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Axillary web syndrome after axillary dissection

Alexander H. Moskovitz, M.D.[a], Benjamin O. Anderson, M.D.[a], Raymond S. Yeung, M.D.[a], David R. Byrd, M.D.[a], Thomas J. Lawton, M.D.[b], Roger E. Moe, M.D.[a,*]

[a]*Department of Surgery, Surgical Oncology Section, Bio-Clinical Breast Care Program, University of Washington, Box 356410, 1959 NE Pacific Street, Seattle, WA 98195, USA*

[b]*Department of Pathology, Bio-Clinical Breast Care Program, University of Washington School of Medicine, Seattle, WA, USA*

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Abstract

Background: Some patients undergoing axillary lymph node dissection (ALND) experience postoperative pain and limited range of motion associated with a palpable web of tissue extending from the axilla into the ipsilateral arm. The purpose of this study is to characterize the previously undescribed axillary web syndrome (AWS).

Methods: To identify patients with AWS, a retrospective review was performed of all invasive breast cancer patients treated by a single surgeon (REM) between 1980 and 1996. Records were also reviewed of 4 more recent patients who developed AWS after undergoing sentinel node lymph node dissection (SLND) without ALND.

Results: Among 750 sequentially treated patients, 44 (6%) developed AWS between 1 and 8 weeks after their axillary procedure. The palpable subcutaneous cords extended from the axillary crease down the ipsilateral arm, across the antecubital space, and in severe cases down to the base of the thumb. The web was associated with pain and limited shoulder abduction ($\leq 90°$ in 74% of patients). AWS resolved in all cases within 2 to 3 months. AWS also occurred after SLND. Tissue sampling of webs in 4 patients showed occlusion in lymphatic and venous channels.

Conclusions: AWS is a self-limiting cause of morbidity in the early postoperative period. More limited axillary surgery, with less lymphovenous disruption, might reduce the severity and incidence of this syndrome, although SLND does not eliminate its occurrence.

Keywords: Axillary pain; Axillary web syndrome; Mondor's disease; Axillary lymph node dissection; Postoperative morbidity

Axillary lymph node dissection (ALND) is a valued staging procedure for breast cancer, driving therapeutic decision making as it predicts recurrence risk and survival [1–4]. Unfortunately, ALND also has significant short-term and long-term operative complications including pain, numbness, swelling, weakness, and arm or shoulder stiffness [5–10]. Lymphedema, the most dreaded long-term complication of ALND, occurs in 7% to 37% of patients [5,7]. As a result, less traumatic staging procedures are now being used, most notably sentinel lymph node dissection (SLND) for early breast cancer.

We have observed a self-limited post-ALND pain syndrome occurring in a subset of breast cancer patients. This syndrome is characterized by axillary pain radiating down the ipsilateral arm, shoulder range-of-motion limitation, and an axillary web of tissue most obvious on postoperative physical examination when the patient tries to abduct her arm. We hypothesize that this axillary web syndrome (AWS) results from the disruption of superficial lymphatics and vessels during axillary surgery.

Methods

The senior author (REM) maintained a personal database of 750 consecutively treated or clinically evaluated breast cancer patients over the 16-year period 1980 to 1996. Review of this database revealed 44 patients with the signs and symptoms of AWS. In each of the 44 cases, the medical record was obtained, reviewed, and abstracted. Addition-

* Corresponding author. Tel.: +1-206-543-3053; fax: +1-206-543-8136.

E-mail address: rmoe@u.washington.edu.

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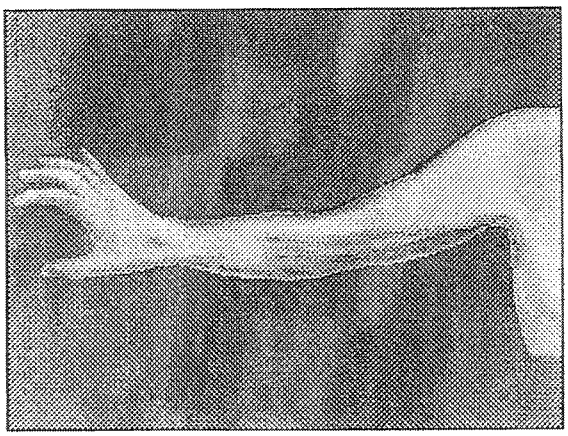

Fig. 1. Diagram of Axillary Web Syndrome. Demonstrates taut cords of tissue extending from mid axilla down the ipsilateral arm, across the antecubital space, and to base of the thumb.

