Massive pulmonary embolism in late pregnancy

David K. Woodward MB CHB MRCP (UK) FRCA,
Richard J.S. Birks MBChB FRCA,
Kath A. Granger MB BS MRCOG

Purpose: To describe the management problems presented by a case of acute massive pulmonary embolism in a labouring woman.

Clinical Features: A case of massive pulmonary embolism is described in a woman who presented in early labour at thirty-eight weeks gestation. Immediate management involved the administration of oxygen and intravenous heparin, and transfer to the regional cardiothoracic centre. Pulmonary angiography confirmed the diagnosis of massive pulmonary embolism, but attempts at percutaneous catheter disruption of the clot were of only temporary benefit. The patient subsequently underwent Caesarean section under general anaesthesia, followed minutes later (because of an abrupt deterioration in her condition) by surgical pulmonary embolectomy. The outcome was successful for both mother and child.

Conclusion: In cases of acute massive pulmonary embolism presenting in late pregnancy and in labour, the risks and benefits of surgical embolectomy, pharmacological thrombolysis, or attempts at mechanical clot disruption have to be weighed on an individual basis. Management at the referral centre was facilitated by having cardiothoracic and obstetric facilities on the same site.

Objectif : Décrire les problèmes de traitement d'une embolie pulmonaire massive d'apparition brutale chez une parturiente en travail.

Aspects cliniques : Un cas d'embolie pulmonaire massive est décrit chez une femme qui s'est présentée à trente-huit semaines de grossesse, en travail obstétrical prématuré. Le traitement immédiat a consisté à administrer de l'oxygène et de l'héparine intraveineuse et de diriger la patiente vers le centre cardiothoracique régional. L'angiographie pulmonaire a confirmé le diagnostic d'embolie pulmonaire massive, mais des essais pour rompre le caillot à l'aide de cathéter percutané n'ont eu que des effets temporaires. La patiente a subi ensuite une césarienne sous anesthésie générale, suivie quelques minutes plus tard (à cause de la détérioration soudaine de son état) d'une embolectomie pulmonaire réussie avec succès pour la mère et l'enfant.

Conclusion : Lors d'une embolie pulmonaire massive d'apparition brutale, qui se présente vers la fin de la grossesse et pendant le travail, les risques et les avantages de l'embolectomie, la thrombolyse pharmacologique ou les essais de rupture mécanique du caillot doivent être évalués sur une base individuelle. Le traitement au centre spécialisé a été facilité ici par le fait d'avoir les services cardiothoraciques et obstétricaux au même site.

From the Departments of Anaesthesia, Northern General Hospital and Royal Hallamshire Hospital, and the Department of Obstetrics and Gynaecology, Northern General Hospital, Sheffield.

Address correspondence to: Dr. R.J.S. Birks, Department of Anaesthetics, Royal Hallamshire Hospital, Sheffield S10 2JF United Kingdom.
Phone: 44-114-2712494; Fax: 44-114-2798314

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PREGNANCY is a recognised risk factor for venous thrombo-embolic disease (VTE), although the occurrence of life-threatening pulmonary embolism is rare. The term venous thrombo-embolism (VTE) embraces both deep vein thrombosis (DVT) and pulmonary embolism (PE), and its occurrence in pregnancy has recently been reviewed.^{1,2} Venous thrombo-embolism has an estimated incidence of 1:1,000-2,000 pregnancies;³ pregnancy increases the risk of VTE five fold (compared with non-pregnant women in the same age group),⁴ with the greatest risk being in the puerperium.⁵ Venous thrombo-embolism is the leading cause of direct maternal death during pregnancy in the UK,⁶ accounting for 35 deaths in the 1991-1993 triennium; 30 of these were due to pulmonary embolism. There has been no change in incidence of maternal deaths due to VTE over the last three triennia, despite the now routine use of subcutaneous heparin in those deemed to be at particular risk. We report a case of massive pulmonary embolism occurring in a labouring woman at thirty-eight weeks gestation, and discuss the subsequent management.

Case Report

A 25 yr old Caucasian woman in the 38th week of her second pregnancy presented to the ante-natal ward of a local district general hospital with a two hour history of an abrupt onset of severe dyspnoea, chest tightness, and dizziness. Examination demonstrated central cyanosis and tachycardia, although she was normotensive (blood pressure (BP) 110/70 mmHg). A clinical diagnosis of pulmonary embolism was made, and, following initiation of treatment with oxygen and intravenous heparin, she was transferred immediately to the cardiothoracic unit at this hospital.

