Patients with non-valvular AS (subvalvular or hypertrophic obstructive cardiomypathy), corrected AS (valvuloplasty or valve replacement without obstruction) or mild AS (peak pressure gradient <36 mmHg) were excluded.

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Table 1 Patient demographic and obstetrical data

Pt #	Age	Gravity/parity Gestation age	Additional medical problems	Severity			Mode of delivery	Peripartum monitoring
				AVA (cm^2)	Peak gradient (mmHg)	NYHA		
Moderate aortic stenosis								
1	16	G1P0, 38 wks	None	0.9	35	I	Vacuum	Standard
2	33	G2P1, 40 wks	None	0.9	50	I	NVD	Standard (without ECG)
3	22	G2P1, 40 wks	Heavy smoker	0.9	60	II	Emergency CS	Standard
4	25	G3P2, 39 wks	Heavy smoker	0.9	62	II	NVD	Standard + IBP
5	27	G1P0, 39 wks	AV balloon dilatation	1.0	44	I	Forceps	Standard
6	37	G9P3, 37wks	Aortic root diameter 4.2 cm	1.0	48	I	Elective CS	Standard +IBP
Severe aortic stenosis								
7	36	G2P1, 38wks	Moderate AI	0.8	67	II	Vacuum	Standard
8	26	G5P1, 38 wks	Asthma, CHF, aortic coarctation	0.8	70	III	Vacuum	Standard +IBP
9	34	G2P1, 38 wks	Previous CS	0.8	64	II	Elective CS	Standard +SpO2
10	32	G1P0, 39 wks	MVS, CVA	0.7	80	I	Forceps	Standard +IBP
11	36	G13P6, 37 wks	Aortic root diameter 4.8 cm	0.5	130	II	Elective CS	Standard +IBP+TEE
12	31	G1P0, 36 wks	MVR	0.5	130	III	Elective CS	Standard +IBP

Standard monitoring: non-invasive blood pressure cuff, continuous electrocardiogram, and pulse oximetry. AI: aortic insufficiency; AV: aortic valve; MVS: mitral valve stenosis; CVA: cerebrovascular accident; MVR: mitral valve regurgitation; AVA: aortic valve area; NVD: normal vaginal delivery; CS: cesarean section; IBP: invasive blood pressure; TEE: transesophageal echocardiography; ECG: electrocargigarm. Early labor, fetal distress.

Patients were assessed in the third trimester of pregnancy, within three weeks of delivery but before the onset of labor. At that time, the New York Heart Association (NYHA) functional class and the aortic valve area and gradients were determined. These data and the demographics, mode of delivery, anesthetic management, peripartum monitoring, intrapartum fluids and complications were summarized and entered into a database.

Guidelines written by the American College of Cardiology and the American Heart Association defined moderate AS as a valve area of 1.0-1.5 cm^2 or a peak pressure gradient between 36 and 63 mmHg. Severe AS was defined as a valve area of $\leqslant$1.0 cm^2 or a peak pressure gradient >63 mmHg.[18] Patients in our report were classified as *severe* only if the gradient was >63 mmHg; this was done to include only those parturients with significant hemodynamic compromise. Using these pressure gradient criteria, all of our patients with a valve area of 0.8 cm^2 or less were classified as *severe*.

Previously reported cases were identified by searches conducted on MEDLINE (1966 to December 2005) and EMBASE (1980 to December 2005) using the following key words: anesthesia/anaesthesia; aortic stenosis; pregnancy. There were no restrictions on language or publication type. Case reports of hypertrophic obstructive cardiomyopathy or sub- and supra-valvular aortic stenosis were excluded. All cases were classified using the criteria above and available demographic, peripartum and anesthetic information were summarized and entered into the database.