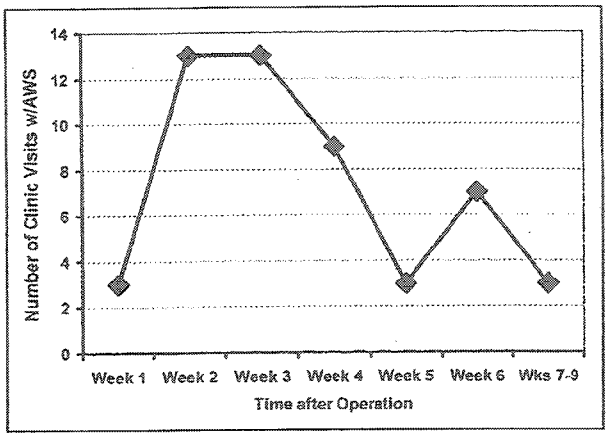

Fig. 2. Postoperative syndrome timing. Graphic representation of the number of clinic visits with documented AWS compared to the time after ALND.

ally, our surgical oncology group observed 4 patients who developed AWS after SLND for staging of early breast cancer. These charts were also obtained, reviewed, and abstracted.

Four of the AWS patients had surgical biopsies of their axillary webs. The pathologic results of these AWS biopsies were reviewed by our breast pathologist (TJL). All histologic analysis was done with standard light microscopy on hematoxylin and eosin stained, formalin-fixed tissue. Lymphatics were identified and defined as vessels without prominent medial smooth muscle, red blood cell components, or hemosiderin pigments. All similar thin-walled vessels with red blood cell components or hemosiderin were considered to be veins rather than lymphatics.

This retrospective chart review was approved by the University of Washington Human Subjects Committee.

Results

Physical characteristics of axillary web

The defining characteristic of this syndrome is a visible web of axillary skin overlying palpable cords of tissue that are made taut and painful by shoulder abduction (Fig. 1). The web is always present in the axilla and extends into the medial ipsilateral arm, frequently down to the antecubital space, and occasionally to the base of the thumb. Typically, there are two or three taut, tender, nonerythematous cords of tissue under the skin. Notably, the axillary web is neither immediately adjacent to the axillary sheath nor does it lie in the course of the intercostobrachial nerve. By contrast, the web is consistently observed to be more superficial and caudal in the axilla. In the majority of cases these cords extend across the antecubital fossa and into the forearm, occasionally as far as the radial aspect of the wrist at the base of the thumb.

Clinical syndrome

Forty-four of 750 patients (6%) treated or seen by our senior author developed AWS. AWS presented in the early postoperative course after axillary dissection and was associated with a characteristic finding of limited shoulder range-of-motion. Typically, the syndrome was self-limited, resolving without any specific treatment (Fig. 2). In 42 of 44 cases, there was no documentation of the syndrome developing more than 8 weeks postoperatively. The AWS typically did not present in the first several days after operation; there were only three recorded instances of AWS in the first 7 days after ALND. Thus, the syndrome typically presented after an initial postoperative delay and resolved within 3 months of onset in all patients. In most patients, the web syndrome appeared to be a major cause of limitation in shoulder range of motion. Shoulder abduction was limited to 90 degrees or less in 74% of all the AWS patients. Lymphedema developed in 11% of all AWS patients either early or late in the postoperative period. All AWS patients remained afebrile and had no constitutional symptoms. Two patients had postoperative complications of skin flap necrosis, and seroma infection, which appeared unrelated to the appearance of AWS.

