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Hypovolemic Shock in pregnancy secondary to DKA with superimposed Sepsis: Dilemmas and clinical patient safety pathways are critical components to prevent Maternal and Neonatal mortality: A Case Report

Dr. Sandeepika Dogra[1], Dr. Sunil T Pandya[2], Dr. Manokanth Madapu[3], Dr. Kanika Gupta[3]

[1,4]Assistant Professor, Dept of Anaesthesiology, AIIMS Jammu, UT of Jammu & Kashmir, India

[2]Chief, Dept of Anaesthesiology, Perioperative Medicine & Critical Care, AIG Hospitals, Hyderabad, India

[3]Senior Consultant and Academic In charge, Dept of Anaesthesiology, Fernandez Hospitals, Hyderabad, India

***Corresponding Author:**

Dr Sandeepika Dogra

Email ID: sandipikadogra@gmail.com

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ABSTRACT

We want to report a case of a 26-year-old primigravida at 31 weeks with type 1 Diabetes Mellitus (BMI 31) who was admitted for persistent vomiting and fever and diagnosed with Diabetic Ketoacidosis (DKA). In the ICU, she developed a right breast abscess, worsening metabolic acidosis, and septic shock, requiring mechanical ventilation and inotropes. The patient landed in Hypernatremia, making the multidisciplinary team switch from normal saline to Plasmalyte. Due to hemodynamic instability, a Category I cesarean section under general anesthesia was performed, delivering a 1.64 kg baby girl (APGAR 5/6/6). Post-delivery, she received intensive care, and the abscess was drained. Quick management and decisive actions, including reconsidering fluid therapy and timely C-section, were crucial to the rapid improvement, averting double jeopardy and imminent maternal and neonatal morbidity and mortality. Both mother and baby gradually recovered in the ICU, bonding via.

Keywords: *Diabetic Ketoacidosis, Hypernatremia, Septic shock, Cesarean delivery*

1. INTRODUCTION

Diabetic ketoacidosis (DKA) is a severe and potentially life-threatening emergency for both pregnant women and their babies. It can affect all forms of diabetes, including type 1 diabetes mellitus (DM), type 2 DM, and gestational DM. Pregnancy is a state that tends to promote ketosis; therefore, DKA in pregnancy can occur at lower glucose levels. The incidence of DKA during pregnancy varies in different studies, with reports ranging from 0.5% to 10% of all diabetic gestations (1).The reasonsfor Diabetic ketoacidosis of Pregnancy (DKP) are relative insulin resistance in pregnancy along with a concomitant increase in counter-regulatory hormones (cortisol, growth hormone, etc)(2).Infection is the most common predisposing factor for developing DKA,with an estimated range of 32–60%(3).The prompt recognition and treatment of sepsis decreases sepsis-related mortality.Appropriate source control is a key principle in managing sepsis and septic shock. Itincludes drainage of an abscess, debriding infected necrotic tissue, removing a potentially infected device, or definitive control of a source of ongoing microbial contamination (4).During management, hypernatremia can result fromexcessive administration of saline solutions, which can lead to a disproportionate increase in sodium compared to water content in the body.The change to Plasma-Lyte reflects a clinical decision to address iatrogenic hypernatremia with a balanced electrolyte solution, aiming for safer, more controlled normalization of serum sodium levels(5). The case report illustrates how the maternal condition can quickly worsen with DKA. In addition, it also highlights that a timely cesarean section, effective source control,and proactive resuscitative approach can significantly enhance fetomaternal outcomes.The case report was prepared after obtaining the patient's informed consent.

2. CASE REPORT

A 26-year-old pregnant woman, witha BMI of 31,at 30.5 weeks gestation and with a history of Type 1 diabetes managed on insulin, was admitted due to three days of vomiting, aggerated to four episodes on the day of admission, and low-grade fever for the last two days. On examination, she had a fever of 100 F; her initial vital signs were stable. Thelabs showed no abnormalities, including serum electrolytes, kidney and liver function. Blood cultures after 48 and 72 hours were sterile. Her random blood glucose (RBS) was 364 mg/dland 3+ urine ketones. Arterial blood gas analysis indicated metabolic acidosis and respiratory alkalosis.

