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AXILLARY WEB SYNDROME: NATURE AND LOCALIZATION

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ABSTRACT

Axillary Web Syndrome (AWS) is a complication that can arise in patients following treatment for breast cancer. It is also known variously as syndrome of the axillary cords, syndrome of the axillary adhesion, and cording lymphedema. The exact origin, presentation, course, and treatment of AWS is still largely undefined. Because so little is known about AWS, we undertook a case series study consisting of 15 women who had undergone breast cancer surgery and presented with AWS. All subjects received a clinical examination which included body size determination and detailed measurements of the size and location of the cords. The cords were found to originate from the axilla, continue on the medial aspect of the arm up to the epitrochlea region, then to the antero-median aspect of the forearm, and finally reaching the base of the thumb. The cords averaged approximately 44% of the limb length. Correlation of the cord location with anatomical studies shows that in fact this path follows the specific course taken by the antero-radial pedicle which arises at the anterior aspect of the elbow from the brachial medial pedicule to anastomose in the axilla at the level of the lateral thoracic chain nodes. Although our series is small, the correspondence between the physical findings and the anatomical studies strongly supports the notion that the cords are lymphatic in origin.

Keywords: Axillary Web Syndrome, lymphatic vessels, cording lymphedema

The term axillary web syndrome first appeared in the literature in 2001 in an article by Moskovitz et al. (1) (*Fig. 1*). They defined this syndrome as the appearance of a palpable cord which begins at the axilla and spreads down the arm even at times as far as the thumb. This syndrome was deemed responsible for a significant decrease in shoulder mobility. Later on, Leidenius and Reedijk (2,3) confirmed this description, and all three groups have stated that axillary lymph node dissections are the cause for the syndrome.

Most often, this syndrome occurs after a delay of one week post-surgery and resolves within the following three months (3- 8). The incidence of this post-surgical complication differs among authors: Moskovitz (1) reported 6% AWS after axillary lymph node dissection (ALND) and 0.5% following sentinel node biopsy (SNB). Leidenius (2) reported 72% AWS after ALND and 20% following SNB. LaComba et al reported 48.3% after ALND, and Tengrup et al (8) mentioned one case of AWS after subcutaneous node biopsy where the origin

Fig. 1. Axillary Web Syndrome displaying the cord structure in the axilla and upper arm.

was presumed to be a thrombus in a lymphatic vessel.

The pathogenesis we adopted in this study is the one proposed by Moskovitz (1), who attributed the syndrome to lympho-venous damage, stasis, and hypercoagulation in axillary vessels. The hypercoagulation results in thrombosis of large veins of the arm or of the superficial lymphatics, which in turn appear as palpable cords. We reasoned that an evaluation of the anatomical features of the cords would allow us not only to gain a more detailed knowledge but also a better understanding of this syndrome.

METHODS

The study population consisted of 15 females, aged from 32 to 68 years (mean of 53.1), who developed AWS following breast cancer surgery *(Table 1)*. All subjects had undergone an axillary lymph node dissection combined with tumorectomy (n= 10) or mastectomy (n= 5). All patients gave their informed consent, and the study was approved by the local ethical committee.

Clinical investigation included height and weight to calculate BMI. Limb and cord length was determined by means of a tape measure. In order to limit the measurement error, we divided the length of the cord by the full length of the limb. Limb length was measured from the coracoid process to the tip of the third finger, and the cord was closely localized by means of protractors of variable diameters laid on the limb (*Fig.* 2). The limb was divided into 10 identical segments, reference points were marked, and measurements performed at each point using a measuring tool developed in our laboratory. The accuracy of measurements as well the inter-observer reliability were previously assessed by two separated practitioners on a single patient with no significant statistical difference found (Student's *t*-test, after passing Kolmogorov Smirnov normality test). Reproducibility was also evaluated by a test re-test procedure performed 4 times by each

