Cureus
Part of SPRINGER NATURE

Open Access Case Report

# Advanced Hemodynamic Monitoring During Cesarean Section for Placenta Accreta Spectrum in a Pregnant Patient With Cardiac Disease and an Elevated BMI

**Review began** 10/16/2026
**Review ended** 11/01/2026
**Published** 11/05/2026

**© Copyright** 2026
Ntalamagka et al. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

**DOI:** 10.7759/cureus.119187

Georgia Ntalamagka [1], Giolanda Varvarousi [2], Emmanouil Stamatakis [2], Michail Pavlidis [2], Dimitrios Valsamidis [2]

1. Department of Anesthesiology, Attikon University Hospital, Athens, GRC 2. Department of Anesthesiology, Alexandra General Hospital of Athens, Athens, GRC

**Corresponding author:** Georgia Ntalamagka, geo.dalamaga@gmail.com

## Abstract

Placenta accreta spectrum (PAS) in parturients with significant cardiovascular disease presents major anesthetic and hemodynamic challenges, particularly when complicated by obesity and a high risk of hemorrhage. We report the successful perioperative management of a 42-year-old parturient at 35 weeks of gestation with repaired patent foramen ovale, hypertensive cardiomyopathy with reduced left ventricular ejection fraction (40%), regional left ventricular wall motion abnormalities, moderate mitral regurgitation, obesity, and lumbar degenerative disc disease who underwent cesarean delivery under advanced hemodynamic monitoring.

Regional anesthesia was selected over general anesthesia to minimize myocardial depression, sympathetic stimulation, and postoperative respiratory complications. A low-dose combined spinal-epidural technique was administered with gradual epidural extension to a T4 sensory level. Continuous invasive hemodynamic monitoring using the Hypotension Prediction Index (HPI; HemoSphere, 7.6 advanced monitoring platform from BD; software version 3.1) provided continuous assessment of cardiac output, stroke volume, systemic vascular resistance, dynamic arterial elastance, and left ventricular contractility (dP/dt). Norepinephrine was initiated immediately following intrathecal anesthesia and titrated to maintain arterial pressure and systemic vascular resistance close to baseline values, thereby minimizing the risk of neuraxial anesthesia-induced hypotension and potential myocardial hypoperfusion.

The surgical procedure was complicated by dense pelvic adhesions, difficult bladder mobilization, and a prolonged skin-to-delivery interval of 12 minutes. Despite these challenges, hemodynamic stability was maintained throughout the procedure. Cardiac output increased from 5.5 L/min at baseline to 6.9 L/min following completion of epidural dosing, while stroke volume remained close to baseline. Although this change occurred temporally after completion of epidural dosing, a direct causal relationship could not be established from the available data. Following delivery, cardiac output decreased to 5.8 L/min without significant hemodynamic instability. Estimated blood loss was 1000 mL, and one unit of packed red blood cells was administered. Rotational thromboelastometry (ROTEM) analysis demonstrated preserved clot firmness and adequate fibrinogen contribution, with no evidence of clinically significant coagulopathy based on the available assessment. The neonate was delivered with an Apgar score of 8.

This case highlights the potential value of combining carefully titrated neuraxial anesthesia with advanced hemodynamic monitoring in high-risk obstetric patients with cardiomyopathy and PAS. HPI-guided monitoring facilitated proactive vasopressor therapy and individualized hemodynamic management in a patient with limited cardiovascular reserve. Together, continuous hemodynamic assessment and point-of-care ROTEM provided complementary information for cardiovascular and coagulation management. Further studies are needed to determine the role of HPI-guided management in parturients at high risk for hemorrhage and cardiovascular instability.

