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Original Research Article

Impact of uremia on early sternal dehiscence after cardiac surgery in obese patients with uncontrolled diabetes

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Abstract

Background & Methods: Sternal dehiscence is the partial or complete separation of the sternum after a median sternotomy, which is a common approach in cardiac surgeries like coronary artery bypass grafting (CABG) or valve replacements. This is a serious complication because it can lead to significant morbidity, infection, prolonged hospital stay, and even mortality.

Results: CABG on pump and CABG and valve replacement/repair combined has the highest risk for sternal dehiscence, suggesting that these procedures might require extra caution regarding wound healing. Mitral Valve Repair had no cases of sternal dehiscence, suggesting it may be a safer procedure in terms of chest wound healing compared to others. Overall, the sternal dehiscence rate in this group of procedures is 5.3%, indicating that while it's a potential complication, it's not highly prevalent across all surgeries.

Conclusion: Uremia significantly impacts various physiological systems, many of which directly contribute to an increased risk of early sternal dehiscence after cardiac surgery. Management of these risks involves careful monitoring of renal function, careful surgical technique to minimize trauma, and ensuring adequate postoperative care to prevent infection and bleeding. Some strategies that could reduce the incidence include preoperative dialysis optimization, use of systemic anti-inflammatory agents, and improved wound management protocols.

Keywords: Uremia, sternal, dehiscence, cardiac & surgery.

Study Design: Observational Study.

Introduction

Postoperative wound reopening is still a serious and potentially fatal complication following heart surgery, even with advancements in surgical methods, anesthetic, and antimicrobial therapy [1]. Up to 5% of patients experience sternal wound infection, which can result in sternal wound dehiscence. Mediastinitis has been documented to occur in 0.8% to 2.3% of individuals. With a mortality rate of up to 8.1%, postoperative mediastinitis is one of the most dreaded side effects in patients after heart surgery.
the cause of uremia, a disorder marked by high blood levels of urea and other nitrogenous

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waste products [2]. Numerous physiological factors, such as sternal dehiscence during heart surgery, might have a substantial impact on surgical results [3].

Impaired collagen synthesis with uremia: Uremia disrupts the metabolism and production of collagen, which is essential for wound healing. Following surgery, collagen is required to preserve the structural integrity of tissues, including the sternum [4]. Wound dehiscence is more likely when collagen production is inadequate.

Microvascular dysfunction: Endothelial function is compromised by uremia, which lowers blood flow to the wound site. The likelihood of sternal separation may rise as a result of the reduced perfusion, which may further hinder the healing process [5].

Uremia arises when the kidneys fail to adequately filter waste products from the blood, leading to elevated levels of urea and other nitrogenous substances. This condition is commonly associated with chronic kidney disease (CKD), acute kidney injury (AKI), or end-stage renal disease (ESRD), often necessitating treatments like hemodialysis[6]. Uremia has a broad range of systemic effects on the body, affecting various organs and physiological processes, including immune function, wound healing, coagulation, and nutritional status. These disturbances can significantly impact surgical outcomes, particularly in patients undergoing cardiac surgery[7].

Material and Methods

Patients who were obese (BMI more than 30) and had uncontrolled diabetes preoperatively were included in the study. They were further grouped on the basis of presence of uremia. And incidence of partial and complete sternal dehiscence within 30 days of surgery were recorded.

Inclusion Criteria:

1. Adult patients (≥ 18 years) who have undergone open cardiac surgery involving median sternotomy (such as CABG, valve replacement).
2. Uremic patients: Defined as those with chronic kidney disease (CKD), acute kidney injury (AKI), or end-stage renal disease (ESRD) requiring dialysis (either preoperatively or postoperatively).
3. Control group: Non-uremic patients undergoing the same types of surgery, matched by factors such as age, comorbidities, and surgery type.

Exclusion Criteria

1. Patients with active infections at the time of surgery.
2. Reoperative surgeries where a second sternotomy is involved.
3. Pediatric patients.
4. Patients who received non-sternotomy surgical approaches.

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5. Patients with peripheral vascular disease, cancer or on steroids, NSAIDS or immunosuppressive drugs.

Statistical Analysis:

A chi-square test was used to compare the proportion of early sternal dehiscence in patients with and without uremia, calculation done by IBM SPSS 20.0. Patients who have undergone cardiac surgery (e.g., coronary artery bypass grafting [CABG], valve replacement).

Result

Table No. 1: Demographic Profile

S. No.	Parameter	Mean	SD
1	Age	65.3	11.7
2	BMI	33.5	2.6
3	Hospital stay (days)	24.6	3.9
4	eGFR (mL/min/1.73m²)	21.6	5.8
	HbA1C	8.1	
5	Gender	No.	Percentage
	Male	62	50.5
	Female	61	49.5

The sample consists of patients with a range of ages (65.3 ± 11.7 years), mostly overweight/obese (BMI of 33.5 ± 2.6). They had an extended hospital stay (24.6 ± 3.9 days) and significantly impaired kidney function (eGFR 21.6 ± 5.8). All the participants had diabetes, with elevated HbA1C levels (mean 8.1%). Gender distribution is almost equal between males and females.

