

## Case Report

### *Insulin Resistance in a Nondiabetic Patient Aggravated After Coronary Artery Bypass Grafting: A Case Report*

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#### ABSTRACT

Hyperglycemia in hospitalized patients presents a significant challenge, as it is linked to adverse clinical outcomes such as heightened infection risks, delayed wound healing, cardiovascular complications, and extended hospital stays. Research indicates that factors like underlying medical conditions, physiological stress, and certain medications contribute to elevated blood sugar levels in these patients. Additionally, transient insulin resistance worsens hyperglycemia in both diabetic and nondiabetic individuals, underscoring the need for meticulous management—especially in post-cardiac surgery settings, where complication risks are elevated. Although insulin resistance is a well-documented phenomenon, its occurrence in patients undergoing coronary artery bypass grafting (CABG) is relatively rare. This case study details the successful management of a 67-year-old woman with hypertension and hyperlipidemia but no prior history of diabetes, who developed insulin resistance following CABG. The article underscores the significance of recognizing insulin resistance and implementing appropriate postoperative interventions, highlighting the necessity for a tailored care strategy after CABG. (*Iranian Heart Journal 2025; 26(2): 77-81*)

**KEYWORDS:** Coronary artery bypass grafting, Insulin resistance, Diabetes

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**Received:** April 3, 2024

**Accepted:** July 15, 2024

Cardiovascular diseases pose a substantial threat to human health, contributing to high rates of global morbidity, mortality, and disability.<sup>1</sup> With the rising number of cardiovascular surgeries among elderly patients, this demographic faces an increased risk of postoperative complications, making it essential to optimize potential risk factors. Diabetes, a well-established risk factor for cardiovascular disease, is prevalent among patients undergoing coronary artery bypass grafting (CABG).<sup>2,3</sup> Research has explored the role of

insulin resistance (IR) in patients undergoing cardiac surgery,<sup>4,5</sup> driven in part by evidence linking IR indices to the severity of coronary artery disease (CAD)<sup>6</sup> and the progression of coronary atherosclerosis.<sup>7</sup>

Nonetheless, only a limited number of studies have focused on investigating IR indices during cardiac surgery. CABG, a common treatment for CAD, can be complicated by factors such as carbohydrate metabolism disorders and IR. IR plays a significant role in the development and progression of various diseases, including cardiovascular

conditions.<sup>8</sup> Over a century has passed since insulin was first recognized as a critical regulator of blood sugar levels, vasodilation, cell growth, and protein metabolism. When tissues exhibit reduced responsiveness to insulin, IR ensues—a condition marked by diminished sensitivity, impaired glucose regulation, and often elevated insulin levels to maintain blood sugar stability.<sup>9</sup> IR is a critical factor that can substantially elevate blood glucose levels, hindering postoperative healing and increasing susceptibility to complications such as infections, delayed wound recovery, and potential graft failure. While some individuals with IR may remain asymptomatic for extended periods without experiencing hyperglycemia, these issues can emerge under specific stressors, particularly during major surgical procedures. A recent study investigated the effects of carbohydrate metabolism disorders and IR on complication rates following CABG in patients with CAD. Notably, the study identified IR in a nondiabetic patient undergoing CABG, highlighting the importance of addressing this condition as part of the comprehensive management of CAD patients.<sup>10</sup>

The present case report highlights the potential impact of IR on CABG outcomes in patients with CAD. Further research is necessary to better understand the relationship between carbohydrate metabolism disorders, IR, and postoperative complications in this patient population. By taking these factors into account, healthcare providers can enhance the care and outcomes of patients who have undergone CABG.

## CASE PRESENTATION

A 67-year-old woman, weighing 87 kg and measuring 160 cm in height, presented to the emergency department with unstable angina. Her medical history included chronic hypertension and hyperlipidemia. Urgent coronary angiography revealed 100%

stenosis of the left anterior descending artery (LAD) and 80% stenosis of the right coronary artery. An attempt at percutaneous coronary angioplasty for the LAD was unsuccessful, prompting a referral for CABG. Preoperative medications included aspirin, captopril, metoprolol, and atorvastatin. Prior to surgery, it is essential to conduct biochemical tests to assess the patient's overall health. In this case, all biochemical tests, including kidney and liver function tests, were within normal limits, indicating good overall health and suitability for surgery. Preoperative transthoracic echocardiography showed mild mitral valve prolapse without signs of regurgitation and mild superior tricuspid regurgitation. Following comprehensive monitoring, including ECG, pulse oximetry, and invasive blood pressure measurement, the patient was anesthetized using midazolam (10 mg), fentanyl (500 µg), and cis-atracurium (10 mg). Tidal volume and respiratory rate were adjusted accordingly. A 3-lumen internal jugular central venous catheter was inserted and secured for the patient. Anesthesia was maintained with an infusion of midazolam (2 mg/kg), fentanyl (100 µg/h), and atracurium (5 mg/h), while cerebral oximetry was used for additional monitoring. Following the initiation of the procedure, heparin was administered at a dose of 400 U/kg, and an activated clotting time <500 seconds was achieved. The patient was then placed on cardiopulmonary bypass. The left internal mammary artery and saphenous vein were harvested, and CABG was performed. At the conclusion of the surgery, she was weaned off the heart pump with the assistance of epinephrine (0.1 µg/kg) and norepinephrine (0.5 µg/kg). After ensuring hemostasis and closing the sternum, the patient was transferred to the open-heart ICU. During the procedure, she received 2 units of packed red blood cells, 2 units of platelets, and 2 units of fresh frozen plasma. The patient maintained