Operations and pathology

AWS occurred in a diverse population of patients with invasive breast cancer. These 44 adults of all ages had a variety of breast cancer histologies and presented in all stages of disease (see Table 1). Thirty-three of the 44 patients were operated upon by the senior author (REM) at the University of Washington Medical Center. Ten of the 44 AWS patients underwent operation at an outside institution prior to evaluation in the University of Washington multidisciplinary Breast Cancer Specialty Center. Twenty-eight

Table 1
Axillary web syndrome patient demographics and cancer staging (n = 44)

Patient age	
Range 27–73 years, median age 46	
Pathologic diagnoses	
Ductal carcinoma in situ with microinvasion	4 (9%)
Colloid carcinoma	2 (5%)
Tubular adenocarcinoma	1 (2%)
Ductal adenocarcinoma NOS	31 (70%)
Poorly differentiated carcinoma	5 (11%)
Apocrine carcinoma	1 (2%)
Stage of disease	
I	16 (36%)
II	20 (45%)
III	7 (16%)
IV	1 (2%)

AWS patients had an ALND in combination with a more localized breast procedure, and 14 underwent modified radical mastectomy. No operative records were available for 1 AWS patient.

All patients who had ALND performed by our senior author (n = 33) underwent a standard level I and II dissection as part of their breast surgery procedure. More extensive dissections including level III nodes were performed only for clearance of palpably abnormal axillary disease at this high axillary level. Closed-suction drainage was used in axillary dissections. Range-of-motion restrictions were not placed on patients in the immediate postoperative period. Any documented complications were noted. A patient was considered to have lymphedema if the medical record reported that the patient had arm swelling apparent on physical examination and was symptomatic from this limb enlargement. Formal measurement of arm circumferences was not routinely reported.

Ten of the remaining 11 AWS patients underwent operation at an outside institution and then came to the University of Washington for follow-up care where they were then seen and evaluated by our senior author. These patients were all reported to have undergone standard level I and II axillary dissection. All of these patients were seen and examined by the senior author and hence underwent the same postoperative evaluation as did those patients operated on at the University of Washington.

One patient with the web syndrome had neither an axillary procedure nor a breast operation, but was diagnosed with stage IV breast cancer and extensive fixed nodal disease in her axilla on the side of the axillary web.

Of the patients who underwent axillary dissection (n = 43), 21 (49%) had metastases to the axillary nodes and in this group the mean number of nodes positive for metastases was 6.5 (Table 2). Fourteen patients (33%) had four or more axillary nodes positive for metastasis. The intercostobrachial nerve was preserved in 43% of AWS cases. Two of the 43 patients developed postoperative complications (seroma infection and skin flap necrosis).

Table 2
Lymph node status in axillary web syndrome (AWS) patients*

Number of patients with axillary metastasis	21 (49%)
Number of nodes removed, all AWS patients	Mean 16.0 (± 0.9 SEM)
Number of nodes removed, in patients with metastastic disease	Mean 17.6 (± 1.3 SEM)
Number of nodes with nodal metastasis, in patients with metastatic disease	Mean 6.5 (± 1.6 SEM; median 4)

* n = 43, nonoperative stage IV patient excluded.

The syndrome appeared to be associated with lymph node dissection. There were no cases of the web syndrome after a breast procedure in the absence of axillary lymph node dissection. Of the 43 AWS patients who underwent operation, 10 had their breast procedure on a date different than their ALND. In this group, the web syndrome occurred much closer to the ALND than to the breast procedure in the postoperative time course. The mean number of postoperative days until documentation of AWS was 51.2 (± SEM 11.3) after the breast procedure compared with a mean of 16.4 (± SEM 2.7) days after ALND (Table 3).

Observations after sentinel node biopsy

In addition to the above patient series, our surgical oncology group has recently observed the axillary web syndrome in 4 patients after lumpectomy and SLND. These patients have had the characteristic findings of pain and an axillary web in the early postoperative period following SLND. None of the patients developed cords down to the wrist, as we have observed in the most severe cases after ALND. Three of the 4 patients had histologically normal sentinel lymph nodes and did not undergo ALND. One of the patients had a positive SLND and went on to have an ALND, but her AWS developed prior to that completion node dissection.

Axillary web tissue sampling

One of the 44 patients underwent biopsy of her axillary web in the course of her medical treatment. More recently,

Table 3
Timing of axillary web syndrome (AWS), breast procedure versus ALND*

Operation	Time (days) after procedure until AWS documentation
Breast procedure	mean 51.2 (± 11.3 SEM), range 14 to 150
ALND	mean 16.4 (± 2.7 SEM), range 5 to 36

* Ten patients for whom breast procedure and ALND were performed on different days.

