Subxiphoid incisional hernias post median sternotomy: A literature review

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Abstract

Background: Subxiphoid incisional hernias are one of the complications following a median sternotomy, a surgical procedure to provide access to the mediastinum. Incidence has been reported between 1% and 4%, although the true incidence is not well known due to its asymptomatic nature.

Method: A comprehensive search was performed on multiple sites. Keywords included “incisional hernia OR Subxiphoid hernia” AND “Median sternotomy OR Cardiac Surgery OR Coronary artery bypass graft OR Transplant OR Valve replacement”. Articles up to August 1, 2020, were included in this study.

Results: Eight articles were included in the study, with a total number of 132 patients identified. The incidence ranged from 0.81% to 3.44%. There was a mixture of repair methods and follow-up period reported. Recurrence post repair ranged from 10% to 43%.

Conclusion: Subxiphoid incisional hernias remain challenging to manage. We have discussed the incidence, risk factors, preventions, and management of subxiphoid incisional hernias including both the open and laparoscopic techniques.

KEYWORDS
incisional hernia, literature review, subxiphoid hernia

1 | INTRODUCTION

Subxiphoid incisional hernias (SIH) are a recognized complication following a median sternotomy. SIH is known to be difficult to repair and therefore associated with a high rate of recurrence.1-3 SIH occurs due to a defect created during median sternotomy. The defect mainly occurs in the caudal part of the sternotomy that allows protrusion of tissue such as fat or bowel. But the reported incidence of SIH is relatively low, at 1%-4.2%,4 the true incidence is not fully understood due to their asymptomatic nature, and the tendency to recur post repair.5 Several articles have been reported their experiences of minimizing the risk of developing SIH as well as open and laparoscopic repair of SIH. We, therefore, aim to perform a literature review to summarize the existing shreds of evidence available in the research field.

2 | METHOD

A comprehensive search was performed on PubMed, Ovid, SCOPUS, EMBASE, Cochrane library, and Google Scholar. The search terms included “incisional hernia OR Subxiphoid hernia” AND “Median sternotomy OR Cardiac Surgery OR Coronary artery bypass graft OR Transplant OR Valve replacement”. Articles up to August 1, 2020, were included in this study.
sternotomy OR Cardiac Surgery OR Coronary artery bypass graft. Articles published before August 1, 2020, were included in this study. All types of publications were included for review. The references of the identified articles were then searched for any potential articles that can be included. A literature search was performed by two reviewers (Joshua McKenna and James O’Hanlon) independently. A further review was performed by the third reviewer (Jeremy Chan). Articles that discussed the incidence and the management of SIH were included. Case reports, expert opinion, editorials, duplicates studies, and conference abstracts were excluded. This study is exempted from the informed consent and International Review Board review as this literature only involved the analysis of existing data that are publicly available.

3 | RESULTS
Eight articles were included in the study. The incidence of SIH, number of patients included, repair method, recurrence rate, and follow-up data were summarized in Table 1. All studies were performed retrospectively, with a total number of 132 patients included in the study ranged from 4-45. All 132 patients underwent median sternotomy for coronary artery bypass grafting, valve replacement, or cardiac transplant. The incidence reported in three out of eight articles ranged from 0.81% to 3.44%. There was a mixture of repair methods and follow-up period reported. Recurrence post repair ranged from 10% to 43%, this is likely due to the small sample size included in the study.

4 | DISCUSSION
4.1 | Anatomy and challenges in repairing
Subxiphoid hernias generally occur in the midline and are inferior to the tip of the xiphoid. According to the European Hernia Society classification, SIH occurs within 3 cm of the xiphoid and are terms midline (M)1 hernias. Subxiphoid incisional hernias can occur either on or off the midline although in the midline is more common.

Figure 1 demonstrates the anatomy of subxiphoid incisional hernia on computed tomography images. Intraoperative photo of a subxiphoid hernia is shown in Figure 2.

