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ORIGINAL RESEARCH

# Prevalence and Risk Factors of Adhesive Capsulitis in Asian Breast Cancer Patients Undergoing an Outpatient Community Cancer Rehabilitation Program

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**Abstract**

**Objectives:** To investigate the prevalence and risk factors for adhesive capsulitis in postoperative breast cancer patients up to 5 years after surgery who were attending an outpatient community cancer rehabilitation program, and to determine whether any significant relationship exists between arm lymphedema and adhesive capsulitis.

**Design:** Cross-sectional observational study.

**Setting:** National cancer rehabilitation center.

**Participants:** Asian women (N = 135) who underwent breast surgery and were referred for an outpatient community cancer rehabilitation program.

**Interventions:** Not applicable.

**Main Outcome Measures:** Presence of adhesive capsulitis, lymphedema.

**Results:** The prevalence of adhesive capsulitis and lymphedema in this population was 22.2% and 33.3%, respectively. A history of mastectomy (odds ratio [OR], 3.93; 95% confidence interval [CI], 1.23-12.63; $P = .021$), mastectomy with reconstruction (OR, 2.72; 95% CI, 1.27-30.54; $P = .024$), and lymphedema (OR, 7.92; 95% CI, 2.73-22.95; $P < .001$) were found to be significantly associated with adhesive capsulitis on multivariate analysis.

**Conclusions:** Adhesive capsulitis and lymphedema are common in breast cancer survivors. The design of cancer rehabilitation programs for breast cancer survivors should include surveillance and management of adhesive capsulitis, especially in the presence of lymphedema.

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Despite improved survival outcomes in breast cancer patients, which is the most common cancer among women in Singapore, morbidity remains high. Upper extremity dysfunction has been shown to be one of the most common complications after breast cancer surgery.[1-4] The prevalence of shoulder morbidity and mobility restriction has been reported to be 30% to 40%, even up to 5 years after surgery, depending on the method of assessment.[3,5-7] Restricted mobility and associated pain have also been shown to correlate with a lower health-related quality of life in breast cancer survivors, which persists in the long term.[2,3]

Adhesive capsulitis, also known as frozen shoulder, is a common cause of shoulder morbidity. Although believed to be self-limiting in nature, studies in the general population have revealed that between 20% and 50% of patients with idiopathic adhesive capsulitis develop long-lasting symptoms beyond 2 years.[8,9] Although breast cancer surgery is a well-established risk factor for adhesive capsulitis,[10,11] there is sparse literature on the prevalence in the breast cancer population. A prevalence of 7.7% of adhesive capsulitis has been reported in a population of women after breast surgery who were recruited during a postoperative

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period of 13 to 18 months,[10] whereas a retrospective study based on medical records indicated a lower prevalence of 3.8% in a cohort of patients who had undergone breast surgery in the previous 12 months or later.[12] Despite the fact that adhesive capsulitis may persist beyond 2 years, the long-term prevalence in breast cancer patients has not been well-described. This is surprising as effective physical and rehabilitative treatment modalities exist for both early and late stages of adhesive capsulitis.[13,14]

Studies have identified risk factors for general shoulder dysfunction after breast cancer surgery, including an older age, higher body mass index, preoperative breast pain, psychological disorders, type of surgery, axillary lymph node dissection, chemotherapy, and radiotherapy.[15-17] However, few studies have investigated the risk factors for the specific diagnosis of adhesive capsulitis in breast cancer patients. Some evidence suggests that an age of 50 to 59 years, presence of mastectomy, breast reconstruction, and lymph node dissection may be independent risk factors in this specific population.[10,12] A small study of 47 women with breast cancer-related lymphedema also suggests that lymphedema may result in a progressive pathologic shoulder effect.[18]

With an increasing survival rate and the use of rehabilitative services for upper limb dysfunction in breast cancer survivors, it is important to understand the prevalence and risk factors of adhesive capsulitis in patients attending rehabilitation services to guide the development of such survivorship programs.[19] Therefore, the aims of this study were to investigate the prevalence and risk factors for adhesive capsulitis in postoperative breast cancer patients up to 5 years after surgery in a national outpatient community cancer rehabilitation program, and to determine whether any significant relationship exists between arm lymphedema and adhesive capsulitis.