TABLE 1
Subject Age and Clinical Morphology

Subjects	Age	Weight (kg)	Size (m^2)	BMI	Arm length (cm)	Cord length (cm)	Cord length (%)
1	54	65	1.6	19.5	71	57	80.28
2	61	59	1.58	26.0	68	33	48.52
3	48	67	1.5	26.2	65	30	46.15
4	67	72	1.55	27.9	72	24	33.33
5	66	75	1.62	27.4	70	25	35.71
6	55	54	1.84	22.2	72	26.5	36.80
7	68	68	1.61	20.8	68	29.5	43.38
8	47	50.5	1.6	26.6	71	32	45.07
9	55	75	1.6	19.7	72	27.5	38.19
10	48	65	1.68	26.6	70	29	41.42
11	32	65	1.7	22.5	70.5	28	39.71
12	63	51	1.71	22.2	74	47	63.51
13	37	53	1.61	19.7	70	29	41.42
14	46	74	1.64	19.7	70	24	34.28
15	49	65	1.6	28.9	68	26	38.23
Mean	53.06	63.9	1.63	23.7	70.1	31.2	44.4
SD	10.27	8.59	0.079	3.45	2.19	9.05	12.39

practitioner on the same patient with no significant statistical difference found ($p= 0.63$).

RESULTS

The BMI was calculated for all 15 subjects with 8 having a normal BMI between 18.5 and 24.9 Kg/m^2 and 7 an overweight BMI between 25 and 29.9 Kg/m^2 (*Table 1*). The average BMI for all 15 subjects was 23.7 Kg/m^2.

Limb and cord lengths were measured, and the average cord length was 44.4% of the full limb length (*Table 1*). The course description of the cord measured and recorded with the use of protractors (*Fig. 2*) showed that the cord first started at the axilla, then continues along the medial aspect of the arm to reach the elbow at the level of the ulnar third. We observed this cord positioning in all 15 cases, and the standard deviation of the measurements was very small for reference points 1 to 5 (*Table 2*). For the cords that were still visible on the forearm, the cord moved further down towards the middle of the forearm (two out of two cases), progressed laterally, and ended at the base of the thumb in one case. The cord path crossed the forearm at the midline of the forearm, which was determined using the straight-line through the mid-point between the lateral and medial condyles of the humerus and the styloid process of the ulna and radius (*Fig. 2*, white arrow).

DISCUSSION

The average BMI for this sample of patients was 23.73 Kg/m^2, which corresponds to slightly overweight. In Leidenius' study (2), patients who presented with AWS had a low BMI or were thin. He explained this observation by stating that the cords were more easily palpable in thin individuals. However, Brandao (9) and our present study found a BMI above normal or an overweight value, which leads us to believe that size morphology doesn't seem to have an impact on the diagnosis of AWS. However, in large or very large patients, it may not be as apparent.

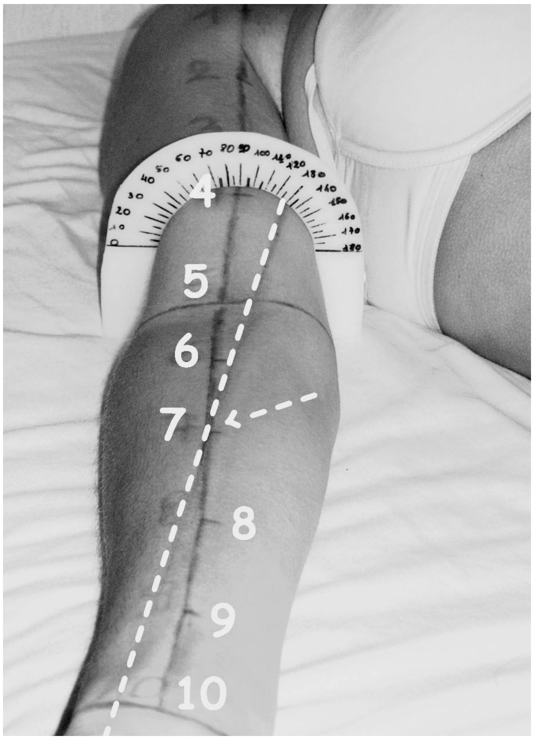

Fig. 2. Measurement system using a circular protractor and marks (4-10) to determine the position of the cord in study subjects. The white interrupted line represents the cord and the arrow at point 7 depicts the typical location of midline cross-over.

Previous anatomical studies (10,11) performed on fetuses after injection of all the fingers and the thumb have shown that the superficial lymphatic pathways, radial anterior and ulnar anterior, are visualized in 100% of the experiments. At the level of the upper arm, superficial pathways are visualized in: the brachial medial pathway in 100%; the basilic pathway in 62%; and the cephalic pathway in 32%.

