A christmas miracle: A case of previable premature rupture of membranes complicated by transfusion-related acute lung injury, transfusion-associated cardiac overload, adult respiratory distress syndrome, and septic shock

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A 38 year-old woman presented to our institution with previable Prelabor Rupture Of Membranes (PROM). She desired expectant management at home but represented several hours later with metabolic acidemia, leukocytosis, and Adult Respiratory Distress Syndrome (ARDS). She underwent a Dilation and Evacuation (D&E) complicated by hemorrhage necessitating a hysterectomy and several hundred units of blood products. This led to Transfusion-Related Acute Lung Injury (TRALI), Transfusion-Associated Cardiac Overload (TACO), and worsening ARDS. She underwent unsuccessful cannulation for venovenous Extra Corporeal Membrane Oxygenation (ECMO), and was later successfully discharged. This case demonstrates the anesthesiologist's role in a peripartum multidisciplinary critical care team.

Key Words: *Septic shock; Transfusion-related acute lung injur; Adult respiratory distress syndrome; Previable preterm premature rupture of membranes; Extracorporeal membrane oxygenation; Prelabor*

INTRODUCTION

On Christmas Eve, a 38-year-old female presented with loss of fluid at 21 weeks gestation of twin pregnancy. She had no significant medical history, and obstetric history included cesarean section eighteen years prior. After discussion between the patient and the obstetricians, she was given three options for management of previable PROM: Labor induction, D&E, or expectant management. She opted for expectant management and was discharged home with strict return precautions.

Nine hours later, she represented with a fever at home. Her labs on presentation (Table 1) demonstrated leukocytosis. She appeared clinically stable (Table 2), and agreed to admission for IV antibiotic therapy with ampicillin and gentamicin, and fluid resuscitation. She continued to decline termination, despite new ultrasound evidence of fetal demise of baby A.

TABLE 1

Lab values and clinical correlation

Test (normal range)	Initial value on admission	Intraoperative	ICU admission	Discharge
WBC (4.50 - 11.00 K cu/mm)	27.23		6.28	7.86
Hgb (12.0-15.0 g/dL)	9.4	13.3	13.4	6.9
HCT(36.0%-46.0%)	28.7		40.2	21.8
Platelets (150-350 K cu/mm)	208	62	99	246
pH, arterial (7.35-7.45)	7.49	7.26	7.38	
pCO_2 (35-45 mmHg)	24	39	31	
pO_2 (75-100 mmHg)	73	245	192	
HCO_3 (calculated, arterial) (22-28 mmol/L)	18	17	18	
O_2 saturation (92.00%-99.00%)	95.60	99.40	99.10	
Base Excess (-2 to 3 mmol/L)	-4	-10	-6	
Lactate (0.5 - 2.0 mmol/L)	3.0	7.3	10.0	
Creatinine (0.5-1.2 mg/dL)	0.7		0.9	4.1

Note: HCT: Hematocrit; HCO3: bicarbonate; WBC: White blood cell count

TABLE 2

Vital signs over clinical course

Vital sign	Initial evaluation	Re-admission	Transition of care to OR	Arrival to ICU	Discharge
Temperature (celcius)	36.8	37.5	37.4	36.6	37.1
Heart rate (bpm)	86	114	125	104	105
Blood pressure (mmhg)	117/59	105/56	73/46	135/74	141/94
Respiratory rate	16	22	34	21	16
SpO_2 (%)	Not documented	95	96	100	95
Pain score	0	7	10	N/A; patient intubated, sedated	3

Note: bpm: Beats per minute; mmHg: Millimeters mercury

Within hours, her vital signs worsened despite maintaining a normal mental status. An arterial catheter was placed, and her blood gas demonstrated metabolic acidemia with respiratory compensation. Aerobic and anaerobic blood cultures were obtained. A sensitive multidisciplinary discussion was had with the patient about her worsening clinical status and the escalating imperative to proceed with delivery by labor induction or surgical evacuation.

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The patient accepted labor induction, and oxytocin infusion was initiated. Given suspected sepsis, intravenous fentanyl patient-controlled analgesia rather than neuraxial anesthesia was offered.

1 hour after her induction began, she became progressively hypoxic and hypotensive, despite additional crystalloid administration, and ultimately required oxygen supplementation with a nonrebreathing mask. This raised suspicion for septic shock with evolving ARDS. At this point, the patient agreed to a D&E as definitive source control.