**Categories:** Obstetrics/Gynecology, Anesthesiology
**Keywords:** advanced hemodynamic monitoring, combined spinal-epidural anesthesia, hypotension prediction index, maternal cardiovascular disease, obstetric anesthesia, perioperative hemodynamic optimization, placenta accreta spectrum (pas), rotational thromboelastometry

## Introduction

The integration of Hypotension Prediction Index (HPI)-guided hemodynamic monitoring and rotational thromboelastometry (ROTEM)-guided hemostatic management may represent a rational approach in high-risk obstetric patients, such as placenta accreta spectrum (PAS) complicated by maternal cardiac disease and elevated body mass index (BMI). This approach may support individualized fluid management and targeted transfusion, potentially mitigating the adverse effects of hypotension and myocardial strain in parturients

with limited physiological reserve [1]. However, the effect of HPI-guided hemodynamic management on blood loss and transfusion requirements in patients with PAS remains uncertain [2].

PAS is associated with a substantial risk of obstetric hemorrhage [3,4]. In patients with impaired cardiac function, significant blood loss and abrupt changes in preload and afterload may be poorly tolerated, while excessive fluid administration may increase the risk of volume overload [5]. HPI uses arterial pressure waveform analysis to provide information on the risk of impending hypotension, whereas ROTEM enables rapid point-of-care assessment of clot formation and strength to support targeted hemostatic management.

In our case, the coexistence of PAS, cardiomyopathy, impaired left ventricular function, and mitral regurgitation complicated the management of anticipated major hemorrhage. To the best of our knowledge, this is the first reported case describing the anesthetic management of a parturient with placenta accreta, cardiomyopathy, and elevated BMI using advanced hemodynamic monitoring with HPI and ROTEM.

## Case Presentation

A 42-year-old woman (weight: 124 kg; height: 174 cm), gravida 3, para 2, presented for an elective cesarean section at 35 weeks' gestation. Her first child was delivered vaginally in 2008, and the second via cesarean section in 2013. The current pregnancy was complicated by placenta accreta. PAS was suspected based on magnetic resonance imaging (MRI) performed at 31 weeks and three days of gestation. The examination demonstrated a low-lying, marginally previa placenta with areas of abnormal myometrial invasion along its anterior lower uterine attachment. Focal irregularity of the underlying bladder dome contour was also described, raising concern for deeper placental invasion and possible placenta percreta.

The patient had a history of patent foramen ovale, surgically repaired during childhood. Transthoracic echocardiography revealed left ventricular dilation (65 mm) with eccentric hypertrophy and regional wall motion abnormalities. The left ventricular ejection fraction was estimated at 40%, with moderate systolic and diastolic dysfunction. It also demonstrated dilation of the ascending aorta (39 mm) and left atrium, as well as moderate mitral regurgitation. Lung auscultation was unremarkable. She also had a history of chronic hypertension. Despite the documented left ventricular systolic and diastolic dysfunction, the patient was clinically asymptomatic from a cardiovascular perspective during the preoperative assessment, with no reported symptoms suggestive of heart failure.

A previous lumbar spine MRI report from 2021 described degenerative changes with disc protrusions at the L3-L4, L4-L5, and L5-S1 levels, as well as findings suggestive of a lipoma of the filum terminale. This MRI was performed when the patient presented with neurological symptoms attributed to these findings. The patient had no neurological symptoms or clinical neurological deficits at the time of the preoperative assessment. These findings were taken into consideration during the pre-anesthesia evaluation before neuraxial anesthesia.

Her medication regimen included methyldopa, labetalol (100 mg), and enoxaparin (6000 IU). The last dose of enoxaparin was administered 24 hours before neuraxial anesthesia. On the day of surgery, laboratory tests revealed a high-sensitivity cardiac troponin T level of 7.7 ng/L (reference range: <14 ng/L) and an NT-proBNP level of 14.3 pg/mL (reference range: <125 pg/mL).

In the operating room, standard monitoring, including six-lead electrocardiography and pulse oximetry, was applied. Radial artery catheterization was performed for invasive arterial blood pressure monitoring using a 20-gauge arterial cannula. Additionally, two 17-gauge and one 18-gauge peripheral intravenous lines were inserted.