# Methods

## Participants

This was a cross-sectional observational study of Asian women who underwent breast surgery and presented at a national cancer rehabilitation center for an initial evaluation visit during the period from August 2017 to July 2019, after enrolling in an outpatient community cancer rehabilitation program run by the Singapore Cancer Society. This is the first and only outpatient multidisciplinary community cancer rehabilitation program currently available nationally in Singapore, and these breast cancer survivors were referred from clinical specialists or primary care physicians from local health care institutions after they had completed their acute oncological treatment. The national outpatient community cancer rehabilitation program provides comprehensive rehabilitation services with a physician-led multidisciplinary team, which includes physiotherapists, nutritionists, medical social workers, and psychologists. All participants had access to complex decongestive therapy that comprises manual lymph drainage, compression, exercises, and skin care at our cancer rehabilitation center. Patients were assessed by a rehabilitation physician, physiotherapist, and occupational therapist during their initial visit.

Patients were eligible for this study if they were 21 years of age or older and underwent surgery for breast cancer with a postoperative period of up to 5 years during the initial assessment visit. Patients were excluded if they had metastatic disease, glenohumeral osteoarthritis, previous shoulder joint trauma or shoulder surgery, inflammatory shoulder arthritis, and a previous history of adhesive capsulitis before oncological treatment. This clinical study was performed in accordance with the principles of the Declaration of Helsinki. This audit study was approved by the local institutional review board, Agency for Integrated Care (2019-009).

*List of abbreviations:*

| | |
|---|---|
| **ALND** | **axillary lymph node dissection** |
| **CI** | **confidence interval** |
| **OR** | **odds ratio** |
| **ROM** | **range of motion** |

## Evaluation of adhesive capsulitis

Goniometer-derived shoulder range of motion (ROM) was measured for forward flexion, abduction, and external rotation of both arms while the patient was in a sitting position. External rotation was measured at 0-degree shoulder abduction and 90-degree elbow flexion. A restriction of 30 degrees or more compared with the sound side indicated ROM restriction in that direction. A diagnosis of adhesive capsulitis was made if there was restricted passive ROM in 2 or more planes of movement, with normal radiographic findings.[20,21]

## Assessment of comorbidities and breast cancer treatment

Basic demographic and clinical information were collected from chart review and patient interview. Age, ethnicity, presence of diabetes mellitus, presence of thyroid disease, stage of breast cancer, and type of breast cancer treatment were recorded. Breast cancer surgery was categorized as either breast-conserving surgery or mastectomy with or without reconstruction. Lymph node surgery was categorized as either no surgery, sentinel lymph node biopsy, or axillary lymph node dissection (ALND).

## Assessment of lymphedema

Diagnosis of lymphedema was made clinically by a trained lymphedema physiotherapist. Lymphedema was diagnosed by arm-circumference measurements or self-reported symptoms. Patients who wore compression sleeves removed them 1 hour before the measurements were taken. An arm circumference of more than 2 cm between affected and non-affected side indicated presence of lymphedema.[22,23] Symptoms of lymphedema included whether or not a participant had noticed that her hand, lower arm, or upper arm on the side of the cancer was larger, puffier, or swollen.[22]

## Statistical analysis

Descriptive statistics were used to illustrate patient demographics and clinical characteristics. Logistic regression analyses were used for the univariate and multivariable analyses of the risk factors for adhesive capsulitis. The following variables were subjected to univariate analysis investigating their relationship with the presence of lymphedema: age, ethnicity, duration after surgery, history of diabetes mellitus and thyroid disease, type of breast cancer surgery, lymph node dissection, chemotherapy, radiotherapy, hormone therapy, targeted therapy, stage of cancer, and presence

of lymphedema. The type of breast cancer surgery, lymph node dissection, and presence of lymphedema, which were statistically significant on univariate analysis, were included as covariables in the regression analysis. A $P$ value of less than .05 was considered statistically significant for a 2-tailed test. Statistical analyses were performed using the Statistical Package for the Social Sciences, version 25.0.[a]

