

# Prevalence of acute frozen shoulder with functional limitation following cardiac surgery: A descriptive study from Sri Lanka

Kurukulasuriya SAF<sup>1</sup>, Mettananda KCD<sup>1</sup>

*Journal of the Ceylon College of Physicians, 2023, 54, 113-117*

## Abstract

**Introduction:** A high incidence of frozen shoulder (FS), of up to 33% is reported in patients undergoing cardiac surgery, which is tenfold higher than in the normal population. Early diagnosis and treatment may prevent progression to chronic, treatment-resistant disease. However, data on the prevalence of acute FS following cardiac surgery in Sri Lanka is not known. The aim of this study was to identify the prevalence and associations of acute FS following coronary artery bypass graft with or without valve replacement in two cardiac surgical units in Sri Lanka.

**Methods:** We studied consecutive patients who underwent cardiac surgery from April 2022 to November 2022. Patients were recruited to the study before discharge from the hospital and were reviewed at 2 and 12 weeks following surgery. Acute FS was diagnosed in the presence of pain and limitation in lateral rotation, abduction, and medial rotation. Data on demographics and risk factors were collected using an interviewer-administered questionnaire.

**Results:** We studied 142 patients, 110 (77%) males, mean age of 60.3 SD years (range 28-78 years), 142 had coronary artery bypass grafting (CABG) and 3 of them additionally had valve replacement. Of them, 55 (38.7%) developed FS at 12 weeks post-surgery. Prevalence of FS was highest among the 50-60-year age group, 25 (45%). Development of post-surgical acute FS was more in patients with ischaemic heart disease (OR 5.5,  $p < 0.01$ ), hyper-

lipidaemia (OR 15.1,  $p < 0.01$ ), and who did not have regular post-op physiotherapy (6.1  $p < 0.01$ ).

**Conclusion:** More than one-third of patients undergoing cardiac surgery developed acute FS at 12 weeks. Patients with ischaemic heart disease, and hyperlipidaemia, and who did not engage in regular post-op physiotherapy were at high risk of developing acute FS.

**Key words:** adhesive capsulitis, frozen shoulder, post-cardiac surgery, LAM test

## Introduction

Frozen shoulder (FS)/adhesive capsulitis is defined by the American Academy of Orthopaedic Surgeons as “a condition of varying severity characterized by the gradual development of global limitation of active and passive shoulder motion where radiographic findings other than osteopenia are absent”. It is one of the most common causes of shoulder pain and disability and the lifetime prevalence of frozen shoulder is estimated to be 2 to 5 percent of the general population,<sup>1,2</sup> and its one-year prevalence rate is around 0.35% among adults aged 65 years and older.<sup>3</sup>

It is a severely restrictive condition of the shoulder, frequently precipitated by lack of use due to pain following an injury. Interestingly, the Upper Extremity Committee of ISAKOS defined the term “frozen

<sup>1</sup>Department of Pharmacology, University of Kelaniya, Sri Lanka.

Correspondence: SAFK, e-mail: [skurukulasuriya@kln.ac.lk](mailto:skurukulasuriya@kln.ac.lk)

 <https://orcid.org/0000-0001-8765-9366>

Received 16 June 2023, accepted 10 September 2023.



This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

shoulder” as idiopathic stiff shoulder, that is, without a known cause.<sup>4</sup>

The shoulder is not a single joint, but a complex arrangement of bones, muscles, ligaments, and tendons, that is more appropriately called the shoulder girdle. It is mainly made up of two joints, the acromioclavicular and the glenohumeral. The glenoid is shallow and flat. It is rimmed with a rubbery cartilage labrum that makes the socket deeper to fit the humeral head. The joint is surrounded by the capsule. The shoulder has a high range of movement. This increased flexibility makes the shoulder joint more prone to injury. One of the common problems that occur in the shoulder is FS.

Initially, it was thought that adhesive capsulitis progresses through a painful phase to a recovery phase, lasting one to two years with full resolution of symptoms even without treatment.<sup>5</sup> Recent evidence of persistent functional limitations, if left untreated, has changed this thinking.<sup>1</sup> Reeves, in a prospective study of 41 patients with 5-10 years’ follow-up, found that 39% had full recovery, 54% had clinical limitation without functional disability, and 7% had functional limitations.<sup>2</sup> Shaffer et al., showed that 50% of his 61 patients with frozen shoulder had some degree of pain and stiffness for an average of seven years after onset of the disease.<sup>6</sup>

The aetiology of frozen shoulder remains unclear and there remains a significant lack of understanding of the molecular mechanisms underlying this commonly encountered fibrotic disorder. Persistent fibroblast activation is an important mechanism for the development of chronic inflammation in soft tissue musculoskeletal conditions such as frozen shoulder.<sup>7</sup> Disagreement prevails about whether the underlying pathological process is an inflammatory condition, a fibrosing condition, or even an algo-neurodystrophic process.<sup>6</sup> FS is clinically categorized into three stages.<sup>8</sup>

Stage I: Patients could not actively move their shoulders due to acute pain, but a full range of passive movements is possible.