Results

In our series, six patients had moderate AS and six had severe AS. A description of the population, including maternal age, gestational age at the time of delivery, gravity, parity, severity of AS and concomitant medical conditions is shown in Table 1. Two cases were managed in Israel (#10 and #11), with the remainder in Canada. The etiology of AS in 11 patients was a congenital bicuspid aortic valve and one patient (#10) had rheumatic heart disease. In patients with moderate AS, four were asymptomatic (NYHA I) and two had mild symptoms (NYHA II). In this group, patients with symptoms had higher peak gradients. In contrast, all but one patient with severe AS (#10) had cardiac symptoms. Two patients (#6 and #11) had aortic root dilatation.

All patients had non-invasive blood pressure and electrocardiogram monitoring but only one patient, with dilatation of the aortic root (#6), had continuous blood pressure monitoring using an arterial line (Table 1). In patients with moderate AS, four delivered vaginally and two had cesarean deliveries. Epidural or combined spinal-epidural (CSE) analgesia was used for pain relief

Table 2 Demographic data and peripartum management of our patients

Case #	Anesthesia		Hemodynamic Before and after anesthesia		Intrapartum fluids (mL)	Apgar scores (1/5 min)	Postoperative care and analgesia	Vasopressors and complications
	Type	Medications	Pre HR (bpm) BP (mmHg)	Post HR (bpm) BP (mmHg)				
1	Epidural	Bup 0.0625%+fent 2 μg/mL, 10mL/h +PCEA For vacuum: 2% lido 6mL	100 110/60	96 95/65	500	8/9	24 h HDU	
2	Epidural	Bup 0.0625%+fent 2 μg /mL, 10mL/h +PCEA	90 101/66	76 106/65	800	9/9	Delivery suite 4 h	
3	General	Thiopental 250 mg, fent 50 μg SCH 100mg, Isoflurane 0.8%	80 120/70	70 100/50	500	7/9	24 h HDU i.v. morphine	Failed epidural (no block)
4	Epidural	Bup 0.25%-5 mL; bup 0.08%+ sufentanil 1μg /mL – 9 mL/h	90 115/65	105 110/60	500	8/9	Delivery suite 6 h	
5	CSE	Spinal: bup 3 mg+ sufentanil 5μg Forceps: 1.5% lido 13 mL	94 180/74	78 110/63	200	7/8	Delivery suite 6 h	
6	Epidural	Bup 0,5% 20 mL+ fent 100 μg for 20 min	115 145/98	105 140/90	300	8/9	24 h HDU Epidural morphine 4 mg	
7	i.v.	morphine 2 mg x 3	110 150/80	110 150/80	500	8/9	24 h HDU	
8	Epidural	1.5% lido 12 mL	110 140/70	100 120/60	150	8/9	24 h HDU	
9	Epidural	2% lido 20 mL+ fent 100 μg for 25 min	90 110/65	80 100/45	800	9/9	24 h HDU Epidural: morphine 4 mg	Ephedrine 25mg
10	Epidural	Ropivacaine 0.1%+ fent 2 μg/mL, 10 mL/h +PCEA; for vacuum, 2% lido 5 mL	128 97/51	115 82/48	500+ 3 uPC	6/8	24 h HDU Epidural: morphine 4 mg	PPH+ laceration Ephedrine 20 mg phenylephrine 200 μg
11	General	Etomidate 10 mg; succinylcholine 120 mg; remifentanil 300 μg	70 98/66	85 125/70	1000	8/9	48 h HDU i.v. morphine	
12	General+ spinal	Etomidate 10 mg; succinylcholine 100 mg; fent 100 μg			1000	9/9	24 h HDU Spinal morphine 150μg + fent 20μg	

bpm: beats/min; CSE: combined spinal-epidural; Bup: bupivacaine; lido: lidocaine; fent: fentanyl; HDU: high dependence unit; PPH: postpartum hemorrhage.

during labor and vaginal delivery. Analgesia was maintained with low concentrations of bupivacaine (0.0625-0.08%) with fentanyl or sufentanil (1-2 μg/mL). None of the patients required vasopressors or had complications related to their analgesia. The remaining two patients had cesarean deliveries. Epidural anesthesia was planned for cesarean delivery, but in patient #3, general anesthesia was required due to fetal distress (Table 1). Neither patient required vasopressors or suffered complications. No neonate had an Apgar score <7 at 1 or 5 min.