Combined spinal-epidural anesthesia (CSE) was performed with initial intrathecal administration of 1.2 mL of ropivacaine 0.75%, plus 15 mcg fentanyl. An epidural catheter was successfully placed without complications at the L3-L4 lumbar interspace. The decision to proceed with neuraxial anesthesia was based on the clinical assessment, taking into consideration the previously documented MRI findings and the absence of neurological manifestations at the time of surgery. After positioning the patient supine with left uterine displacement, the following hemodynamic variables were continuously recorded directly from the HemoSphere Platform at 20-second intervals: cardiac output (CO), stroke volume (SV), dynamic arterial elastance (Eadyn), systemic vascular resistance (SVR), HPI, and left ventricular contractility (dP/dt). Invasive arterial blood pressure was also continuously monitored using an arterial pulse contour monitoring system (HemoSphere 7.6 advanced monitoring platform from BD; software version 3.1).

Five minutes after intrathecal administration, sensory block assessment revealed a sensory level of T10. Subsequently, a mixture containing 8 mL of lidocaine 2% and 2 mL of 4% sodium bicarbonate was administered via the epidural catheter, resulting in extension of the sensory block to T6 after five minutes. An additional 3 mL of 0.75% ropivacaine was administered to achieve a T4 sensory level.

Baseline pre-anesthesia hemodynamic parameters were as follows: SBP/DBP: 155/90 mm Hg; HR: 87 bpm; CO: 5.5 L/min; SV: 63 mL; SVR: 1542 dyne·sec·cm$^{-5}$; HPI: 2/100; dp/dt: 1112 mmHg/sec; Eadyn: 1.1.

Premedication included intravenous cimetidine 200 mg and metoclopramide 10 mg. She was also given 1 g tranexamic acid. Immediately following intrathecal administration of ropivacaine and fentanyl, a continuous intravenous infusion of norepinephrine (8 mcg/mL) was initiated at 0.05 mcg/kg/min and titrated to maintain systolic and diastolic blood pressure within 20% of baseline values. Changes in HPI provided an early warning of impending hypotension, allowing timely recognition of evolving hemodynamic changes before significant reductions in blood pressure occurred. Norepinephrine infusion was titrated in response to changes in HPI, interpreted in conjunction with the other continuously monitored hemodynamic parameters, including systemic vascular resistance, blood pressure, heart rate, and left ventricular contractility. Treatment adjustments were therefore based on the hemodynamic profile rather than on HPI values alone. The norepinephrine infusion was continued until the end of surgery.

Despite the preoperative MRI findings raising suspicion of placenta percreta, cesarean delivery was ultimately performed without hysterectomy. Intraoperatively, placental tissue was identified along the anterior uterine wall. A live female neonate was delivered in breech presentation. The placenta was subsequently separated and delivered using the Crede maneuver, followed by thorough uterine cavity inspection and cleaning.

Following delivery of the neonate and umbilical cord clamping, the patient received one unit of packed red blood cells (RBCs) and calcium chloride, paracetamol 1 g, ondansetron 4 mg, oxytocin 3 IU as a bolus, and a continuous infusion of oxytocin 17 IU administered slowly to minimize hemodynamic instability. ROTEM analysis was performed before and after transfusion, demonstrating normal coagulation parameters. The neonate had an Apgar score of 8 at one minute [6]. Total crystalloid administration was 2400 mL, estimated blood loss was 1000 mL, and urine output was 300 mL following administration of 5 mg intravenous furosemide.

Cardiac output increased to 6.6 L/min following intrathecal anesthesia and further increased to 6.9 L/min after completion of epidural dosing and achievement of a T4 sensory block. After delivery, CO decreased to 5.8 L/min. Stroke volume was maintained near baseline (71 mL) after intrathecal administration and increased to 75 mL after epidural supplementation, and subsequently decreased slightly to 68 mL after delivery. Heart rate and mean arterial pressure remained stable throughout the procedure (Figure *1*).

