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Navigating Surgical Challenges: Successful Robotic Radical Hysterectomy in a Patient with Glucose - 6 - Phosphate Dehydrogenase Deficiency

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Abstract: ***This case report presents the successful management of a patient with Glucose - 6 - Phosphate Dehydrogenase (G6PD) deficiency who underwent a robotic radical hysterectomy for the treatment of cervical cancer. In order to treat cervical cancer, the patient underwent a robotic radical hysterectomy. A genetic enzyme disorder known as G6PD deficiency presents surgical complications in the form of oxidative stress and hemolysis. Emphasising the significance of a multidisciplinary approach in the management of these patients and the reduction of hemolysis risk during surgical procedures is the objective of this report. In this instance, we deliberate on preoperative evaluations, perioperative interventions, and postoperative results, underscoring the criticality of a meticulously customised anaesthetic and surgical strategy to safeguard the patient and achieve a favourable surgical outcome. This case highlights the importance of healthcare providers developing strategies to reduce the risk of hemolysis and other complications during surgical interventions in G6PD - deficient patients, as well as being aware of the potential difficulties that may arise. The perioperative management, comprising preoperative evaluation, intraoperative safety measures, and postoperative attention, was deliberated upon as factors that contributed to the patient's smooth recuperation.***

Keywords: G6PD deficiency, Oxidative stress, Hemolysis, Enzyme disorder, Genetic inheritance

1. Introduction

Glucose - 6 - phosphate dehydrogenase (G6PD) deficiency, an X - linked genetic disorder, can induce hemolysis when triggered by oxidative stressors like specific medications, infections, or anesthesia. Hemolysis may occur upon exposure to various factors, including infections (viral and bacterial), hypoxia, hypothermia, blood products, stress, metabolic acidosis, ingestion of fava beans, and certain medications like sulphonamides. This condition presents through over 400 different variants, with a prevalence of 20% among individuals of African descent and 11% in African - American males. Other variants are observed in populations with Mediterranean and Southern Chinese ancestry. [1 - 2] This case report showcases the successful management of a patient with a known G6PD deficiency who required robotic radical hysterectomy for cervical cancer treatment.

2. Case Report

A 38 - year - old female diagnosed with cervical cancer was scheduled for robotic radical hysterectomy. Her medical history included a known G6PD deficiency, previously identified during an episode of hemolysis triggered by a sulfa - based antibiotic. Additionally, she had a medical history of hypothyroidism. Preoperative tests revealed normal hemoglobin levels (12.6 g/dL) but indicated low G6PD enzyme activity (2.4 U/g Hb) consistent with her condition. Cholesterol levels were observed at 231 mg/dL, HDL at 40mg%, LDL at 161 mg%, Triglycerides at 154 mg%, and TSH at 0.29 micro-IU/dL. Other investigations and examinations showed normal results.

Preoperative Evaluation:

a) Discussed the patient's medical history, focusing on G6PD deficiency, and obtained informed consent.
b) Reviewed medications to ensure avoidance of oxidative stress - inducing agents.
c) Consulted with a hematologist and anesthesiologist for comprehensive perioperative planning.

Intraoperative Precautions:

a) Minimized oxidative stress: Avoided medications and anesthetics known to trigger hemolysis in G6PD - deficient patients.
b) Ensured meticulous hemostasis during surgery to minimize bleeding and oxidative stress.
c) Used warmed intravenous fluids to prevent cold - induced hemolysis.
d) Monitored hemoglobin levels and vital signs closely throughout the procedure.

Postoperative Care:

a) Regularly assessed postoperative hemoglobin levels to monitor for signs of hemolysis.
b) Conducted close observation for hemolysis indicators like hemoglobinuria and jaundice in the recovery room.
c) Maintained proper pain management and fluid balance for optimal recovery.
d) Avoided aspirin - containing painkillers to prevent hemolysis.

Outcome:

The robotic radical hysterectomy proceeded successfully without any intraoperative or postoperative complications related to the patient's G6PD deficiency. Her recovery was uneventful, and she was discharged on the third

postoperative day. Hemoglobin levels remained stable throughout her hospital stay, showing no signs of hemolysis.

3. Discussion

Glucose - 6 - Phosphate Dehydrogenase (G6PD) deficiency, a genetic enzyme disorder impacting red blood cells, heightens their vulnerability to oxidative stress, leading to hemolysis. Its pathogenesis revolves around its genetic inheritance, mutation in the G6PD gene, reduced enzyme activity, and increased susceptibility to oxidative stress. [3]

Genetic Inheritance:
G6PD deficiency is an X - linked recessive disorder primarily affecting males, though females can also be affected. Females typically have milder symptoms due to the presence of two X chromosomes, while affected males, with only one X chromosome carrying the mutation, often manifest the deficiency. [4]

Mutation in the G6PD Gene:
The pathogenesis initiates with a mutation in the G6PD gene, located on the X chromosome. Multiple mutations can cause G6PD deficiency, determining the severity of the deficiency based on the specific mutation involved. [5]

Reduced Enzyme Activity:
G6PD is pivotal in the pentose phosphate pathway, crucial for red blood cells to handle oxidative stress. In G6PD deficiency, the mutation leads to reduced or absent enzyme activity, compromising the cell's ability to counteract oxidative stress. [6]

Vulnerability to Oxidative Stress:
Red blood cells, unable to synthesize new proteins or repair oxidative damage, are highly susceptible to oxidative stress. G6PD deficiency exacerbates this vulnerability, rendering these cells less effective in neutralizing reactive oxygen species.

When exposed to triggers like certain medications, infections, or dietary factors, G6PD - deficient red blood cells struggle to effectively manage reactive oxygen species. Managing surgery in patients with G6PD deficiency, especially those prone to oxidative stress, necessitates meticulous preoperative assessment and comprehensive planning. This case underscores the critical collaboration among surgical, anesthesia, and hematology teams to ensure patient safety and well - being during surgical procedures. [7]

4. Conclusion

The management of patients with Glucose - 6 - Phosphate Dehydrogenase (G6PD) deficiency undergoing surgical procedures necessitates a nuanced approach due to the increased susceptibility to oxidative stress and subsequent hemolysis associated with this genetic disorder. Understanding the underlying pathogenesis, characterized by the mutation in the G6PD gene resulting in reduced enzyme activity, highlights the vulnerability of red blood cells to oxidative damage. This susceptibility can be triggered by various factors, including medications, infections, or dietary elements, underscoring the need for careful preoperative assessment and meticulous planning to mitigate potential risks during surgery.

Collaboration among surgical, anesthesia, and hematology teams is imperative to ensure a comprehensive and tailored perioperative management strategy for patients with G6PD deficiency. Strategies aimed at minimizing oxidative stress, such as avoiding medications known to induce hemolysis and ensuring strict hemostasis during surgery, are crucial. Furthermore, maintaining vigilant postoperative monitoring for signs of hemolysis and providing adequate pain management are integral components of ensuring favorable outcomes in this patient population.

This case underscores the successful completion of robotic radical hysterectomy in a patient with a history of G6PD deficiency, highlighting the importance of meticulous perioperative management. By implementing proactive measures and close interdisciplinary collaboration, including a thorough medication review and intraoperative precautions to minimize oxidative stress, the patient underwent surgery without any complications related to her G6PD deficiency. The effective navigation of surgical challenges in this case underscores the significance of tailored perioperative planning and emphasizes the potential for favorable outcomes in patients with G6PD deficiency undergoing surgical procedures.

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