## Results

A total of 135 Asian women were recruited, after 5 were removed from analysis owing to the aforementioned exclusion criteria. Most of our patients were of an older age group, with the majority being 50 to 59 years old (33.1%) and 60 to 69 years old (33.8%). The majority were Chinese (88.9%), followed by Malay (8.9%) and Indian (2.2%). Although 45 patients (32.4%) presented at 1 year postsurgery, 50 patients (36.0%) were 2 years postsurgery, 14 patients (10.1%) were 3 years postsurgery, 23 patients (16.5%) were 4 years postsurgery, and 7 patients (5.0%) were 5 years postsurgery. There were 17 patients (12.6%) who had a diagnosis of diabetes mellitus, and 11 patients (8.1%) with thyroid disease. A majority had undergone mastectomy (53.3%) and had ALND (56.3%). Most patients had previous chemotherapy (75.6%), radiotherapy (61.5%), and hormone therapy (59.3%), with a minority receiving targeted therapy (3.0%). Most of the patients were also diagnosed with stage I (42.2%) or II (52.6%) breast cancer. A large proportion had lymphedema (33.3%), and 30 patients (22.2%) had adhesive capsulitis (table 1).

In univariate analysis, significant risk factors for adhesive capsulitis were a history of mastectomy (odds ratio [OR], 3.23; 95% confidence interval [CI], 1.12-9.33; $P=.30$), ALND (OR, 2.60; 95% CI, 1.06-6.36; $P=.037$), and the presence of lymphedema (OR, 6.40; 95% CI, 2.65-15.46; $P<.001$). However, age, ethnicity, duration postsurgery, presence of diabetes mellitus, presence of thyroid disease, chemotherapy, radiotherapy, hormone therapy, targeted therapy, and stage of cancer were not significant risk factors for adhesive capsulitis (table 2).

Upon performing multivariate analysis, the only significant risk factors for adhesive capsulitis were treatment with mastectomy (OR, 3.93; 95% CI, 1.23-12.63; $P=.021$), mastectomy with reconstruction (OR, 2.72; 95% CI, 1.27-30.54; $P=.024$), and the presence of lymphedema (OR, 7.92; 95% CI, 2.73-22.95; $P<.001$) (table 3).

**Table 1** Characteristics of study cohort

| Characteristics | All Patients n = 135 |
|---|---|
| Age at surgery, n (%) | |
| <40 years | 7 (5.2) |
| 41-49 years | 17 (12.6) |
| 50-59 years | 45 (33.3) |
| 60-69 years | 45 (33.3) |
| ≥70 years | 21 (15.6) |
| Ethnicity, n (%) | |
| Chinese | 120 (88.9) |
| Malay | 12 (8.9) |
| Indian | 3 (2.2) |
| Duration postsurgery, n (%) | |
| 1 year | 45 (33.3) |
| 2 years | 48 (35.6) |
| 3 years | 14 (10.4) |
| 4 years | 22 (16.3) |
| 5 years | 6 (4.4) |
| Diabetes mellitus, n (%) | 17 (12.6) |
| Thyroid disease, n (%) | 11 (8.1) |
| Type of breast cancer surgery, n (%) | |
| Breast conserving surgery | 47 (34.8) |
| Mastectomy | 72 (53.3) |
| Mastectomy with reconstruction | 16 (11.9) |
| Lymph node dissection, n (%) | |
| None or SLNB | 59 (43.7) |
| ALND | 76 (56.3) |
| Chemotherapy | 102 (75.6) |
| Radiotherapy | 83 (61.5) |
| Hormone therapy | 80 (59.3) |
| Targeted therapy | 4 (3.0) |
| Stage of cancer, n (%) | |
| 0 | 2 (1.5) |
| I | 57 (42.2) |
| II | 71 (52.6) |
| III | 5 (3.7) |
| Presence of lymphedema, n (%) | 45 (33.3) |
| Presence of adhesive capsulitis, n (%) | 30 (22.2) |

Abbreviation: SLNB, sentinel lymph node biopsy.

## Discussion

We found a prevalence of 22.2% of adhesive capsulitis in our study cohort, which was markedly higher than in other study populations. This is likely because the study was conducted in the setting of a cancer rehabilitation program, where patients would have presented with rehabilitation needs. In addition, some of these patients were relatively pain free and had learned to cope with their daily activities of living and would not have mentioned their shoulder ROM limitation if not for active screening during the initial multidisciplinary evaluation in the cancer rehabilitation program. Moreover, the high prevalence may be also owing in part to the high number of patients who had ALND (56.3%), mastectomies (53.3%) instead of breast conservation surgeries, and presence of lymphedema (33.3%), the latter of which has not been well-described in previous study populations investigating adhesive capsulitis.