SIH repair presents several challenges. First, the shearing forces generated by the muscular attachments results in high intra-abdominal pressures. This tension is further enhanced by an anatomical variant bifid xiphoid process or by dividing the xiphisternum surgically. The high pressure in the subxiphoid region makes repair under minimal tension and approximation of the medial borders of the anterior sheath difficult and increases the risk of dehiscence. Second, the close proximity of the ribs, diaphragm, and central tendon make securing a mesh more difficult compared with other types of hernia repair. This is made more challenging if a hypoplastic xiphoid process is present as there is only a small retro-xiphoid space available. Lastly, the xiphoid process has vascular supply from the xiphoid artery, a terminal branch of the internal thoracic artery, and from a branch of the superior epigastric artery. Blood supply may be compromised to this area if damage occurs to the internal thoracic or superior epigastric arteries so care must be taken during surgery.

4.2 | Incidence
An incisional hernia is a common complication of abdominal operations, affecting 10%–26% of patients. However, incisional hernias following a median sternotomy are less well reported than their abdominal counterparts. The incidence of subxiphoid incisional hernias has been reported ranged between 1% and 4.2%. Although most agreed that the true incidence is unknown due to the asymptomatic nature.

| First author, Year | Incidence of SIH | Number of patients | Repair method | Follow-up period (months) | Recurrence n(%) |
|-------------------|-----------------|--------------------|--------------|--------------------------|----------------|
| Bouillot, 1997⁶    | NS              | n = 23             | Open repair with mesh | 12–60                    | 3 (13.04)      |
| Cohen, 1985⁷       | NS              | n = 14             | Open repair with mesh | 4–36                     | 0 (0)          |
| Davidson, 1987⁴    | 3.44% (20/582)  | n = 8              | Open repair with direct suture closure | 8–43                     | 0 (0)          |
| de Mesquita, 2017⁷ | NS              | n = 15             | Open repair with mesh | 7–33                     | 0 (0)          |
| Eisenberg, 2008⁸   | NS              | n = 4              | Laparoscopic repair with mesh | 6                        | 0 (0)          |
| Kim, 2012¹        | 0.81% (13/1599) | n = 13             | Open repair with direct suture closure | 3–84                    | 0 (0)          |
| Landau, 2001²     | 1.02% (10/984)  | n = 10             | Laparoscopic repair with mesh | 20–42                    | 1 (10)         |
| Mackey, 2005³      | NS              | n = 45             | Open repair with direct suture closure (n = 14) | 3–48                    | 6 (43)         |
|                    |                 |                    | Open repair with mesh (n = 21) |                              | 7 (33)         |
|                    |                 |                    | Laparoscopic repair with mesh (n = 10) |                              | 3 (30)         |

Abbreviations: NS, not stated, SIH, subxiphoid incisional hernia.
4.3 Risk factors

There is a variety in the reported risk factors for developing incisional hernias following a median sternotomy. The most commonly reported are obesity, wound infection, male sex, left-sided heart failure, long incisions (specifically > 18 cm), and repeat operations. Other, less-reported suggestions include a history of chronic obstructive pulmonary disease, diabetes mellitus, a positive smoking history, and postoperative bleeding—specifically, a transfusion requirement within 24 h of cardiac procedure was identified as an independent risk factor specifically for subxiphoid incisional hernia development.

A retrospective review suggested that a history of hernias could be a risk factor for developing further hernias, claiming that “hernias beget hernias,” so there is potentially cause for caution when operating on patients with a history of hernias.

4.4 Prevention of incisional hernias

Barner reported a technical modification of median sternotomy to reduce the incidence of SIH. It emphasizes a slightly shorter incision and avoids opening the linea alba by diverting the midline incision at the tip of the xiphoid process and connecting it with a stab wound made in the left xiphoidcostal angle, shown in Figure 3. Barner reported his experience in 2500 operations with no recorded incidence of subxiphoid or paraxiphoid incisional hernias.

Barner’s technical modification has been acknowledged and developed by multiple studies, suggesting that paraxiphoid extension of the sternotomy, reinforcement near the xiphoid end of the incision, optimizing closure of the distal sternotomy and the linea alba, and nonabsorbable aponeurotic suturing of the epigastrum may further improve the closure’s stability.

4.5 Management of subxiphoid incisional hernias

Several approaches have been reported to manage SIH. The treatment of the hernia follows basic principles that emphasize tension-free repair and all methods were performed under general anesthetic using appropriate prophylactic antibiotics.