Stage II: Both active and passive movements of the shoulder are restricted.

Stage III: Shoulder pain is negligible, and patients could move their shoulders to a certain extent.

The diagnosis of a frozen shoulder is clinical. LAM test is a clinical test that can be used to diagnose frozen shoulder.<sup>8</sup> The LAM test looks for the presence of limitation in lateral rotation, abduction, and medial rotation of the shoulder joint in the patient. Sometimes

an ultrasound scan of the shoulder joint or an MRI of the shoulder joint may be needed when the diagnosis is not clear. Imaging reveals pathological changes occurring in the coracohumeral ligament, axillary fold, and rotator interval. Obliteration of the subcoracoid fat triangle also appeared to be pathognomonic.<sup>9</sup> Prevalence of post-cardiac surgery FS is reported to be as high as (33%) in a study in the United States.<sup>10</sup> Therefore, early detection of a frozen shoulder during early post-operative follow-up would help to take steps to treat the condition and this will help reduce discomfort to the patient. Moreover, early diagnosis with prompt referral and treatment may prevent progression to chronic, treatment-resistant adhesive capsulitis.<sup>8</sup> However, there is no data on the prevalence of post-cardiac surgery acute FS in Sri Lanka.

Therefore, we aimed to study the prevalence of acute FS among a sample of post-cardiac surgery patients in Sri Lanka to understand the gravity of the problem.

### Methods

We conducted an observational study in two private-sector cardiothoracic surgical units in Colombo, Sri Lanka from April 2022 to November 2022. Consecutive adult patients above 18 years of age who underwent cardiac surgery, and who had no history of previous shoulder pathologies such as adhesive capsulitis, autoimmune joint disease, or subacromial bursitis were recruited to the study. Patients were recruited to the study before discharge from the hospital and were reviewed at 2 and 12 weeks following surgery. The data was collected on key variables of interest from the patients, by face-to-face interviews using a standardized and validated questionnaire by a trained medical officer. The questionnaire included the demographic data of the patient, symptoms of frozen shoulder, details of comorbid diseases such as diabetes, hypertension, and hyperlipidaemia, type of cardiac surgery, number of postoperative visits, and regularity of physiotherapy follow-up post-surgery. FS was diagnosed in the presence of pain and limitation in lateral rotation, abduction, and medial rotation using the LAM test.<sup>7</sup> A pilot study was carried out on twenty patients. The LAM test was performed by a trained medical officer at the 2-week and 12-week routine follow-up visits after surgery. All patients with shoulder pain and a positive LAM test were seen by the consultant rheumatologist and treated.

Ethical approval for the study was obtained from the Ethics Review Committee of the Faculty of Medicine, University of Kelaniya, Ragama, Sri Lanka. Informed written consent was obtained from all the participants.

**Results**

We studied 142 post-cardiac surgery patients, looking for clinical features of the frozen shoulder at the 2-week and 12-week post-op visits. All 142 patients had coronary artery bypass grafting (CABG)

and 3 of them underwent valve replacement as well. Of the study population, 110 (77%) were males. The mean age was 60.3 SD years (range 28-78 years), The baseline characteristics of the patients are shown in Table 1.