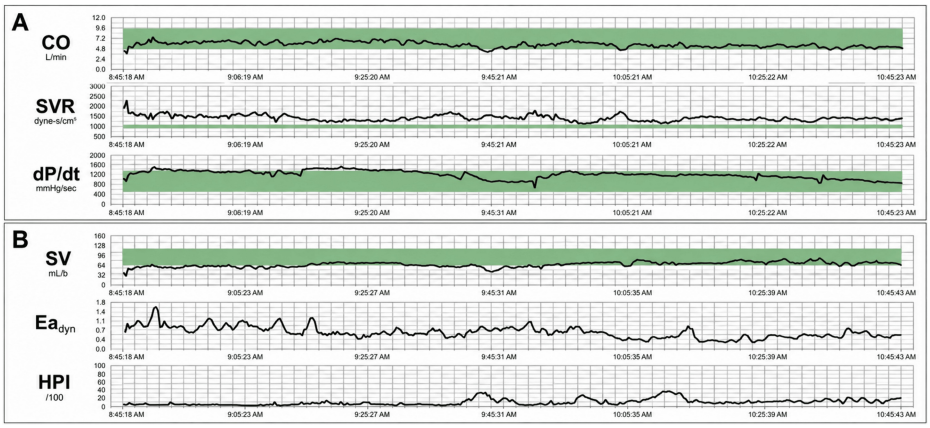



**FIGURE 1: Intraoperative hemodynamic monitoring using the Acumen platform**

CO: cardiac output; SVR: systemic vascular resistance; dP/dt: left ventricular contractility; SV: stroke volume; HPI: Hypotension Prediction Index

The main intraoperative events occurred at the following times: baseline recording, 08:46; intrathecal administration, 09:00; epidural top-up doses, 09:05 and 09:10; skin incision, 09:38; and fetal delivery, 09:50

(A) Continuous trends in CO, SVR, and dP/dt during the intraoperative period. (B) SV, dynamic arterial elastance (Eadyn), and HPI trends demonstrating overall hemodynamic stability throughout the procedure

ROTEM analyses were performed before transfusion and at the end of the surgical procedure to evaluate coagulation status. EXTEM analysis demonstrated preserved clot initiation and clot firmness, while FIBTEM findings suggested adequate fibrinogen contribution to clot strength. Overall, the findings did not indicate clinically significant coagulopathy (Figures *2*-*3*).