In parturients with severe AS, three delivered vaginally with vacuum assistance or forceps. One of them received i.v. morphine for labor analgesia (three doses of 2 mg), one had epidural lidocaine 1.5% for the second stage of labor, and one had continuous epidural analgesia with 0.1% ropivacaine plus fentanyl 2 μg/mL (Table 2). Three patients from this group had elective cesarean deliveries, two with general and one with epidural anesthesia. Although intrapartum monitoring was similar in these patients, more patients had continuous blood pressure monitoring. In addition, one patient had critical aortic stenosis with dilatation of the aortic root and was monitored by transesophageal echocardiography. Two patients with severe AS required ephedrine or phenylephrine; one for cesarean delivery and one for operative vaginal delivery under epidural anesthesia. One neonate had an Apgar score of 6 at 1 min, but the other neonates had Apgar scores of ≥7 at 1 and 5 min.

All patients with severe AS and three with moderate AS were observed in a high-dependency unit for 24-48 h after delivery. Epidural morphine (3-4 mg) was given for postoperative analgesia in three patients and i.v. morphine in two patients. One patient (#12) received spinal morphine and fentanyl for postoperative analgesia after general anesthesia. Two patients required vasopressors, but none of the patients suffered significant morbidity or died.

Results of the literature review

Fourteen articles published between 1987 and 2005 were retrieved. Peripartum anesthetic management was described in 19 patients (16 severe, two moderate and one unknown severity).[4–17] Date of publication, etiology and severity of AS, mode of delivery and peripartum care are shown in Table 3. All the patients with moderate AS received regional anesthesia or analgesia without complications. One patient had invasive monitoring including central venous pressure monitoring. Ten patients with severe AS received regional anesthesia and six received general anesthesia. All patients with severe AS had invasive monitoring, three patients had central venous pressure monitoring and five had pulmonary artery pressure monitoring. There were no maternal deaths among these cases.

An additional 24 patients were reported as part of the UK registry of high-risk obstetric anesthesia.[19] The clinical details for each case were not given.

Discussion

Etiology

Valvular AS is uncommon in young patients and is most often the result of stenosis of a congenital bicuspid aortic valve. Approximately 1 to 2% of the population has this congenital anomaly and about 10% of bicuspid valves become stenotic. However, the majority of parturients with AS have bicuspid valves,[20] as indeed did 11 of 12 patients in our series. Of interest, two patients (#6 and #11) had aortic root dilatation, perhaps secondary to cystic medial necrosis associated with a bicuspid aortic valve. These patients are at risk for Type A aortic dissection, particularly in the third trimester when sheer stress to the aortic valve is greatest.[21] Only one of our patients (#10) had AS because of rheumatic heart disease. She also had concomitant mitral stenosis with a history of thromboembolic disease related to her cardiac condition. Since the incidence of rheumatic heart disease is declining in developed countries, the proportion of parturients presenting with this condition is also likely to decrease over time.

Diagnostic echocardiography

The assessment of stenosis severity in a congenitally bicuspid valve can be challenging. The echocardiographic gold standard for the assessment of stenosis severity is by the Doppler method, which yields the effective valve area. Alternatively, the anatomic valve area may be directly measured by planimetry, particularly during transesophageal echocardiography, but for a given anatomical orifice, functional severity tends to be greater in bicuspid vs. tricuspid AS. This appears to be primarily related to greater jet eccentricity and reduced pressure recovery.[22] Despite these limitations, the severity of valvular AS can be classified according to the aortic valve area or by the peak pressure gradient between the left ventricle and aortic root.