The management was initiated with POCUS-guided fluid resuscitation, IV antiemetics, and insulin adjustments and HCO3 . On the next day of admission, she complained of right breast tenderness. A focused physical examination revealed engorgement in the lower quadrant of the right breast. Antibiotic therapy was started with Inj. CefoparzoneSulbactum 1.5gm and Inj. Clindamycin, and she was transferred to the ICU as her acidosis persisted. A breast scan revealed small collections suggestive of cellulitis in the right breast lower quadrant.

The surgeon performed aspiration of a right breast abscessunder local anaesthesia after 4 hrs of admission, which cultured Staphylococcus aureus. Repeat investigations revealed elevated WBC count with procalcitonin and lactates of 5. Treatment was escalated to Inj. Vancomycin and Inj. Meropenem, but her condition continued to deteriorate. The patient initially received 2 litersof 0.9% saline solution for hypovolemia induced by DKA. Electrolytes repeated every 6 hoursrevealed an increase of sodium from 132 meq/L to 155meq/L, landing her in hypernatremia. The fluid choice was then shifted to Plasma-lyte infusion at 100 mL/hour.Over the next 36 hours, her condition worsened with increased tachypnea, a PaO2/FiO2 ratio below 300 mmHg despite oxygen via a Hudson mask, and hypotension requiring moderate doses of noradrenaline. This necessitated invasive ventilatory support with titrated PEEP and invasive hemodynamic monitoring via an arterial line and central venous catheter. In another few hours, she became so hemodynamically unstable that she required triple inotropic support, including Noradrenaline at 3 mcg/kg/min, Vasopressin at 0.04 U/min, and Adrenaline at 0.08 mcg/kg/min, all at maximum titration. She remained on IV antibiotics and IVfluids, with continuous monitoring, including a fluid intake & output chart, potassium levels every 2 hours, arterial blood gases every 4 hours, and fetal heart rate every 2 hours (Table 1).Later, the patient's bedside ultrasound showed no fetal movements, cardiotocography showed suspicious traces, and her temperature was 102°F with a pulse rate of 140/min and blood pressure of 100/80 mmHg on triple inotropes.Her ABG analysis revealed worsenedmetabolic acidosis Fig 1(A), 1(B), 1(C) showing serial worsened ABG over 36 hours. Due to severe, ongoing hemodynamic instability and the high risk of maternal cardiac arrest, the multidisciplinary team obtained consent for a category Icesareansection. The family was counselledfor the high-risk cesarean section, including the possibility of maternal death. She underwent a cesarean section under general anaesthesia.Simultaneously,a repeat I/D of the Breast abscess was done thoroughly, which showed induration and yielded 5 ml pus.Post-operatively,ICU bundled care for central line-associated bloodstream infection (CLABSI), Ventilator-associated pneumonia (VAP), and catheter-associated urinary tract infection (CLAUTI) was maintained. Deep vein thrombosis (DVT) preventive measures like sequential compression device (SCD)were maintained, and trophic feeds were administered via an orogastric tube after 6 hrs of Caesarean section. Vancomycin was replaced with Linezolid 600 mg intravenously every 12 hours, continuous intravenous infusion (CIVI) of Inj. Fentanyl was started for pain management. Her insulin, potassium chloride (KCL), and bicarbonate (HCO3) were continued to manage her metabolic status. Notably, there was a sudden improvement in lung compliance after the cesarean section. Arterial blood gas (ABG) measurements taken 6 hours after the surgery were reassuring, Table 1 shows the serial better ABGs after the procedure. The patient was eventually tapered off from KCl and HCO3 infusions to single inotrope and extubated after 26 hours of cesarean delivery. She continued to receive standard ICU careforthe next 2 days. Neonatal mother bonding was done through video calls during their co-ICU care, Photo 1, depicts the neonatal mother bonding being done through a video call from their respective ICUs. Mother was transferred back to the ward on the second postoperative day (POD 2). Her ward stay was uneventful,during which supportive care with physiotherapy, a soft diet, and ambulation was given. She was discharged on the fifth postoperative day (POD 5).The cultures came sterile, and antibiotics were de-escalated and stopped in 7 days. The baby's APGAR at 0, 1, and 10 min was 5/6/6clinical course involved initial support with CPAP, followed by supplemental oxygen via nasal hoods, and subsequently, the baby was weaned off oxygen entirely. The baby's stay was otherwise uneventful, and he was discharged on day 7.