If we reference the anatomical features of the superficial lymphatic pathways of the anterior aspect of the upper extremity (*Fig. 3a-c*), we notice that the radial anterior pathway arises next to the root of the thumb. This lymphatic pathway follows the antero-median aspect of the elbow to reach the axilla via the brachial medial pedicle and finally terminates in the lateral thoracic nodes (lateral mammary) and/or in the scapular anterior lymph nodes. Between the elbow and the axilla, this route matches perfectly the course taken by the cords in our study. At this level, the cord closely corresponds to the brachial medial lymphatics.

In our study population, we have found only two AWS visible on the forearm with both crossing the midline of the forearm and one reaching the root of the thumb. Although the number of subjects is too small to fully support our conclusion, this latter pathway

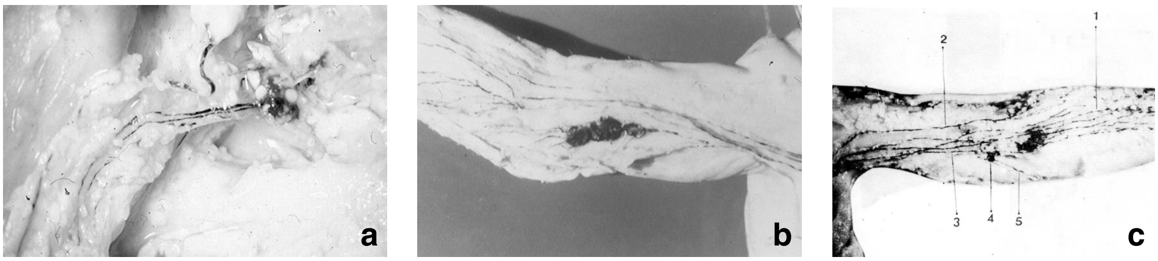

Fig. 3 a. Brachial medial pedicle reaching the axillary lymph nodes. b. Elbow: epitrochlean nodes and brachial medial pedicle up to the axilla with the brachial medial pedicle penetrating the axilla. c. Arm and elbow: the different lymphatic pedicles and lymph nodes
1. Radial anterior pedicle. 2. Brachial medial pedicle. 3. Basilic pedicle. 4. Trochlear nodes.
5. Ulnar posterior pedicle reaching the trochlear lymph nodes.

TABLE 2
Positioning of the Cords (Values in Degrees) at the 10 Reference Points

Subjects	Ref point 1	Ref. point 2	Ref. point 3	Ref. point 4	Ref. point 5	Ref. point 6	Ref. point 7	Ref. point 8	Ref. point 9	Ref. point 10
1	160	140	130	130	130	125	120	100	75	75
2	165	160	150	140	140					
3	160	150	140	130	125					
4	165	140	140	130						
5	160	160	150	140						
6	160	150	150	140						
7	160	150	150	130	120					
8	160	150	140	130	120					
9	160	150	140	135	120					
10	160	145	135	120						
11	160	150	140	130	120					
12	160	150	140	135	120					
13	150	150	145	125	120	110	95	85		
14	160	150	140	125	115					
15	165	150	140	130						
Mean	160.3	149.7	142	131.3	123	117.5	107.5			
SD	3.52	5.50	5.92	5.82	7.15	10.61	17.68			

closely corresponds to the radial anterior lymphatic pathway.

Documenting the natural history of AWS was a challenge encountered in this investigation because the syndrome usually spontaneous disappears within a period of three months and enrolling subjects in a timely fashion can be difficult. In the future, biopsies on cadavers with AWS could possibly be performed at multiple sites since the associated morbidity precludes biopsies on living patients. In addition, use of newer lymphatic- specific and conventional blood vessel markers in assessing these biopsies would be helpful to determine more precisely the nature of the vessels of origin in AWS.

CONCLUSION

We propose that the palpable cords presented by some patients after breast cancer surgery are lymphatic vessels whose course has been interrupted or occluded during the axillary lymph node removal. However, our population was limited to a small sample size of 15 subjects with AWS, and therefore our data are not yet robust enough to ascertain this definitive diagnosis and conclusion. This study should be continued and expanded to a larger population of patients presenting the spectrum of AWS disease.

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