There appears to be limited studies examining the prevalence of adhesive capsulitis in patients with breast cancer in the cancer rehabilitation setting. In addition, most studies have evaluated the restriction in ROM after breast surgery, rather than defining individual etiologies.[24-26] The high prevalence of adhesive capsulitis in this study is a compelling factor for a cancer rehabilitation program incorporating surveillance, evaluation, and management of adhesive capsulitis and other shoulder dysfunction in breast cancer survivors,[27] which may not take precedence in a busy oncology practice. This is important as various treatment modalities exist for adhesive capsulitis, including physical therapy interventions, pharmacologic agents, intraarticular steroid injections, hydrodilation, nerve blocks, and operative management.[13,14] Early diagnosis and management in the rehabilitative

**Table 2** Univariate analysis for adhesive capsulitis

| Characteristics | Odds Ratio | 95% CI | *P* Value |
|---|---|---|---|
| Age | | | |
| <40 years | 1.00 | | |
| 41-49 years | 1.29 | 0.110-15.00 | .841 |
| 50-59 years | 1.50 | 0.160-14.10 | .723 |
| 60-69 years | 2.18 | 0.238-20.04 | .491 |
| ≥70 years | 1.88 | 0.180-19.52 | .599 |
| Ethnicity | | | |
| Chinese | 1.00 | | |
| Malay | 1.27 | 0.319-5.03 | .737 |
| Indian | 7.60 | 0.662-87.24 | .103 |
| Duration postsurgery | 0.979 | 0.948-1.01 | .178 |
| 1 year | 1.00 | | |
| 2 years | 1.82 | 0.702-4.71 | .218 |
| 3 years | 1.09 | 0.251-4.75 | .908 |
| 4 years | 0.400 | 0.079-2.04 | .270 |
| 5 years | 0.800 | 0.083-7.73 | .847 |
| Diabetes mellitus | 1.55 | 0.499-4.81 | .448 |
| Thyroid disease | 0.762 | 0.156-3.73 | .737 |
| Type of breast cancer surgery | | | |
| Breast conserving surgery | 1.00 | | |
| Mastectomy | 3.23 | 1.12-9.33 | .030 |
| Mastectomy with reconstruction | 3.82 | 0.936-15.58 | .062 |
| Lymph node dissection | | | |
| None or SLNB | 1.00 | | |
| ALND | 2.60 | 1.06-6.36 | .037 |
| Chemotherapy | 1.08 | 0.416-2.81 | .872 |
| Radiotherapy | 0.773 | 0.339-1.76 | .539 |
| Hormone therapy | 1.25 | 0.539-2.88 | .607 |
| Targeted therapy | 0.00 | NA | NA |
| Stage of cancer | | | |
| 0-I | 1.00 | | |
| II-III | 1.75 | 0.748-4.10 | .197 |
| Presence of lymphedema | 6.40 | 2.65-15.46 | <.001 |

Abbreviation: NA, not available.

**Table 3** Multivariate analysis for adhesive capsulitis

| Characteristics | Odds Ratio | 95% CI | *P* Value |
|---|---|---|---|
| Type of breast cancer surgery | | | |
| Breast conserving surgery | 1.00 | | |
| Mastectomy | 3.93 | 1.23-12.63 | .021 |
| Mastectomy with reconstruction | 2.72 | 1.27-30.54 | .024 |
| Lymph node dissection | | | |
| None or SLNB | 1.00 | | |
| ALND | 0.908 | 0.303-2.72 | .863 |
| Presence of lymphedema | 7.92 | 2.73-22.95 | <.001 |

setting also allows for early resolution of shoulder stiffness and pain, and hence improves the long-term morbidity and quality of life of breast cancer patients.