**Table 1. Baseline characteristics of the study population**

	<i>Male n=110</i>	<i>Female n=32</i>	<i>Total n=142</i>
<b>Ethnicity, n(%)</b>			
Sinhala	47 (42.72)	6 (18.75)	53 (37.32)
Tamil	19 (17.27)	7 (21.88)	26 (18.30)
Muslims	34 (30.90)	12 (37.50)	46 (32.39)
Other	10 (9.09)	7 (21.87)	18 (12.67)
<b>Age category years, n(%)</b>			
40-50	9 (8.18)	3 (9.37)	12 (17.04)
50-60	45 (40.90)	14 (43.75)	59 (41.54)
60-70	46 (41.81)	13 (40.63)	59 (41.54)
>70	10 (9.09)	2 (6.25)	12 (8.45)
<b>Ischaemic heart disease n(%)</b>	85 (77.27)	20 (62.50)	105 (73.94)
<b>Dyslipidaemia, n(%)</b>	78 (70.90)	25 (78.12)	103 (72.53)
<b>Diabetes, n(%)</b>	52 (47.27)	19 (59.37)	71 (50.00)
<b>Hypertension, n(%)</b>	38 (34.54)	12 (37.50)	50 (35.21)
<b>HbA1C n(%)</b>			
≥7.0	52 (47.27)	19 (59.37)	71 (50.00)
6.1-6.9	17 (15.45)	7 (21.87)	24 (16.90)
≤6.1	41 (37.27)	6 (18.75)	47 (33.09)
<b>Total cholesterol (mmol/L), n(%)</b>			
≥6.2	78 (70.90)	25 (78.12)	103 (72.53)
5.1-6.1	23 (20.90)	5 (15.62)	28 (19.71)
≤5.1	10 (9.09)	2 (6.25)	12 (8.45)

**Table 2. Risk associations for developing post-cardiac surgery acute frozen shoulder**

Association	OR	p-value
IHD	5.54	0.019
Hypertension	0.44	0.508
Hyperlipidaemia	15.11	<0.01
Hypothyroidism	0.01	0.939
Diabetes	0.47	0.494
Age	1.15	0.284
Absence of regular post-op physiotherapy	6.11	0.013

Of the 142 patients, 55 (38.7%) developed FS at 12 weeks post-surgery. Prevalence of FS was highest among the 50-60-year age group (25.45%). Development of acute FS following cardiac surgery was higher in patients with ischaemic heart disease (OR 5.5,  $p < 0.01$ ), dyslipidaemia (OR 15.1,  $p < 0.01$ ), and in patients who did not undergo regular post-op physiotherapy (6.1  $p < 0.01$ ) Table 1. Of patients who had undergone regular physiotherapy following surgery, only 6 patients (11%) developed frozen shoulder. In contrast, 20 patients (36%) of those who did not have regular physiotherapy post-surgery developed frozen shoulder ( $p$  value  $< 0.01$ ).

### Discussion

We found that more than one-third of patients undergoing cardiac surgery developed acute FS at 12 weeks post-op. Patients with ischaemic heart disease, hyperlipidaemia, and those who were not engaging in regular post-op physiotherapy were at a higher risk of developing acute FS. This study highlights the importance of actively looking for the development of post-cardiac surgery acute FS as early treatment is known to be beneficial in these patients.

Our findings of the prevalence of acute FS following cardiac surgery were comparable with the study done in Chennai India.<sup>8</sup> In another study from the United States, Tuten et al. demonstrated a high incidence (33%) of adhesive capsulitis of the shoulder in male postcardiac surgery patients.<sup>10</sup> However, we did not find an association with diabetes mellitus or hypertension. The study by Chokkalingam et al., also done in an Asian population demonstrated a significant

association of the development of post-cardiac surgery FS with the above commonly implicated risk factors.<sup>8</sup> This study by Chokkalingam et al., was conducted in 2015. The knowledge and administration of newer antihypertensives and anti-diabetic agents resulting in better control of diabetes and high blood pressure may be responsible for the difference in results.<sup>11</sup>

Our study recognized hyperlipidaemia as a significant association of FS following cardiac surgery. A relationship between frozen shoulder and hypercholesterolemia is recognized in previous studies which were done in the general population.<sup>12-14</sup> The connecting link might be represented by the correlation between HDL and transforming growth factor beta (TGF- $\beta$ ): normally, HDLs stimulate TGF- $\beta$  expression; the latter is employed in the development of fibrous tissue.<sup>10</sup>

The underlying mechanism of the association of FS in post-cardiac surgery patients is difficult to explain, but may also be related to the increased age of the patients undergoing surgery and the presence of other risk factors such as diabetes, hypertension, and hyperlipidaemia.<sup>8</sup> Furthermore, patients in the post-operative period tend to restrict the movement of upper limbs due to fear of pain, which tends to precipitate the development of a frozen shoulder. Therefore, post-op physiotherapy plays a vital role during this period. Regular physiotherapy was associated with a significantly lower risk of developing a frozen shoulder. In this study, only 11% ( $n=6$ ) of the LAM test-positive patients belonged to the group with regular post-op physiotherapy. The physiotherapy involved graded stretching exercises starting from post-op day four onwards, gradually increasing in intensity for up to two months and beyond after surgery.