stable hemodynamics in the open-heart ICU. In the ICU, the endotracheal tube was successfully removed after 4 hours. Nevertheless, on the second day, laboratory tests revealed that the patient had developed mild metabolic lactic acidosis, with  $p\text{CO}_2$  at 28 mm Hg, bicarbonate at 18 mmol/L, and arterial pH at 7.25 (normal range: 7.35–7.45). She was administered 100 mEq of sodium bicarbonate twice, but her acidosis worsened. Her urinary output remained within the normal range ( $>1$  mL/kg/h), and no abnormalities were detected in her biochemical tests. Central venous pressure was measured at 8 mm Hg, and a portable chest X-ray showed no issues. Her blood pressure increased to 180/90 mm Hg. During the discontinuation of inotropes and with normal hemoglobin levels, no physical or hemodynamic signs indicative of metabolic disturbances were observed. Furosemide and nitroglycerin were administered to manage her condition. However, her blood glucose level rose above the normal range, reaching 180 mg/dL. Her serum creatinine remained stable at 0.9 mg/dL (normal range: 0.7–1.2 mg/dL), and her potassium levels were within the normal range. Based on consultations with a nephrologist and internal medicine specialist, it was recommended to measure her insulin levels, which revealed hyperinsulinemia (elevated blood insulin levels).

Given the possibility of IR, insulin therapy was initiated at a dose of 2 U/h, diluted in a 5% dextrose solution. The patient's blood sugar and arterial blood gas levels were monitored hourly. After 6 hours, her arterial blood gas parameters returned to normal. Following 2 days of hospitalization, she was discharged in good overall condition.

## DISCUSSION

This report details the comprehensive treatment approach for a 67-year-old female patient with central obesity, hypertension,

and hyperlipidemia. These conditions initially complicated her management during the first 48 hours due to unexpected and complex IR. After her hospital admission, a carefully tailored management strategy was implemented to address post-CABG IR. Through this targeted approach, her condition improved significantly, resulting in a successful discharge with positive overall health outcomes.

IR is a complex metabolic disorder that plays a significant role in the development and progression of type 2 diabetes and related conditions. The onset of IR following surgery presents a considerable challenge to the healthcare system, requiring effective and targeted management strategies. A key mechanism driving IR involves the upregulation of pro-inflammatory cytokines, such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF- $\alpha$ ). These cytokines disrupt insulin signaling pathways by activating serine kinase instead of tyrosine kinase, which impairs cellular glucose uptake and utilization. This interference disrupts normal glucose homeostasis and plays a critical role in the development of type 2 diabetes and related metabolic disorders. The upregulation of these cytokines is a significant factor in the pathogenesis of IR, highlighting their importance in understanding and managing this condition. Targeting the inflammatory pathways associated with IR offers potential for developing innovative therapeutic strategies to manage and prevent IR and its related complications.<sup>11,12</sup> In their study, Yokoyama et al,<sup>13</sup> described a case of severe IR requiring a 24-hour infusion of 90,000 units of insulin to treat diabetic ketoacidosis and cardiogenic shock in a patient with long-standing type 2 diabetes. Although the patient experienced transiently low pH levels, the investigation found no significant impact on insulin binding, activity, or degradation rates. Additionally, the absence of auto-insulin

antibodies and insulin receptor antibodies in the patient made it challenging to identify the exact mechanism responsible for the observed IR. When comparing the current study with this evaluation, it is clear that the patient in our case experienced a relatively brief episode of IR. This significant difference highlights the complexities involved in managing severe IR cases. While Yokoyama et al<sup>13</sup> emphasized the challenges associated with such scenarios, our patient's case underscores the need for further research to better understand the mechanisms driving IR in individuals with diabetes. Recent studies have revealed a complex relationship between myocardial infarction and IR,<sup>14,15</sup> uncovering an intricate pathophysiological landscape where subclinical cellular oxidative damage plays a critical role. Ohta et al<sup>16</sup> explored the underlying mechanisms of severe IR in the context of cardiac ischemia. Through carefully designed experiments on mice with cardiac ischemia and a control group, the researchers provided compelling evidence of how ischemic injury disrupts insulin signaling pathways. Additionally, proactive monitoring of free fatty acid levels before surgery can provide valuable insights into the patient's metabolic profile, helping to predict potential postoperative complications. Targeted interventions designed to address elevated free fatty acids, such as strategies to improve insulin sensitivity, show promise in enhancing patient outcomes and reducing the risk of postoperative complications.<sup>17</sup> In summary, the link between free fatty acids and adverse outcomes following CABG highlights the importance of addressing metabolic factors in perioperative care.

## CONCLUSIONS

This case report explored the management of a nondiabetic patient who developed IR after cardiac surgery. Through a collaborative effort among healthcare professionals, the

patient achieved full recovery and was successfully discharged. The study underscores the significance of thorough preoperative clinical assessment and effective coordination by the anesthesia team during the patient's 48-hour hospitalization following CABG. Such rare occurrences, due to their complexity, demand meticulous medical attention. This report provides a detailed account of comprehensive care as a practical framework for similar cases.

## Conflict of Interest

The authors of this article declare no conflicts of interest.

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