Physiological changes

Compared to non-pregnant state, cardiac output in the pregnant patient increases by 25 to 50% by 24th week of gestation. This is accompanied by a similar increase in blood volume.[23] Valvular AS increases resistance to systemic blood flow. Patients with severe AS cannot meet the metabolic demands of pregnancy because of fixed left ventricular outflow tract obstruction. The inability to respond by increasing cardiac output may lead to cardiac decompensation and possibly maternal death.[24] In one series, 65% of pregnant patients with AS had shortness of breath, palpitations, angina or dizziness in the peripartum period.[19] The rate of significant

Table 3 Review of peripartum anesthetic management of patients with aortic stenosis

Author year (reference)	Etiology and severity of AS	Mode of delivery	Anesthesia	Monitoring	Postpartum care	Complication and notes
Redfern 1987[4]	MG 70 mmHg unknown etiology	Elective CS	General: etomidate +sch alfentanil +N_2O/O_2; pancuronium, halothane			Apneic baby needed naloxone
Marron-Pena 1992[5]	Rheumatic NYHA II cardiomegaly	NVD	Epidural: bup+fent for labor lid for forceps delivery			Discharged home after 24 h.
Choi 1992[6]	Congenital MG 100 mmHg	Elective CS	Epidural: lid + bup + fent	Standard + IBP + PAC	HDU postpartum	Discharged home after 4 days.
Brian 1993[7]	Congenital, MG 90 mmHg	Elective CS	Slow titrated epidural (~30 min)	Standard + IBP + PAC	HDU 48 h, continues epidural bup 0.125%	Hemodynamic changes secondary to oxytocin infusion
Colclough 1995[8]	Congenital, AVA 0.7cm^2, MG 104 mmHg	CS and TL for breech presentation	Slow titrated epidural bup +sufent (~80 min)	Standard + IBP + PAC		Short period of intraoperative unstable angina
Pittard 1998[9]	MG 57 mmHg asymptomatic	Elective CS @ 36 weeks	Continuous spinal bupivacaine 0.5% 2mL (1+1) over 10 min	Standard + IBP + CVP	Delivery suite 6 h	Mild headache
Tamura 1998[10]	VSD repair, AVA 0.7cm^2, MG 80 mmHg	Elective CS twins @ 29 weeks	2 epidural L1-2 and L4-5	Standard + IBP + PAC	HDU 24 h	
Suntharalingam 2001[14]	#1 bicuspid MG 87 mmHg	Induction VD @ 38 weeks	Epidural: bup + fent	Standard + IBP		Two transient episodes of hypotension
	#2 bicuspid, VSD, PDA, PFO repair MG 85 mmHg NYHA I	Operative VD @ 40 weeks	Epidural: bup + fent			
	#3 bicuspid MG 44 mmHg	Induction VD @ 39 weeks	Epidural: bup + fent			
Van de Velde 2003[15]	bicuspid MG 101 mmHg NYHA 2	Induction VD @ 39 weeks	Continuous spinal L3-4	Standard + IBP	HDU 24 h	
Orme 2004[16]	#1 bicuspid MG 64 mmHg AVA 0.7cm^2	Elective CS @ 38 weeks for fetal anomalies	*All four patients*: general anesthesia: etomidate + sch + remifent + N_2O+O_2 and isoflurane	Standard + IBP + CVP		Significant postpartum hemorrhage (once)
	#2 AVA 0.6 cm^2 MG 86 mmHg	Elective CS @ 38 weeks for breech		Standard + IBP + CVP		
	#3 AVA 0.8cm^2 MG 120 mmHg	Elective CS @ 38 weeks		Standard + IBP + CVP		
	#4 bicuspid MG 90 mmHg	CS @ 35 weeks		Standard + IBP + CVP		
Molins Espinosa 2004[11]	Bicuspid MG 130 mmHg NYHA III	CS @ 32 weeks	General remfent + etomidate +fent rocuronium sevoflurane + O_2	Standard + IBP + CVP	HDU 24 h	Digoxin and diuretics for 25 days
Kuczkowski 2004[12]	AVA 0.7cm^2 MG169 mmHg asymptomatic	Induction @ 40.5 weeks Emergency CS for fetal distress	CSE for labor general for CS: etomidate +sch fent+ isoflurane	Standard + IBP+PAC	HDU 48 h	
Tihtonen 2005[13,*]	MG 101 mmHg	Elective CS @ 40 weeks	Spinal anesthesia 12.5 mg hyperbaric bup	Standard + whole-body impedance cardiography	HDU 48 h	Postoperative pulmonary edema
Hamlyn 2005[17]	AVA 0.7 cm^2 MG 70 mmHg NYHA III, LAD stenosis 60%	Elective CS @ 38 weeks	CSE: Spinal: bup + fent; epidural bup	Standard + IBP + CVP	In HDU epidural diamorphine + i.v. oxytocin	ST depression when mean BP <70 mmHg.