On arrival on the cardiac intensive care unit (four hours after initial presentation), the patient was found to be conscious, tachypnoeic and cyanosed, with an SpO₂ of 89% breathing oxygen by face mask (nominal F_IO₂ of 0.9). She was tachycardic (pulse rate 140 bpm) but remained normotensive (BP 125/75 mmHg). Blood gas analysis demonstrated a pH of 7.44, PaCO₂ of 3.5 kPa, PaO₂ of 7.7 kPa and base deficit of 5.3 mmol·l⁻¹. An ECG demonstrated sinus tachycardia with partial right bundle branch block, and right ventricular strain. Cardiotocography indicated fetal well-being (with a baseline rate of 150 bpm and good variability). The presence of regular 'tightenings' and vaginal examination confirmed that the patient was in early labour.

The immediate management of the patient was discussed with obstetrics, cardiothoracic surgery, cardiology, anaesthetics and radiology. In view of the evidence of early labour, it was considered that to pro-

vide the best chance of survival for both mother and child, delivery by urgent Caesarean section was indicated. The need for surgical pulmonary embolectomy was a distinct possibility, and pulmonary angiography was required to confirm the diagnosis; attempts at mechanical clot disruption during this investigation also held the possibility of improving the patient's haemodynamic status.⁷ As the patient was at term and in early labour, and an active surgical approach to management had been selected, pharmacological thrombolysis to supplement percutaneous mechanical clot fragmentation was considered too dangerous because of the attendant risks of bleeding.

The patient subsequently underwent pulmonary angiography (two hours after arrival at our hospital), which confirmed bilateral large proximal pulmonary emboli, with preserved perfusion only of the left upper lobe. Attempts at mechanical disruption of the proximal thrombus using a pigtail catheter were met with some improvement in her symptoms and arterial oxygen saturation, and radiologically improved perfusion to the right lung. An infra-renal caval filter was inserted.

However, the initial improvement in the patient's condition was not maintained, and re-examination within the hour confirmed progression of labour; the fetal heart rate remained satisfactory. It was, therefore, decided to proceed to delivery of the baby by Caesarean section under general anaesthesia, with full preparation being made to proceed to emergency surgical pulmonary embolectomy if indicated.

She received premedication with sodium citrate and 50 mg ranitidine *iv*, and a radial arterial cannula for blood pressure monitoring was secured. She was transferred to theatre three hours and ten minutes after admission. Following pre-oxygenation, general anaesthesia was induced with 500 µg alfentanil and 20 mg etomidate, and 100 mg succinylcholine was given to facilitate tracheal intubation after cricoid pressure was applied and tracheal intubation was easily performed. Maintenance of anaesthesia was by means of ventilation with oxygen, isoflurane 1%, with vecuronium for relaxation. Alfentanil 500 µg, followed by 300 µg fentanyl, were given after delivery of the baby.

A pre-induction BP of 140/70 mmHg decreased to 95/70 mmHg post-induction, and increased to 140/95 mmHg during delivery. A live but asphyxiated 3.8 kg male infant was delivered within ten minutes of induction of anaesthesia (and just under four hours after the patient had been admitted to this hospital). Apgar scores: 1 at 1 min; 2 at 5 min; 6 at 10 min; 8 at 15 min). Following administration of 10 IU syntocinon and fentanyl post-delivery, the BP decreased to 80/60 mmHg. A sinus tachycardia of 140-160 bpm persisted throughout this period. However, approxi-

mately ten minutes after delivery, and while the uterus was being closed, the patient's blood pressure decreased suddenly to 50/30 mmHg. On suspicion of a further massive PE, median sternotomy was performed, and normothermic, non-cardioplegic cavo-aortic cardiopulmonary bypass was instituted following full heparinisation. A 20 cm length of embolic thrombus was extracted from the main pulmonary artery bifurcation. An innominate vein central line was inserted by the surgeon following embolectomy, (as attempts at internal jugular line insertion following delivery had been interrupted by the need to institute CPB); the CVP after separation from CPB was 10 cmH₂O.

An adrenaline infusion (0.1 - 0.2 µg·kg⁻¹·min⁻¹) was required to support separation from cardiopulmonary bypass, and this was continued throughout a ten hours of post-operative ventilation. The heparin was reversed with 200 mg protamine when CPB was discontinued, and a syntocinon infusion of 20 IU over five hours was commenced in theatre.