It is also noteworthy that there was a high prevalence of adhesive capsulitis even though a significant proportion of our patients were assessed at more than 1 year after breast surgery. Although shoulder dysfunction has been widely reported in the first year after breast surgery,[28,29] late shoulder morbidity has not been widely reported. Our study adds to the growing consensus that late onset of shoulder morbidity beyond the first year can occur and has been found to range between 12% and 51%.[30,31] Moreover, patients have been reported to have residual pain and limited ROM for several years after the onset of adhesive capsulitis.[32] Although complete symptom resolution may not be achievable, improvement in function and mobility can still be realistic goals even if commencement of physiotherapy is delayed for as long as 6 months postoperatively.[9,33] These findings of a high prevalence of adhesive capsulitis may reflect our developing health care system in which cancer supportive and survivorship care is still in the early stages, and issues of care fragmentation, poor integration of rehabilitative services, passive engagement of community partners, and lack of specialized skill sets in survivorship care still remain.[34] This study highlights the need for a postacute rehabilitation model for the management of adhesive capsulitis and similar shoulder conditions in patients who have undergone breast surgery, especially in countries where such rehabilitative services do not exist.[35] Early identification through a survivorship and rehabilitative program is important, and timely intervention can reduce long-term shoulder morbidity.[33,36]

As many as 42% of breast cancer survivors may develop lymphedema,[37] although the association with adhesive capsulitis has not been well-described. In our study, we found that the presence of lymphedema was a significant risk factor for adhesive capsulitis. This is supported by the findings of Jang et al, who found a high prevalence of adhesive capsulitis (23.4%) in a cohort of patients with lymphedema.[18] An earlier study also found that 21.1% of patients with breast cancer-related lymphedema also had adhesive capsulitis. Several reasons have been hypothesized, including chemotherapy-induced fatigue, shoulder position for radiotherapy, and an inflammatory process during the early stages of lymphedema.[18] Chronic lymphedema is also believed to strain the rotator cuff musculature and lead to substantial immobilization, which is also a risk factor for adhesive capsulitis.[38] In addition, a study on shoulder kinematics found sizable limitations in external rotation in patients with arm lymphoedema,[39] reinforcing a possible biomechanical link with adhesive capsulitis. Fibrogenic, inflammatory, and angiogenic pathways have also been postulated to underpin both adhesive capsulitis and lymphedema.[40] The lack of association with diabetes mellitus and thyroid disorders in our study further affirm a unique pathomechanism for adhesive capsulitis independent of endocrine disorders in breast cancer survivors. Hence, the clinician is well-advised to assess for shoulder dysfunction in breast cancer patients with concurrent lymphedema.

The association between mastectomy and adhesive capsulitis has been well-reported.[10,11] Pain, scar formation, and pectoralis tightness are common after mastectomy, especially when compared with breast conserving surgery.[10] Breast reconstruction has also been reported to increase the risk of adhesive capsulitis,[10] which corroborated with our findings. The biomechanical derangements after surgery lead to stress of the joint capsule, predisposing the patient toward the development of secondary adhesive capsulitis. This is supported by findings of an abnormal shoulder girdle after breast cancer surgery in other studies.[41,42] Although older age has been reported to be associated with adhesive capsulitis,[10] we did not find it to be a significant risk factor, possibly because of our largely older study population.

## Study limitations

The first limitation of our study is its cross-sectional nature with a small number of patients recruited. Second, although the diagnosis of adhesive capsulitis can be made clinically, advanced shoulder investigations with ultrasound or magnetic resonance imaging were not performed to evaluate for concomitant shoulder pathologies, which may have predisposed to secondary adhesive capsulitis. Third, the diagnosis of lymphedema was made through arm circumference measurement, although alternative direct or indirect methods such as perometry, bioimpedance, or lymphoscintigraphy have gained traction in recent years. Fourth, we did not have further details on the dosage of radiotherapy received, as an arm or shoulder radiation dose of 15 Gy has been reported to be a risk factor for long-term shoulder morbidity owing to tissue fibrosis.[26] Lastly, we did not assess whether previous episodes of lymphedema, postsurgical or community-based rehabilitation interventions, occupational status, and current physical activity level were risk factors for adhesive capsulitis.[33,43]

## Conclusions

In conclusion, adhesive capsulitis is a common condition in breast cancer patients after breast surgery and can lead to considerable morbidity and impaired quality of life. Lymphedema can persist after surgery as well and can be associated with adhesive capsulitis. Cancer survivorship programs should not just focus on cancer surveillance, but they should also emphasize the early detection and management of physical rehabilitative challenges in breast cancer survivors, including shoulder dysfunction and adhesive capsulitis.

## Supplier

a. Statistical Package for the Social Sciences, version 25.0; IBM Corp.

## Keywords

Breast neoplasms; Community health services; Lymphedema; Rehabilitation; Survivorship

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