Standard monitoring = electrocardiogram + non-invasive blood pressure + continuous oxygen saturation. AV: aortic valve; AVA: aortic valve area; NVD: normal vaginal delivery; VD: vaginal delivery; CS: cesarean section; TL: tubal ligation; IBP: invasive blood pressure; CVP: central venous pressure; PAC: pulmonary artery catheter; MG: maximal peak gradient; VSD: ventricular septal defect; PDA: patent ductus arteriosus; PFO: patent foramen ovale: PCA: patient control analgesia; HDU: high dependence unit; PPH: postpartum hemorrhage; LAD: left anterior descending coronary artery; CSE: combined spinal-epidural; sch: succinylcholine; bup: bupivacaine; lid: lidocaine; fent: fentanyl; remifent: remifentanil; * personal communication.

cardiac complications is almost 10% and includes pulmonary edema and arrhythmias.[3]

Mode of delivery

The mode of delivery should be decided on the basis of obstetrical indications. In our series, three patients had cesarean deliveries for cardiac indications: two had severe dilatation of the aortic root (#6 and #11) and another patient (#12) had severe deterioration in cardiac status (NYHA class III). The high rate of cesarean delivery in our series is consistent with other reports.[20] The choice of cesarean delivery was made after a case conference with the obstetrician, cardiologist, anesthesiologist and neonatologist.

Anesthetic management

Anesthetic management of the patient with AS focuses on hemodynamic stability, but there is continuing controversies regarding the choice of anesthetic techniques.[20,25,26] The nature of AS pathophysiology determines hemodynamic goals regardless of the type of anesthesia. Regional anesthesia may be associated with a rapid, uncompensated decrease in systemic vascular resistance (SVR) resulting in a fall in blood pressure and coronary flow, and tachycardia. Normal patients can compensate for decreased SVR by increasing stroke volume and heart rate. Patients with AS have a fixed stroke volume, and therefore rely on increased heart rate to increase cardiac output. However, severe tachycardia is undesirable and can be hazardous. While many anesthesiologists consider neuraxial anesthesia to be contraindicated in patients with AS, patients in our series and those reported in the literature have been successfully managed with careful slow titration of an epidural or CSE technique to prevent the rapid decrease in SVR, provided the patient is adequately monitored and her hemodynamic status carefully controlled. We avoid epinephrine-containing local anesthetics on a routine basis, although there is no information about their use in the cases reported. We recommend performing a CSE technique, as it combines the reliability of spinal anesthesia with the ability to titrate the anesthetic to the desired effect. The risk of maternal hypotension with careful administration of CSE for cesarean delivery is decreased, therefore this technique is particularly useful in patients suspected of having significant cardiac disease.[17,27] When general anesthesia is necessary, a combination of etomidate or propofol with opioids is a good choice for prevention of the sympathetic response to endotracheal intubation. Vagolitic or tachycardia-inducing agents should be avoided. Remifentanil, used in one of our cases and four in the literature, is effective for minimizing the response to intubation and has a short duration of action.[16] Hypotension should be promptly treated with a direct α-adrenoreceptor agonist such as phenylephrine or metaraminol for maintenance of diastolic blood pressure and coronary perfusion. Optimal intravascular volume should be maintained for adequate left ventricular filling; it can be augmented with the Trendelenburg position and repeated boluses of fluid. Sinus rhythm must be maintained, since adequate left ventricular filling is dependent upon atrial contractility.[16] Perioperative care should include antibiotic prophylaxis against bacterial endocardisis, as for gastrointestinal or genitourinary procedures.[28]