Pre-operatively, Hb was 98 g·l⁻¹ and platelet count 87×10^9 l⁻¹. Following delivery, per-operative Hb was 82 g·l⁻¹, and decreased to 55 g·l⁻¹ during cardiopulmonary bypass (co-oximetry values). The patient received three units of blood (packed cells or SAG-M) in theatre and, subsequently, a further three units overnight in the CICU. In view of the pre-operative thrombocytopenia, period of CPB, and six unit blood transfusion, she was also given five units each of platelets and FFP in CICU. However, there was no evidence of excessive obstetric haemorrhage either in theatre or post-operatively. The patient's arterial blood gas values are recorded in the table.(Table)

Following extubation, she continued an uneventful post-operative course, with good oxygenation on an FiO₂ of 0.4. She was discharged to the post-natal ward 24 hr later. Subcutaneous heparin (5,000 IU bd) was commenced on the first post-operative day, for two days, and warfarin on the second post-operative day. She was discharged home seven days after admission, and she and the baby were progressing well. The caval filter was removed on the tenth post-operative day, as an outpatient procedure.

Discussion

It is estimated that two thirds of those dying from the haemodynamic consequences of acute massive PE will do so within two hours. However, deaths continue to occur in the next 24-48 hr, due to deposition of further thrombus in the pulmonary arteries.⁸ The initial management of VTE in both pregnant and non-pregnant patients includes the administration of heparin by intravenous infusion.¹ Its effect in reducing mortality is probably by discouraging further thrombus deposition rather than by ameliorating the acute haemodynamic consequences of pulmonary artery obstruction, as it has no significant thrombolytic effect.⁸

There are a number of recent case reports of massive PE in pregnancy,⁹⁻¹³ almost all occurring before 30 wk gestation, in which management has involved the use of thrombolytic agents (streptokinase, urokinase, recombinant tissue plasminogen activator, (rt-PA), following diagnosis by means of pulmonary angiography or ventilation-perfusion radionuclide scanning. Despite concerns that thrombolysis may lead to placental abruption, this complication did not occur. In addition, cases treated with thrombolysis that were not in labour either had

TABLE Arterial blood gas values in relation to events

Day:	19th Feb				20th Feb				
Time: (24 hr)	17.00	19.00	20.25	21.10	21.25	01.00	04.00	07.00	12.00
Ventilation:	S/V	CPAP	IPPV	CPB	CPB	IPPV	IPPV	IPPV	S/V
FiO ₂	0.9	0.9	1.0	—	—	0.4	0.4	0.4	0.5
pH	7.44	—	7.03	7.14	7.28	7.31	7.39	7.39	7.4
PCO ₂	3.5	—	10.2	6.5	5.2	4.9	4.74	5.6	5.46
PO ₂	7.7	—	11.8	51.5	56.3	25.9	19.3	16.0	19.3
HCO ₃	18.2	—	15.7	15.5	18.8	18.6	21.7	25.7	28.0
Base Excess	-5.3	—	-8.0	-9.7	-6.5	-6.2	-2.3	1.3	4.4
BM Stix	—	—	—	—	—	11-17	7-9	7-9	7
Comment	(1)	(2)	(3)	(4)		(5)	(5)	(5)	(6)

(1) on admission to CICU

(2) in angiography suite: no blood gas values recorded

(3) following induction/ventilation in theatre

(4) 50 mmol HCO₃⁻ administered *iv*

(5) post-op on CICU: adrenaline infusion @ 0.12 µg·kg⁻¹·min⁻¹; insulin infusion @ 1-2 IU ·hr⁻¹

(6) Adrenaline/insulin infusions off.

(CPAP = continuous positive airway pressure; IPPV = intermittent positive pressure ventilation).

no,^{10,11,13} or limited⁹ obstetric bleeding, all proceeding to successful outcomes of pregnancy.

Considerable problems with obstetric haemorrhage have occurred, however, in a case reported in 1972¹⁴ in which streptokinase was infused throughout labour and delivery, only being discontinued in the third stage due to persisting blood loss which was finally controlled with aminocaproic acid. In a more recent report,¹² streptokinase was commenced for massive PE at 28 wk gestation, but was stopped after 10 hrs for the duration of a pre-term labour and delivery. It was recommenced eight hours later, but discontinued after a total of 29 hr and substituted with heparin. The total post-partum blood loss reached 8900 ml by the 5th day.