ALND = axillary lymph node dissection.

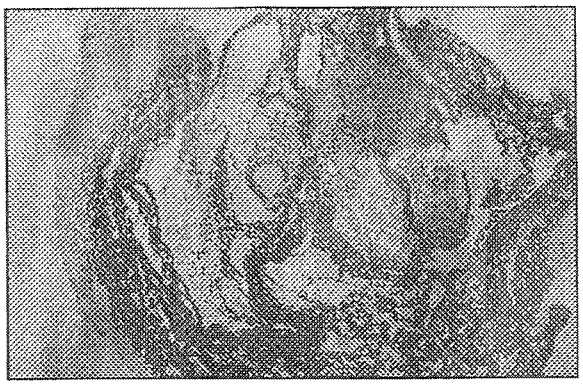

Fig. 3. Thrombosed lymphatic. Hematoxylin and eosin stain, 20× magnification by light microscopy.

3 patients with AWS (not included in the original series) have had biopsies taken by members of our surgical oncology group. Two cases demonstrated dilated lymphatics. One of the lymphatics contained fibrin clot (Fig. 3). In 3 cases, pathology demonstrated venous thrombosis in various stages of recanalization.

Comments

Axillary web syndrome is a self-limited process that developed in 6% of the patients with invasive breast cancer treated by a single surgeon over a 16-year period. Although patients who develop AWS were treated with nonsteroidal anti-inflammatory medications, physical therapy, and range-of-motion exercises, our data failed to demonstrate that the treatments shortened or changed the self-limited course of the syndrome. We identified no long-term sequelae of AWS. Eleven percent of AWS patients developed lymphedema. This is within a commonly accepted rate of lymphedema after breast cancer surgery of seven to 37% and does not suggest a predisposition to lymphedema in AWS patients [5,7].

Axillary web syndrome etiology

Prior to this investigation, we hypothesized that the intercostobrachial nerve might be the origin of the palpable web in AWS. Although preservation of the intercostobrachial nerve (ICBN) has been recommended to minimize post-ALND morbidity [11,12], two randomized prospective investigations have revealed minimal patient benefit with nerve preservation [13,14]. We observed that 43% of AWS patients had preservation of the ICBN, suggesting that ligation of the ICBN does not contribute to the development of AWS.

The interruption of axillary lymphatics appears to play an important role in the development of the AWS. We found no cases of the AWS after isolated breast surgery in the absence of an axillary node dissection. Furthermore, the temporal association of ALND with AWS supports our hypothesis that the axillary procedure, and not the breast procedure, was the etiologic factor in this patient series. It appears that in the single patient in our series with stage IV disease and fixed, matted axillary metastasis, the axillary web syndrome developed without any operation owing to the blockage of normal lymphatic flow through nodes replaced with tumor.

In our patient series, 51% of AWS patients had localized disease (no axillary metastasis). This rate is similar to the 51% to 63% rate of localized disease among female breast cancer patients reported by the National Cancer Institute [15]. Thus, our observations suggest that there may not be an association between AWS and an increased rate of positive axillary dissections.

The occurrence of an axillary web after a limited and focused removal of a very small number of axillary nodes (as is done in SLND) supports our hypothesis of angiolymphatic etiology. The discrete interruption of the axillary lymphatics in the performance of breast SLND may predispose to lymphovenous outflow obstruction for at least a portion of the ipsilateral arm. It is conceivable, based upon a common segmental embryologic derivation, that the lymphatic drainage for the medial arm may overlap that of the breast. Furthermore, anatomic studies of arm and breast lymphatics and more recent lymphatic mapping with lymphoscintigraphy have demonstrated that both arm and breast lymphatics drain to the axilla [16–18]. Thus, in some patients, a limited breast SLND may also disrupt important lymphatic drainage for the medial arm. Perhaps this could contribute to the AWS that our oncology group has seen in a limited number of SLND patients.