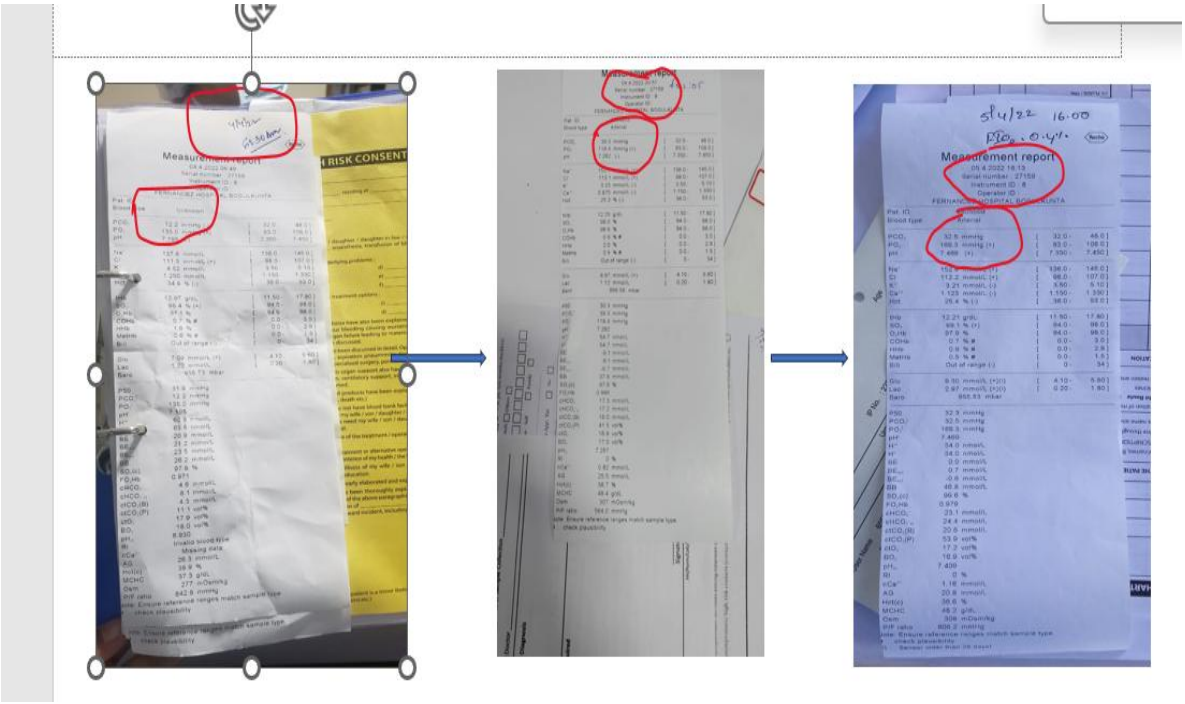

Fig 1(A), 1(B), 1(C) : serial worsened ABG over first 36 hours of admission

Table 1: Trends in Biochemical and Hematological Variables

Variables- (Biochemical and hematological)	**Measurement- Spontaneous breathing, 4 hrs after spontaneous breathing, 4 hrs after arrival**	**Measurement- On Mechanical Ventilation, Pre-Cesarean, 36 hrs after arrival**	**Measurement- Mechanical ventilation- 6 hrs after the cesarean**	**Measurement- On spontaneous breathing- 24 hrs after cesarean**	**Measurement- On spontaneous breathing, POD-2**
pH	7.19	7.06	7.46	7.45	7.44
PCO2	12.2	40.3	35.4	35.2	34.5
PO2	135	118	160	145	130
HCO3	7.4	14.2			
K	4.5meq/l	3.3 meq/l	3.8 meq/l	4.1 meq/l	4.1 meq/l
S. Creatinine	0.8 mg/dl	0.8 mg/dl	0.7 mg/dl	0.8 mg/dl	0.7 mg/dl
Sodium	131 meq/l	132 meq/l	150 meq/l	145 meq/l	138 meq/l
WBC	25500 cu/mm	30500cu/mm	-	23100cu/mm	14700cu/mm
Lactate	1.12	4.97	4.52	3	1.78
Procalcitonin	-	1.07	-	-	-