The technique of percutaneous transvenous fragmentation of pulmonary emboli may be performed using catheters specifically designed for the purpose, or with conventional cardiac catheters. A case report of acute massive P.E. involving three non-obstetric cases⁷ demonstrated this to be a rapid and relatively non-invasive method of improving cardiac output in very sick patients. Two cases subsequently also received an infusion of streptokinase via a pulmonary artery catheter, although the dramatic haemodynamic improvement occurred prior to this, and was maintained in the third case in whom thrombolysis was contra-indicated. The authors questioned whether the streptokinase conferred any additional benefit over and above fragmentation. A combination of streptokinase and percutaneous catheter fragmentation has also been used successfully in pregnancy at 25 wk gestation.⁹

A case report in 1985 discussed a woman presenting at 35 wk gestation with a massive PE, in active labour.¹⁵ Despite cardiorespiratory compromise, labour was allowed to proceed and resulted, eight hours later, in the spontaneous vaginal delivery of a 2.3 kg live infant. Caesarean section was rejected as it was felt that the maternal risk was too great; any surgical intervention should be for 'maternal indications' only (such as embolectomy for worsening status). Thrombolytic therapy was also rejected as carrying too high a risk. However, following delivery, elective ventilation was instituted to maximise oxygen delivery and avoid maternal exhaustion. The patient underwent a V/Q scan, which was positive. Before angiography and caval filter insertion could be performed, she decompensated and required surgical embolectomy. Both mother and baby subsequently fared well.

A case bearing some similarity to ours was reported in 1989,¹⁶ in which a woman presented with cardiorespiratory compromise due to acute PE, at 32 wk gestation. She was not in labour. Heparin was commenced four hours after admission, but there is no record of whether thrombolytic agents were considered. Five

hours after admission, emergency Caesarean section was performed because of fetal bradycardia. The technique used involved awake intubation, prior to induction with ketamine. Following delivery of an asphyxiated 1.86 kg infant, pulmonary artery catheter insertion was attempted, but abandoned after a brief episode of ventricular tachycardia. Blood pressure subsequently decreased to 40/20 mmHg, following which pulmonary embolectomy on cardiopulmonary bypass was performed. Separation from CPB required 5 $\mu\text{g}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ dopamine, .3 $\mu\text{g}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ isoproterenol, and 0.8 $\mu\text{g}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ adrenaline. Heparin was fully reversed with protamine, and she was transfused a total of eight units of blood, and 20 units of platelets (her platelet count on admission was 49×10^9 per litre). Despite 5 IU oxytocin and 'adequate uterine tone' following delivery, she was discovered to have bled 2,000 ml per vaginum when the drapes were removed. Both mother and child had an uneventful recovery.

Our case presented at term, in early labour. Having confirmed the diagnosis angiographically, percutaneous catheter fragmentation did not lead to sustained haemodynamic improvement. The condition of the patient at this stage was considered too precarious to expect her to proceed successfully through labour, as haemodynamic collapse during a trial of labour would have demanded simultaneous resuscitation and immediate surgical intervention, with slim prospects for the survival of either mother or child. Our concerns about the risk of commencing thrombolytic therapy in active labour are borne out by the experience of others.^{12,14} Thus, our management plan was to perform emergency Caesarean section (for both maternal and fetal benefit), fully prepared to proceed to surgical embolectomy if indicated. The sudden haemodynamic collapse within minutes of delivery suggests that either manipulation within the pelvis precipitated a further embolic event, or that obstruction by the pre-existing saddle embolus had worsened. The presence of a caval filter makes the latter more likely. The baby at delivery was severely asphyxiated: as delivery occurred before cardiopulmonary bypass, the asphyxia was more likely to reflect the period of hypoxia, acidosis and placental hypoperfusion prior to delivery than the decision to intervene surgically. Despite full heparinisation for the period of cardiopulmonary bypass immediately following delivery, severe uterine haemorrhage did not occur.

In conclusion, recent case reports support the use of thrombolysis and percutaneous catheter fragmentation in cases of massive P.E. occurring in pregnant women not in labour; furthermore, this should be performed early, and arguably does not require cardiac catheterisation facilities.⁷ Use of thrombolytic agents during labour and delivery can be expected to be associated

with peri-partum haemorrhage, and the risks and benefits of conservative management vs thrombolysis or surgical embolectomy must be made on an individual basis in these patients. However, some maintain that thrombolysis should be strongly contraindicated in the peri-partum period until evidence from controlled trials is available.¹⁵ It may be that increasing experience with 'clot specific' thrombolytic agents (e.g. rt-PA) in pregnancy will further reduce the indications for surgical pulmonary embolectomy.¹¹ Finally, after surviving a 40 min inter-hospital transfer, the management of the patient at this unit was greatly facilitated by having both cardiothoracic and obstetric facilities on the same site.

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