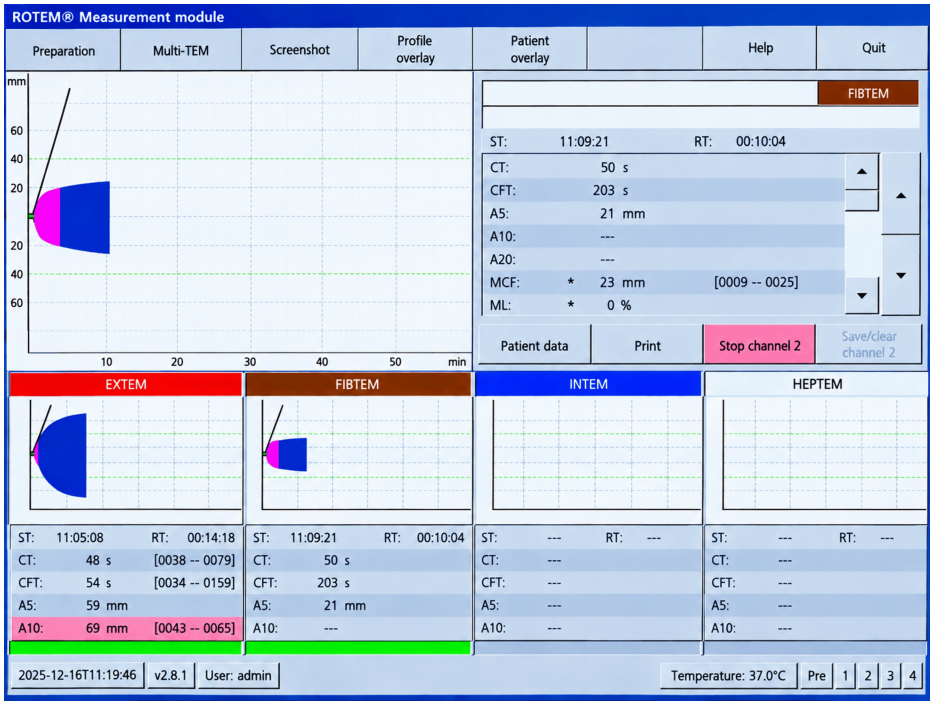



**FIGURE 2: ROTEM analysis performed before transfusion**

CT: clotting time; CFT: clot formation time; MCF: maximum clot firmness; ROTEM: rotational thromboelastometry

EXTEM demonstrated a CT of 48 s, CFT of 54 s, A5 of 59 mm, and A10 of 69 mm. FIBTEM demonstrated a CT of 50 s, CFT of 203 s, A5 of 21 mm, and MCF of 23 mm. The results indicated preserved clot formation and fibrin-based clot firmness, without evidence of clinically significant hypocoagulability

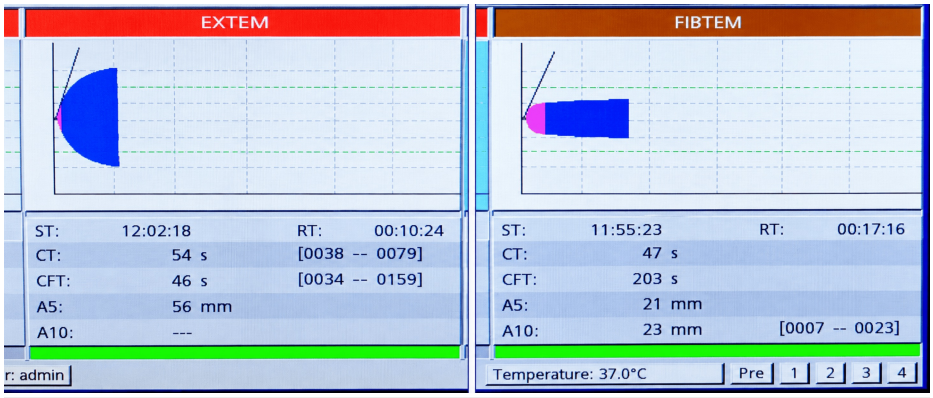



**FIGURE 3: ROTEM analysis performed at the end of the surgical procedure.**

CT: clotting time; CFT: clot formation time; ROTEM: rotational thromboelastometry

EXTEM demonstrated a CT of 54 s, CFT of 46 s, and A5 of 56 mm. FIBTEM demonstrated a CT of 47 s, CFT of 203 s, A5 of 21 mm, and A10 of 23 mm. These findings, obtained following transfusion of one unit of packed red blood cells, indicated preserved clot firmness and fibrin-based clot strength, without evidence of clinically significant hypocoagulopathy

The postoperative course was uneventful for both the mother and neonate, with no complications reported. The mother remained clinically stable and was transferred to the high-dependency unit for 24 hours before being discharged to the general ward on postoperative day one. The neonate also had an uneventful postnatal course.

## Discussion

This case describes the use of advanced hemodynamic monitoring in a parturient with a history of surgically repaired patent foramen ovale, cardiomyopathy with reduced ejection fraction, regional left ventricular wall motion abnormalities, elevated BMI, and coexisting lumbar spine degenerative disease undergoing cesarean section for placenta accreta.