However, there are some limitations to our study. We have looked at the occurrence of FS in the first 12 weeks, but we did not study the long-term outcomes in patients, beyond 12 weeks.

### Conclusion

More than one-third of patients undergoing coronary artery bypass graft with or without valve surgery developed acute FS at 12 weeks. Patients with ischaemic heart disease, hyperlipidaemia, and those not engaging in regular post-op physiotherapy were at high risk of developing acute FS.

### Author declaration

#### Ethics approval

Approval from the Ethics Review Committee, Faculty of Medicine, University of Kelaniya.

**Competing interests**

None.

**Funding**

Grant from the University of Kelaniya.

**Authors' contributions**

SAFK: Conception, collection of data, analysis of data, and drafting of the manuscript and final approval. KCDM: Analysis of data, revision of the draft, and final approval of the version to be published.

**References**

- Ramirez J. Adhesive Capsulitis: Diagnosis and Management. *Am Fam Physician*. 2019; **99**(5): 297-300. PMID: 30811157.
- Reeves B. The natural history of the frozen shoulder syndrome. *Scand J Rheumatol*. 1975; **4**(4): 193-6. DOI: 10.3109/03009747509165255.
- Sarasua SM, Floyd S, Bridges WC, Pill SG. The Epidemiology and Etiology of Adhesive Capsulitis in the U.S. Medicare Population. *BMC Musculoskelet. Disord*. 2021; **22**: 828. DOI: 10.1186/s12891-021-04704-9.
- Itoi E, Arce G, Bain GI, et al. Shoulder Stiffness: Current Concepts and Concerns. *Arthroscopy* 2016; **32**(7): 1402-14. DOI: 10.1016/j.arthro.2016.03.024.
- Le HV, Lee SJ, Nazarian A, Rodriguez EK. Adhesive capsulitis of the shoulder: review of pathophysiology and current clinical treatments. *Shoulder Elbow* 2017; **9**(2): 75-84. DOI: 10.1177/1758573216676786.
- Shaffer B, Tibone JE, Kerlan RK. Frozen shoulder. A long-term follow-up. *J Bone Joint Surg Am*. 1992; **74**(5): 738-46. PMID: 1624489.
- Bunker TD, Anthony PP. The pathology of frozen shoulder. A Dupuytren-like disease. *J Bone Joint Surg Br*. 1995; **77**: 677-83.
- Chokkalingam M, Saradha S, Navitha A, Nayar PG. Incidence and clinical profile of patients with frozen shoulder after cardiac surgery. *J Clin Prev Cardiol*. 2017; **6**: 142-6. DOI: 10.4103/JCPC.JCPC\_17\_17
- Ryan V, Brown H, Minns Lowe CJ, Lewis JS. The pathophysiology associated with primary (idiopathic) frozen shoulder: A systematic review. *BMC Musculoskelet Disord*. 2016; **17**(1): 340. DOI: 10.1186/s12891-016-1190-9.
- Tuten HR, Young DC, Douoguih WA, Lenhardt KM, Wilkerson JP, Adelaar RS. Adhesive capsulitis of the shoulder in male cardiac surgery patients. *Orthopedics*. 2000; **23**: 693-6. DOI: 10.3928/0147-7447-20000701-16
- Sung CM, Jung TS, Park HB. Are serum lipids involved in the primary frozen shoulder? A case-control study. *J Bone Joint Surg Am*. 2014; **96**(21): 1828-33. DOI: 10.2106/JBJS.M.00936.
- Gumina S, Candela V, Castagna A, et al. Shoulder adhesive capsulitis and hypercholesterolemia: role of APO A1 lipoprotein polymorphism on etiology and severity. *Musculoskelet Surg*. 2018; **102**(1): 35-40. DOI: 10.1007/s12306-018-0557-5.
- Bunker TD, Esler CN. Frozen shoulder and lipids. *J Bone Joint Surg Br*. 1995; **77**(5): 684-6. PMID: 7559689.
- Liakos CI, Papadopoulos DP, Sanidas EA, et al. Blood Pressure-Lowering Effect of Newer Antihyperglycemic Agents (SGLT-2 Inhibitors, GLP-1 Receptor Agonists, and DPP-4 Inhibitors). *Am J Cardiovasc Drugs*. 2021; **21**(2): 123-37. DOI: 10.1007/s40256-020-00423-z.