CASE PRESENTATION

While preparing for the procedure, the patient experienced sudden onset severe abdominal pain associated with profound hypotension and tachycardia. Given her prior cesarean delivery and initiation of oxytocin, concern was raised for concealed abruption versus uterine rupture; abdominal ultrasonography was negative for intraabdominal fluid and her lower uterine segment appeared intact. With the patient's hemodynamics declining, she was urgently moved to the operating room (OR). In transit, an 8.5 Fr Rapid Infusion Catheter (Arrow International Inc, Reading PA) was placed for volume resuscitation. Antibiotic coverage was broadened to include clindamycin, for both anti-toxin effects associated with toxic shock syndrome and for its extended spectrum.

On arrival to the OR, balanced transfusion began with packed red blood cells and plasma. She was placed on a norepinephrine infusion and general anesthesia was induced with etomidate and succinylcholine. After an uncomplicated rapid-sequence intubation with video laryngoscopy, additional peripheral IV access was obtained and the D&E began. No vaginal bleeding was observed prior to the start of the D&E, however, a concealed placental abruption was confirmed after immediate 1 liter blood loss. Despite complete uterine evacuation and administration of uterotonics, she continued to hemorrhage and the multilateral decision was made to proceed with hysterectomy. Dissection was notable for extremely friable tissue, with poor integrity and extensive microvascular bleeding. Trauma surgery and gynecologic oncology were called for assistance, and hemostasis took approximately 3.5 hours to achieve. During this time, the anesthesia team was massively transfusing, treating electrolyte and hemodynamic disturbances, and administering antibiotics and antifibrinolytics as indicated. Serial point-of-care transthoracic echocardiography was performed (Figure 1), allowing for echo-guided resuscitation with intravascular volume, vasopressor and inotropic support. ST changes were observed concerning for myocardial ischemia, but hemodynamics was unchanged and no regional wall motion abnormalities were noted.

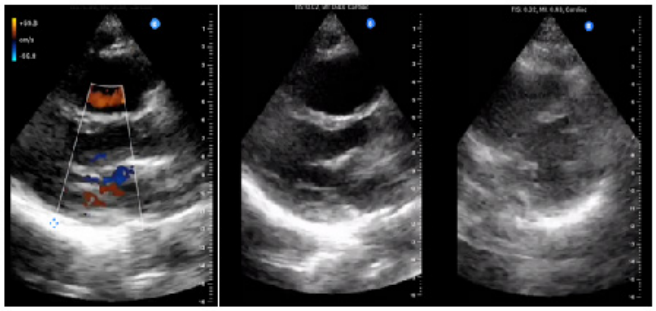

Figure 1) *Various intraoperative parasternal transthoracic echo images throughout her resuscitation*

During the hysterectomy, the patient's lung compliance progressively worsened. Her oxygenation was poor, and suctioning of the endotracheal tube did not reveal any secretions or improve oxygenation. The presumptive diagnosis was worsening ARDS concomitant with TRALI versus TACO. She was placed on an Intensive Care Unit (ICU) ventilator, initially set to assist-control mode with low tidal volumes and high positive end-expiratory pressure [1]. Oxygenation did not improve, and the ventilator mode was transitioned to Airway Pressure Release Ventilation (APRV) without significant improvement. Inhaled epoprostenol was begun to decrease pulmonary vascular resistance. A transesophageal echo was performed, which demonstrated normal biventricular function, an incidentally-discovered nonocclusive inferior vena cava clot, and adequate volume resuscitation with no significant pleural effusions.

The ECMO team was activated. As the surgical technique involved the ligation of pelvic vessels, the only peripheral cannulation option was a dual-stage internal jugular cannula. After multiple attempts at cannulation, her internal jugular vein began to show evidence of intraluminal echogenic material consistent with thrombus. At this point, cannulation was aborted and oxygenation was maintained on APRV ventilation. Inhaled nitric oxide was started for pulmonary vasodilation after no improvement with epoprostenol. After surgical hemostasis was achieved and her ventilatory status was stable for transport, her abdomen was left open and she was taken to the ICU for further resuscitation. In total, she received 157 units of blood products (76 packed red blood cells, 64 fresh frozen plasma, 11 platelet packs, and 6 units of cryoprecipitate).