Regional anesthesia is frequently used in patients undergoing cesarean hysterectomy for PAS, although anesthetic management varies according to patient characteristics and surgical considerations [7]. In the present case, regional anesthesia was selected to allow gradual titration of the neuraxial block while avoiding airway instrumentation and the potential myocardial depressant effects of general anesthetic agents. Despite being clinically asymptomatic preoperatively, the patient's reduced left ventricular ejection fraction and associated systolic and diastolic dysfunction indicated limited cardiovascular reserve, making careful control of preload, afterload, and heart rate particularly important. Regional anesthesia may also offer neonatal benefits by avoiding transplacental exposure to general anesthetic agents before delivery, which may be particularly relevant when delivery is delayed. Low-dose combined spinal-epidural anesthesia was administered, with the norepinephrine infusion titrated according to hemodynamic monitoring using the HPI on the HemoSphere Platform. Concurrent initiation of a norepinephrine infusion allowed maintenance of baseline systemic vascular resistance and mean arterial pressure while keeping the HPI values low. To avoid organ and coronary hypoperfusion, arterial blood pressure was maintained within 20% of baseline values. Gradual extension of the sensory block to the T4 dermatome was achieved via slow incremental epidural administration of local anesthetics, without inducing hemodynamic instability. The sensory block was successfully established and gradually extended, despite the history of lumbar degenerative disc disease and previous radiculopathy, with no neurological symptoms or deficits at the time of surgery.

General anesthesia was avoided because of concerns regarding its potential myocardial depressant effects. Sympathetic stimulation during laryngoscopy and tracheal intubation could have resulted in significant hemodynamic instability in this patient. Although increased heart rate may shorten the duration of mitral regurgitation, concomitant left ventricular dilation and systolic dysfunction made the overall hemodynamic response less predictable. Additionally, general anesthesia in a parturient with elevated BMI may increase the risk of postoperative respiratory complications and difficult airway management [8]. Placenta accreta and prior cesarean section increased surgical complexity, and the urinary bladder was not easily mobilized. Extensive adhesions led to a prolonged skin-to-delivery interval of 12 minutes. Nevertheless, the neonate had an Apgar score of 8 at one minute.

Neuraxial anesthesia in a 35-week parturient with obesity, cardiomyopathy, and placenta accreta requires meticulous hemodynamic monitoring. Previous studies have demonstrated the value of continuous blood pressure monitoring during cesarean delivery under neuraxial anesthesia [9]. Other noninvasive hemodynamic indices, such as the perfusion index, have also been investigated for the prediction of hypotension following spinal anesthesia in parturients undergoing cesarean delivery [10]. Some pregnant patients have poorly developed collateral circulation and abnormally reduced baroreceptor reflexes, predisposing them to severe hypotension in the supine position. It is extremely challenging to identify in advance which patients are at risk. Additionally, pregnancy-related cardiovascular adaptations, including increased cardiac output and reduced systemic vascular resistance, increase sensitivity to iatrogenic sympathectomy [11]. The HPI, derived from arterial pressure waveform analysis, has demonstrated high accuracy in predicting impending hypotension in awake patients undergoing cesarean delivery under spinal anesthesia [1]. Recent studies have also evaluated HPI-guided management during obstetric neuraxial anesthesia and demonstrated the feasibility of proactive hypotension prevention [12]. In this case, changes in HPI provided an early warning of impending hypotension, allowing proactive adjustments of norepinephrine infusion before significant reductions in arterial blood pressure occurred. Importantly, HPI trends were interpreted in conjunction with SVR, blood pressure, heart rate, and dP/dt, rather than being used as an isolated therapeutic threshold. This integrated approach facilitated timely hemodynamic intervention while maintaining stable arterial pressure and preserving cardiac output throughout the procedure.

After delivery, the expected increase in cardiac output associated with uterine contraction and autotransfusion was not observed, likely due to careful titration of norepinephrine and restricted fluid administration before delivery. Despite these expected post-delivery hemodynamic changes, stroke volume did not show a substantial increase. This finding may reflect the limited cardiovascular reserve in the setting of reduced left ventricular systolic function. Furthermore, oxytocin was administered as a slow infusion over 10 minutes in order to maintain hemodynamic stability and to avoid cardiac decompensation [5]. Throughout the procedure, left ventricular contractility was closely monitored, and no additional intervention specifically targeting myocardial contractility was required. Fluid therapy and vasoactive agents were carefully titrated according to continuous hemodynamic monitoring, while ROTEM was used to assess coagulation and clot firmness.