4.5.1 Open, suture repair with tissue approximation

Davidson and Bailey reported their experience in managing SIH in 1987. Their management was based on the size of the defect. For
large subxiphoid hernias (>10 cm in diameter), Davidson and Bailey reported their experience using a double-door flap, applied to the subxiphoid defect area. His method was a modification of the Wells procedures. After the hernia sac was reduced, the flap was created based on the linea alba. The left flap created was mobilized and sutured to the right margin of the defect and vice versa, giving a double-layered repair. On the contrary, for small defects (<4 cm in diameter), a standard direct closure of the defect with nonabsorbable sutures were used instead.

4.5.2 | Open repair with mesh

Cohen et al. reported the first open repair of a subxiphoid hernia with a mesh in 1985. Dissection was done entirely extraperitoneal, to develop a plane between the posterior surface of the musculofascial layer and the peritoneum. It is worth noting that the peritoneum was only entered to free adhesions if necessary. The bifid xiphoid process was excised in the majority of patients. A polypropylene mesh was then placed and secured with sutures on the posterior rectus sheath deep to the rectus abdominus. The anterior sheath was then closed over the mesh with absorbable continuous sutures. A similar technique has been reported by Bouillot and Alexandre.

de Mesquita et al. reported a new repair technique in 2017. Instead of suturing the mesh between the posterior rectus sheath and the rectus abdominus muscle, they closed the rectus sheath using a continuous, nonabsorbable suture. The mesh was then applied over the mesh with absorbable continuous suture around the edge. Figures 4 and 5 illustrate the technique used by de Mesquita et al.

4.5.3 | Laparoscopic repair

Laparoscopic approach for SIH repair has been reported on three occasions. Landau et al. reported the first laparoscopic repair of subxiphoid hernia in 2001. A similar technique was reported by Mackey et al. and Eisenberg et al. It should be noted that the falciform ligament may need to be dissected to provide adequate exposure (Figure 6). After adhesiolysis, the mesh was fixated using sutures into the peritoneal cavity. Figure 7 demonstrates the placement of ports in the laparoscopic approach. Figures 8 and 9 show the intraoperative placement of the mesh.

4.5.4 | Comparisons of repair techniques and outcomes

The consistent outcome measure reported from the various methods for subxiphoid is the recurrence rate.

Recurrence of subxiphoid incisional hernias following surgical repair have been reported at various incidences, ranging from
Multiple factors can influence the risk of recurrence, particularly the surgical technique used for the primary repair; the recurrence in techniques using exclusively sutures for a repair ranged from 0% to 80%, whereas the use of mesh lowered the recurrence rate from 0% to 33%.\(^5\),\(^12\),\(^17\) A laparoscopic approach yields very similar results for the rate of recurrence 0%–30%.\(^2\),\(^3\),\(^8\).

In addition to a lower recurrence rate, laparoscopic repair reported a reduced postoperative stay, and need for pain control.\(^2\) This is likely due to the advantage in subfascial visualization of the epigastrium and edges of the defect, enabling the surgeon to circumferentially cover the defect, avoidance of the previous incision, and minimal tissue trauma.\(^3\),\(^8\) A major disadvantage of the laparoscopic approach is the steep learning curve that it presents which may attribute to a higher rate of recurrence before mastering the technique.\(^8\)

### 4.6 | Risk factors for recurrence

Aside from surgical technique, other risk factors for a hernia recurrence include sternal wound infections, with reports of 75% of patients developing recurrent hernias.\(^1\) Besides, reference has also been made to patients who are immunocompromised—notably transplant patients—due to their reduced capacity for wound-healing and, therefore, increased risk of infection.\(^3\)
4.7 | Limitations

There are several limitations to this literature study. First and most important, the available literature in the research field on SIH remains limited. This is most likely due to its asymptomatic nature and, hence underreporting. In addition to the small sample size, all eight studies included limited pre, intra, and postoperative variables. For example, the postoperative follow-up period varies leading to a variation of recurrence rate. Outcome measured cannot be compared directly.

5 | CONCLUSION

In conclusion, SIH post median sternotomy is rare, however, difficult to repair, and have a high risk of reoccurring.1–3 The true incidence remains poorly understood due to their asymptomatic nature.17 Risk factors, preventions, and several management techniques were discussed in this article.

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CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the Supporting Information Material of this article.

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