On postoperative day 1, she underwent a second-look laparotomy, with a cholecystectomy for gangrenous cholecystitis and a salpingoopherectomy for necrotic adnexa. On postoperative day 3, her abdomen was closed, and she was successfully extubated several days later. Her postoperative course was complicated by acute kidney injury requiring dialysis, a non-ST elevation myocardial infarction, and recurrent c. difficile infection. She was discharged after 37 days, and remains on hemodialysis while undergoing evaluation for renal transplant. Her uterine pathology demonstrated evidence of placenta accreta spectrum and extensive microabscess formation with diffuse focal necrosis, concerning for group A streptococcal infection.

DISCUSSION

While the optimal management for previable PROM remains controversial [2], the possible outcomes for expectant management are well-described [3,4]. Although not confirmed based on a lack of positive culture, the concern for pregnancy-related group A streptococcal sepsis remains high. Outcomes for patients with this condition vary, but estimates of maternal mortality are approximately 60% [5–7].

This patient's rapid development of leukocytosis, fever, chills, abdominal pain, and tachycardia likely heralded her transition to Toxic Shock Syndrome (TSS). TSS occurs in approximately one-third of patients infected with group A streptococcus [8]. Well-described clinical criteria for the diagnosis of streptococcal TSS include tachycardia, hypotension and end-organ impairment (Renal dysfunction, Coagulopathy, liver involvement, ARDS, Skin rashes, or Soft tissue necrosis) [9]. Renal dysfunction occurs among nearly all patients with TSS, and blood cultures are frequently negative during the disease course, especially when antibiotic therapy is initiated [10].

The traditional treatment for streptococcal infections in pregnancy includes resuscitation, adequate antibiotic coverage, source control, and potentially IVIG. Typical antibiotic treatment includes penicillin with clindamycin, but other agents such as vancomycin or linezolid may be used depending on community susceptibilities. While there are no trials that compare surgical and medical management, most agree that end-organ dysfunction or shock should cause a shift towards surgery [7].

Based on Berlin criteria [11], this patient did not meet criteria for ARDS until arrival to the ICU due to lack of chest x-ray (Figure 2-3). However, her oxygenation failure warranted consideration for ECMO, as in-hospital survival rates for adults with infection-driven ARDS may be higher with ECMO than with conventional therapy [12]. Given surgical exposure, our only options were central ECMO cannulation or dual-stage internal jugular cannulation; once her internal jugular vein clotted, she had no further options for ECMO cannulation short of a median sternotomy or thoracotomy, both of which would have been extremely morbid.

Figure 2) *Chest X-Ray on arrival to ICU*

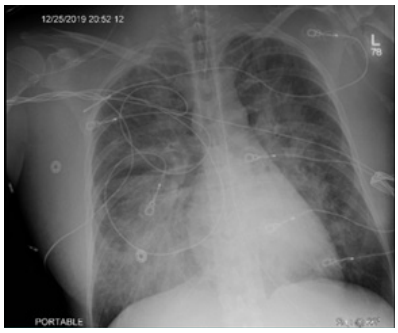

Figure 3) *Chest X-Ray at discharge*

Her ST segment changes and elevated troponin levels suggested the development of group A streptococcal myocarditis, stress cardiomyopathy, or demand ischemia. Once thought to be theoretical, group A strep myocarditis has been shown to mimic myocardial infarctions in young patients [13,14].

This case highlights the importance of resource availability in caring for some of the sickest patients. Multidisciplinary teams have been shown to improve outcomes in a variety of avenues [15], and the spontaneously-occurring multidisciplinary team in this case was key in this patient's survival. The anesthesiology team (two anesthesiology attendings and six residents) kept the patient alive while source control and surgical hemostasis was obtained. One attending was dedicated solely to ventilator management, whereas another was dedicated to resuscitation and intraoperative care. The surgical team consisted of maternal-fetal medicine and family planning surgeons initially, and subsequently included both trauma surgeons and gynecologic oncologists. The ECMO team included a dedicated cardiac anesthesiologist, as well as a perfusionist and a cardiac surgeon. The blood bank had four technicians dedicated to this patient, thawing and preparing hundreds of units. Her good outcome would not have been possible without this team.

CONCLUSION

In summary, the patient presented to our labor floor with previable PROM and returned several hours later with a rapidly progressing infection. Despite the best efforts at uterine evacuation, hysterectomy was required due to massive bleeding and extensive soft tissue infection. The patient developed multiorgan failure in the operating room, requiring maximum multidisciplinary efforts. Against all odds, she survived and remains well with the exception of end-stage renal disease. This case illustrates the capabilities of a skilled multidisciplinary team to come together using the best-available resources to save a patient's life. Her survival was a true Christmas miracle.

CONFLICTS OF INTEREST

Authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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