In parturients with elevated BMI, the risk of hemorrhage is higher due to uterine atony, more frequent comorbidities such as hypertension and diabetes, and placental abnormalities. In our case report, exposure of the uterus for suture placement and manual uterine massage to achieve adequate contraction was limited due to the patient’s obesity. These factors may have contributed to increased blood loss. In placenta accreta,

significant bleeding can occur in the pelvis and retroperitoneal space without being clinically visible [3]. In this case, the urinary bladder was difficult to mobilize, complicating the surgical approach and elevating the risk of trauma to the Santorini venous plexus and subsequent life-threatening bleeding.

In cases of PAS, maintaining stable blood pressure is critical for adequate organ perfusion (kidneys, brain) and for avoiding the 'lethal triad' of acidosis, hypothermia, and coagulopathy triggered by massive blood loss. Continuous hemodynamic monitoring, such as with HPI, provides a reliable method to detect impending hypotension and identify the underlying cause of hypotension. This is particularly important in parturients, as compensatory mechanisms can mask blood pressure decreases, despite substantial blood loss. In this case, continuous hemodynamic monitoring using HPI allowed timely intervention, preventing these potential complications. Although previous literature has not demonstrated superiority of hypotension prediction devices over standard blood pressure monitoring, in this particular high-risk case, involving obesity, cardiomyopathy, and PAS, HPI provided valuable additional information for the early recognition of evolving hemodynamic instability and supported timely therapeutic intervention. Further studies are needed to establish the impact of HPI monitoring on outcomes for parturients with PAS.

In placenta accreta, rapid depletion of fibrinogen and clotting factors is common. Abnormal trophoblast invasion and enhanced trophoblastic activity in placenta accreta increase tissue factor levels and the consumption of coagulation factors prior to cesarean section. For this reason, the risk of intraoperative coagulopathy is increased [4]. Prolonged surgical time and significant occult blood loss increase the risk of hypofibrinogenemia and coagulopathy. Dense adhesions between the bladder and the uterus result in an extended surgical duration and persistent microvascular oozing, which may lead to fibrinogen consumption. In our case, point-of-care ROTEM assessment demonstrated preserved clot firmness and adequate fibrinogen contribution, without evidence of clinically significant coagulopathy.

This report has several limitations. First, as a single case report, it cannot establish a causal relationship between HPI-guided monitoring and the maintenance of hemodynamic stability or improved clinical outcomes. HPI was used as an adjunct to conventional hemodynamic assessment rather than as an independent trigger for therapeutic interventions. Furthermore, arterial waveform-derived hemodynamic measurements, including cardiac output (CO), stroke volume (SV), systemic vascular resistance (SVR), and left ventricular contractility (dP/dt), are estimated values rather than direct measurements. Therefore, these parameters should be interpreted cautiously and in conjunction with the overall clinical and hemodynamic profile.

## Conclusions

PAS is associated with a high risk of massive hemorrhage and abrupt hypotension. The HPI may provide additional information to help early recognition of impending hypotension and can complement conventional hemodynamic monitoring. In this case, combined spinal-epidural anesthesia, carefully titrated norepinephrine infusion, and continuous hemodynamic assessment were associated with stable intraoperative hemodynamics despite the patient's significant cardiovascular comorbidities. Stroke volume remained relatively stable throughout the procedure, while ROTEM assessment demonstrated preserved clot firmness without evidence of clinically significant coagulopathy. This case highlights the importance of individualized, multimodal anesthetic management in complex obstetric patients and illustrates the feasibility of incorporating HPI into perioperative hemodynamic monitoring. Further studies are needed to determine the clinical impact of HPI-guided management in PAS.