Table No. 2: Surgical procedure in obese and uncontrolled diabetes

S. No.	Surgical procedure	No.	Percentage
1	CABG off pump	36	18.5
2	CABG on pump	17	8.7
3	Mitral valve replacement	27	13.9
4	Mitral valve repair	08	4.1
5	Aortic valve replaement	15	7.7
6	Aortic valve repair	02	1.0
7	CABG and valve replacement/repair combined	18	9.2
	Total	123	

The most common surgical procedure in this group is CABG off pump (18.5%), followed by Mitral Valve Replacement (13.9%). The least common procedures are Aortic Valve Repair (1.0%) and Mitral Valve Repair (4.1%). A significant proportion of patients also had combined procedures involving both CABG and valve replacement/repair (9.2%).

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This distribution gives an insight into the surgical needs of the sample, highlighting a preference for coronary bypass surgeries, particularly off-pump, and heart valve replacements.

Table No. 3: Surgical procedure

S. No.	Surgical procedure	Number of patients with uremia	Number of patients with no uremia
1	CABG off pump	05	31
2	CABG on pump	03	14
3	Mitral valve replacement	05	22
4	Mitral valve repair	01	07
5	Aortic valve replacement	07	08
6	Aortic valve repair	02	00
7	CABG and valve replacement/repair combined	06	12
	Total	29	94

Uremia appears to be more common in certain types of surgeries, especially those involving valve replacement (particularly aortic valve replacement) and combined procedures. For procedures like CABG off pump and Mitral Valve Repair, uremia is less common, suggesting these surgeries might be associated with better kidney function or a lower risk of developing uremia post-surgery.

Table 4: Incidence of sternal dehiscence in patients with uremia

S. No.	Surgical procedure	Number of patients with uremia (A)	Incidence of sternal dehiscence (B)	Percentage (B*100/A)	P Value
1	CABG off pump	05	03	60	.049644
2	CABG on pump	03	02	66. 7	
3	Mitral valve replacement	05	01	20	
4	Mitral valve repair	01	00	00	
5	Aortic valve replacement	07	01	14.2	
6	Aortic valve repair	02	01	50	
7	CABG and valve replacement/repair combined	06	00	00	
	Total	29	08	27.5	

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The table suggests that CABG procedures (both on and off pump) are more likely to result in uremia, with CABG on pump having the highest rate. Meanwhile, procedures like Mitral Valve Repair seem to have a much lower incidence of uremia. The combined CABG and valve procedure appears to be a significant risk factor, as all patients in this group developed uremia. The chi-square statistic is 4.0983. The *p*-value is .049644. The result is significant at $p < .05$. The rate of sternal dehiscence is 27.5% in the uremic group.

Table 5: Incidence of sternal dehiscence in patients without uremia

S. No.	Surgical procedure	Number of patients with no uremia (A)	Incidence of sternal dehiscence (B)	Percentage (B*100/A)	P Value
1	CABG off pump	31	01	3.1	.040188
2	CABG on pump	14	01	7.1	
3	Mitral valve replacement	22	01	4.5	
4	Mitral valve repair	07	00	00	
5	Aortic valve replacement	08	01	1.0	
6	Aortic valve repair	00	00	00	
7	CABG and valve replacement/repair combined	12	01	8.3	
	Total	94	05	5.3	

The chi-square statistic is 3.0403. The *p*-value is .040188. The result is significant at $p < .05$.

CABG on pump and CABG and valve replacement/repair combined has the highest risk for sternal dehiscence, suggesting that these procedures might require extra caution regarding wound healing. Mitral Valve Repair had no cases of sternal dehiscence, suggesting it may be a safer procedure in terms of chest wound healing compared to others. Overall, the sternal dehiscence rate in this group of procedures is 5.3%, indicating that while it's a potential complication, it's not highly prevalent across all surgeries.

Discussion

Early sternal dehiscence after cardiac surgery remains a significant postoperative complication, particularly following median sternotomy procedures like coronary artery bypass grafting (CABG) and valve replacements[8]. This condition involves the separation of the sternum, which can lead to severe consequences, including infection, delayed recovery, and in some cases, mortality. Patients with uremia condition characterized by elevated levels of nitrogenous waste products in the blood due to impaired renal function are at a heightened risk for various postoperative complications[9-10]. The effect of uremia on early sternal dehiscence is complex and multifactorial, involving impaired wound healing, immune dysfunction, coagulopathy, and other physiological disturbances. Percentage of sternal dehiscence significantly increase in uremic group as compared to the control. It shows that

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the detrimental effect of uremia on wound healing exaggerates in patients with high BMI and uncontrolled diabetes.

Although improvements in modern cardiothoracic surgery have resulted in markedly better results, sternal wound infection is still one of the most dangerous postoperative consequences in heart surgery [11-14]. More surgeries are being performed on patient populations with comorbidities that previously made them ineligible for cardiac intervention.

Conclusion

Uremia significantly impacts various physiological systems, many of which directly contribute to an increased risk of early sternal dehiscence after cardiac surgery. Management of these risks involves careful monitoring of renal function, careful surgical technique to minimize trauma, and ensuring adequate postoperative care to prevent infection and bleeding. Some strategies that could reduce the incidence include preoperative dialysis optimization, use of systemic anti-inflammatory agents, and improved wound management protocols.

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