Anatomy and histology

The AWS syndrome is analogous to an axillary variant of Mondor's disease. Mondor's disease is a superficial thrombophlebitis of thoracoepigastric veins that has been observed infrequently in patients after breast procedures, from local trauma, as an idiopathic variant, and in patients with previously undiagnosed breast cancer [19,20]. Typical symptoms include the appearance of a palpable, usually painful, subcutaneous cord on the chest wall that has been described as a "string phlebitis" [21]. As in the AWS, symptoms of Mondor's disease have been reported to resolve spontaneously 2 to 10 weeks after onset. Some investigators have observed histologic characteristics more consistent with thrombosed lymphatics than veins [22].

Our observations and biopsy evidence are consistent with a lymphovenous etiology. Each of our four biopsies revealed dilated thrombosed lymphatics or thrombosed superficial veins, or both. Furthermore, lymphangiograms of normal patients obtained in the 1970s show arm lymphatics entering the axilla along the medial arm surface across the axillary space that corresponds to the web seen in our series (Fig. 4) [23,24]. Thus, anatomic and pathologic evidence

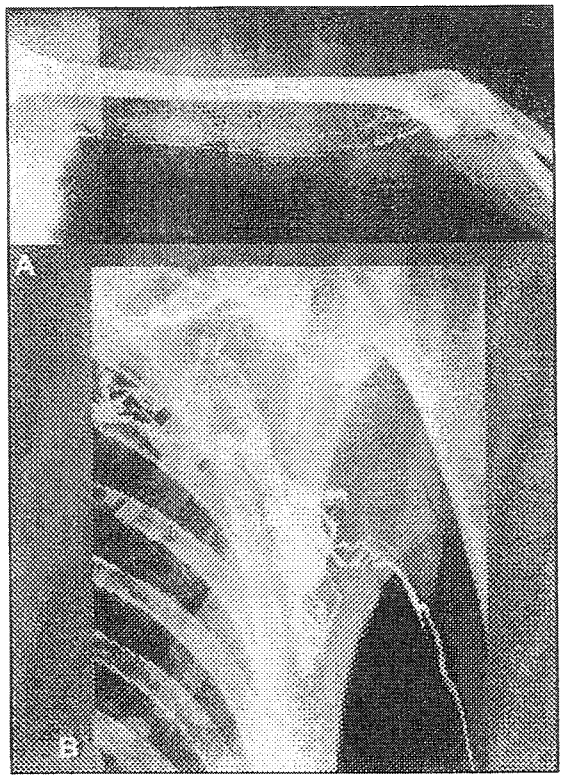

Fig. 4. Normal arm lymphangiogram. **A**, arm view. **B**, axilla view. (Reproduced with permission, see references 23 and 24)

support our hypothesis that angiolymphatics contribute to the observed AWS.

Proposed pathogenesis

Our observation of fibrin clot in superficial veins and lymphatics of biopsied axillary webs suggests that lymphovenous injury, stasis, and hypercoagulability is contributing to the observed syndrome. Lymphovenous injury might occur in the retraction of tissue and patient postitioning during ALND. Additionally, the tissue injury from operation releases tissue factor that could cause hypercoagulability in the surrounding tissues. Stasis of lymphovenous channels would also be expected from the outflow obstruction induced by removal of axillary lymphatics draining the arm. Thus, the removal of axillary lymph nodes could promote the AWS through multiple mechanisms.

If the ALND procedure is causative, one would expect a shorter or less invasive operation, such as SLND, to cause less superficial venous stasis, lymphatic disruption, and tissue injury. This expectation is difficult to reconcile with our observations of AWS after SLND. However, to date, the AWS observed after sentinel node biopsy has been less severe and limited to the axilla and medial arm, without extension to the wrist. Efforts to reduce tissue injury through more limited surgery may diminish the severity, if not the incidence, of AWS. However, this determination would require investigation beyond the scope of this retrospective review.

In this review, AWS is a significant cause of morbidity in the early postoperative period for 6% of patients after ALND. There is no specific treatment. Fortunately, the AWS appears to be self-limited. Prevention may be possible if one has an understanding of pathogenesis. It is possible that more limited axillary surgery, with less disruption of the lymphatics and superficial tissues of the arm might help reduce the incidence and severity of the axillary web syndrome.

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