## Additional Information

### Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

**Concept and design:** Georgia Ntalamagka, Giolanda Varvarousi

**Acquisition, analysis, or interpretation of data:** Georgia Ntalamagka, Giolanda Varvarousi, Emmanouil Stamatakis, Michail Pavlidis, Dimitrios Valsamidis

**Drafting of the manuscript:** Georgia Ntalamagka, Giolanda Varvarousi

**Critical review of the manuscript for important intellectual content:** Georgia Ntalamagka, Giolanda Varvarousi, Emmanouil Stamatakis, Michail Pavlidis, Dimitrios Valsamidis

**Supervision:** Giolanda Varvarousi, Emmanouil Stamatakis, Michail Pavlidis, Dimitrios Valsamidis

### Disclosures

**Human subjects:** Informed consent for treatment and open access publication was obtained or waived by all

participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

## Acknowledgements

Chat GPT was used solely to assist with improving the visual clarity and resolution of the images. No image content, data, or clinical findings were altered.

## References

1. Frassanito L, Sonnino C, Piersanti A, et al.: Performance of the hypotension prediction index with noninvasive arterial pressure waveforms in awake cesarean delivery patients under spinal anesthesia. Anesth Analg. 2022, 134:633-43. 10.1213/ANE.0000000000005754
2. Shih PY, Wei TJ, Lee CT, et al.: Proactive haemodynamic management using the hypotension prediction index during caesarean section: a randomised controlled study. Anaesthesia. 2026, 81:924-32. 10.1111/anae.70161
3. Eller AG, Porter TF, Soisson P, Silver RM: Optimal management strategies for placenta accreta . BJOG. 2009, 116:648-54. 10.1111/j.1471-0528.2008.02037.x
4. Jauniaux E, Hussein AM, Elbarmelgy RM, Elbarmelgy RA, Burton GJ: Failure of placental detachment in accreta placentation is associated with excessive fibrinoid deposition at the utero-placental interface. Am J Obstet Gynecol. 2022, 226:243.e1-10. 10.1016/j.ajog.2021.08.026
5. Meng ML, Arendt KW: Obstetric anesthesia and heart disease: practical clinical considerations . Anesthesiology. 2021, 135:164-83. 10.1097/ALN.0000000000003833
6. Apgar V: A proposal for a new method of evaluation of the newborn infant . Anesth Analg. 2015, 120:1056-9. 10.1213/ANE.0b013e31829bdc5c
7. Padilla A, Stockinger J, Zanolli NC, et al.: Mode of anesthesia for patients with placenta accreta spectrum undergoing cesarean hysterectomy: a report from the Multicenter Perioperative Outcomes Group database. Anesthesiology. 2026, 144:535-45. 10.1097/ALN.0000000000005788
8. Patel SD, Habib AS: Anaesthesia for the parturient with obesity . BJA Educ. 2021, 21:180-6. 10.1016/j.bjae.2020.12.007
9. Juri T, Suehiro K, Kimura A, et al.: Impact of non-invasive continuous blood pressure monitoring on maternal hypotension during cesarean delivery: a randomized-controlled study. J Anesth. 2018, 32:822-30. 10.1007/s00540-018-2560-2
10. Hung KC, Liu CC, Huang YT, et al.: Predictive efficacy of the perfusion index for hypotension following spinal anesthesia in parturient undergoing elective cesarean section: a systematic review and meta-analysis. Diagnostics (Basel). 2023, 13:2584. 10.3390/diagnostics13152584
11. Kuhn JC, Falk RS, Langesæter E: Haemodynamic changes during labour: continuous minimally invasive monitoring in 20 healthy parturients. Int J Obstet Anesth. 2017, 31:74-83. 10.1016/j.ijoa.2017.03.003
12. Aloziem O, Lin HS, Kelly K, et al.: Feasibility of hypotension prediction index-guided monitoring for epidural labor analgesia: a randomized controlled trial. J Clin Med. 2025, 14:5037. 10.3390/jcm14145037