Photo 1: Maternal – neonatal Bonding during Co- ICU stay

3. DISCUSSION

We have presented a case of severe DKA with septic shock in a pregnant woman during her last trimester of gestation as a complication of Type 1 DM.As seen in our patient, the vast majority of cases with DKA in pregnancy emerge mainly during the last trimester of gestation(6). Shepresented with chief complaints of vomiting and fever. Many studies have shown that DKA usually presents with symptoms like nausea, vomiting, and pain in the abdomen, vomiting being the most common complaint (7).Pregnancies complicated with DKA experience higher rates of perinatal morbidity and mortality, which can be the direct consequence of the extremely poor tolerance of the fetus to acidosis, which, in the most severe cases,can lead to intrauterine death or preterm delivery in addition to maternal compromise(8).Due to its insidious onset, often at lower glucose levels than in non-pregnant individuals, and a tendency to progress more rapidly, a high suspicion is necessary.Infection is a well-recognized trigger of DKA. The study done by Azolauyet al. showed that infections are the most common precipitating factors for DKA(9). It is also the most common predisposing factor for the development of otherhyperglycaemic crises,with an estimated range of 32-60 %. It is also the most common cause of death of DKA patients among all the predisposing factors (3). In our study, the patient started complaining of breast tenderness after a few hours of admission, which was the cause of the infection.We managed to explore the abscess within4 hrs of the diagnosis.Early identification of precipitating factors, such as infection, is key to reducemorbidity and mortality in these cases(6). Prompt hospitalization and targeted therapy with intensive monitoring are also of paramount importancein the management of DKA.DKA in pregnancyneeds to be managed in at least Level 2 critical care units, such as HDU or ICU(2,10).Our patient was immediately shifted to ICU when she was diagnosed with DKA with urine ketones, RBS, and ABG analysis for vigilance in hospital care. Diabetic ketoacidosis in pregnancy can result in severe fluid depletion, accompanied by marked metabolic disturbance. Therefore, we immediately started her POCUS-guided resuscitation with normal saline. Studies have demonstrated that POCUS provides additional value in guiding fluid resuscitation, helping to prevent fluid overload and determine the appropriate timing for vasopressor administration(11). In DKA, patients typically present with a metabolic profile that points to hyponatremia. However, our patient abruptly became hypernatremic during initial management. There is no consensus on the optimal approach to fluid resuscitation for hypernatremia in DKA. Initially, we faced hypernatremiaduring fluid resuscitation with 2 liters of normal saline, which prompted us to switch to a balanced salt solution (Plasma-Lyte). It was in accordance withsubgroup analysis done by Sachs et al., who found that in cluster randomized controlled trials, balanced crystalloids were associated with a faster resolution of DKA than saline (11). The patient in our report rapidly deteriorated, and within 30 hrs of admission, she was on mechanical ventilation and triple ionotropic supportwith the possibility of imminent Maternal Cardiac Arrest.As a result, we proceeded with a Category I cesarean section. Guidelines and recommendations state that emergency delivery before maternal stabilization usually should be avoided because it increases the risk of maternal morbidity and mortality. Still, few casereports show that early recognitionwith prompt and appropriate medical and obstetrical management is critical(12). In addition, studies reveal that antibiotics alone are inadequate in several cases, and abscess drainage or removal of infected material is required(13). The surgeonin our case report did a repeat I and Dof breast abscess during cesarean section as he suspected inadequate source control during the first I and D.The highlight of our case report was the rapid recovery of the woman after CS. Source control, change of antibiotic to Linezolid, and management as per the surviving sepsis campaign guidelines (4).

4. CONCLUSION

DKA during pregnancy puts both the mother and the fetus' lives in jeopardy and is an uncommon but serious risk among pregnant women with diabetes. For both the pregnant woman and the fetus, sepsis poses a life-threatening risk and needs to be treated right away. It is critical to restore the mother's metabolic status promptly, take source control measures, and administer appropriate antibiotics while managing DKA. Last but not least, a prompt cesarean section has the potential to

save the lives of both the mother and the fetus, especially if the gravid uterus interferes in respiratory or circulatory dynamics.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the forms, the patient has given consent for her images and other clinical information to be reported in this journal. In addition, it was duly informed to the patient that their names and initials would not be published, and all efforts are made to conceal their identity, but anonymity cannot be guaranteed.

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Conflict of interest

There are no conflicts of interest.

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