Neonatal outcome

Neonates born to mothers with severe heart disease have an increased rate of congenital heart defects, intrauterine growth restriction and early neonatal complications.[29] The severity of such complications is associated with poor maternal functional class, cyanosis, smoking, left ventricular outflow tract obstruction and anticoagulation.[30] The clinical condition of the neonates in our series was good, even when born to the most symptomatic patients. Like the patients reported in the UK registry, many of our patients had relatively mild symptoms and were not in heart failure at the time of delivery, reducing the likelihood of neonatal depression.[19]

Monitoring

Standard monitoring, including frequent non-invasive blood pressure, electrocardiogram and pulse oximetry is usually adequate for vaginal delivery, but invasive monitoring may facilitate management of some patients. An arterial line allows close monitoring of systemic blood pressure. Some authors recommend invasive monitoring of central venous or pulmonary artery pressure, but the risk of mechanical, infectious, and thrombotic complications, with minimal contribution to clinical management, has significantly decreased the use of these procedures.[12,16,31] Intraoperative transesophageal echocardiography may be useful in patients who require general anesthesia since one can rapidly diagnose and treat fluid overload and/or localized myocardial ischemia.[32,33] Sudden and significant hemodynamic changes may be successfully monitored by whole-body impedance cardiography, which is a non-invasive, operator-independent and continuous method of measuring beat-to-beat variability of stroke volume and calculated cardiac output.[13]

Postoperative period

Hemodynamic instability may occur postoperatively and patients with severe AS should be observed for 24-48 h in a high-dependency unit. This allows invasive monitoring and immediate correction of hemodynamic problems. Important goals of anesthetic management in the postoperative period include maintaining adequate SVR and a normal heart rate. Subarachnoid or epidural morphine and fentanyl, given before or after

surgery, prevents acute postoperative pain and tachycardia and promotes postoperative recovery. One of our patients received subarachnoid morphine for pain relief and general anesthesia for cesarean delivery. Using a variety of analgesics in addition to opioids, such as non-steroidal anti-inflammatory drugs, paracetamol, tramadol and low-concentration epidural patient-controlled analgesia can provide effective pain relief and a reduction in opioid consumption, thereby minimizing opioid-related adverse effects.

Conclusion

With all critically-ill patients, a team approach results in the best patient outcome. Good communication among the obstetrician, anesthesiologist, cardiologist, neonatologist, and nurse is necessary for optimal peripartum management. Carefully titrated regional analgesia is usually tolerated in patients undergoing vaginal delivery, provided the patient is in optimum circulatory status and adequately monitored. The choice of neuraxial or general anesthesia for cesarean delivery depends on many factors including co-morbidities, indications for cesarean delivery and patient choice. It is often possible to use neuraxial anesthesia when there is sufficient time to titrate the desired effect. In patients with critical AS or uncompensated failure, general anesthesia may be necessary. Neuraxial opioids for postoperative pain management may still be considered. Regardless of type of delivery or anesthetic, observation in a high-dependency unit for 24 to 48 h will allow detection and treatment of postoperative hemodynamic instability.

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