Clinical Neurology and Neurosurgery 128 (2015) 90–93

Contents lists available at ScienceDirect

Clinical Neurology and Neurosurgery

journal homepage: www.elsevier.com/locate/clineuro

Case Report

# Perineural spread of squamous cell carcinoma: From skin to skin through the brachial plexus

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ARTICLE INFO

*Article history:*
Received 3 October 2014
Accepted 9 November 2014
Available online 15 November 2014

*Keywords:*
Perineural tumor spread
Squamous cell carcinoma
Skin cancer
Brachial plexopathy
Skin metastasis

## 1. Introduction

Perineural spread is an alternative to the more common hematogenous or lymphogenous form of tumor spread. Perineural spread is most frequently reported in head and neck cancers with only a few cases in upper limb nerves. We present a patient with a history of squamous cell carcinoma in the left arm who developed a left brachial plexopathy and subsequently other histologically similar lesions in the soft tissues and skin of the left shoulder. We hypothesize that all of the findings including the secondary lesions could be explained anatomically as perineural spread from the original site along small and major branches of the upper arm nerves to a distant site. Our theory is supported by high resolution imaging. Although perineural spread is frequently reported in squamous cell carcinoma, it has not been described as the mechanism for spread to skin at a distant site.

## 2. Case report

An 86-year-old left-handed man with a 5-year history of a subcutaneous nodule in the left mid anterolateral arm presented to our institution with a progressive left brachial plexopathy. Six weeks prior to presentation, the nodule was resected and diagnosed as squamous cell carcinoma.

### 2.1. History

The patient reported having a hard cigar-sized subcutaneous nodule in the mid left anterolateral arm since 2009. He had a history of multiple unspecified skin cancers involving his scalp, which were treated locally. In September 2012 he noticed intermittent paresthesias and hypesthesia over his left upper arm and shoulder. In October 2012 he developed continuous numbness and a wrist drop, which progressed to fingers extension weakness and numbness over the left lateral forearm extending to the thumb and the dorsum of the hand the following month. An EMG performed in November 2012 showed a left radial neuropathy with involvement of the triceps. Magnetic resonance imaging (MRI) of the brachial plexus was interpreted as normal. In February 2013 he developed shoulder abduction weakness. Electrodiagnostic testing performed in April 2013 demonstrated predominantly a

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http://dx.doi.org/10.1016/j.clineuro.2014.11.004
0303-8467/

posterior cord brachial plexopathy with lesser involvement of the medial cord; needle EMG showed 3+ fibrillations in the deltoid, triceps and brachioradialis muscles. The patient was treated for an inflammatory lesion. In September 2013 electrodiagnostic testing demonstrated progression of the brachial plexopathy involving the posterior and the medial cord. In May 2014 he had a Mohs procedure for the left mid-arm lesion with skin grafting from the thigh. The specimen revealed squamous cell carcinoma.

### 2.2. Physical examination

In July 2014 examination at our institution revealed an approximately 5 cm × 5 cm skin defect in his left anterolateral arm. An approximately 1 cm × 1 cm pink skin lesion on his left shoulder was worrisome for a cutaneous malignancy (Fig. 1A and B). Muscle testing revealed infraspinatus MRC grade 4/5, deltoid 3/5, triceps 0/5, biceps 4/5, brachioradialis 0/5, supinator 0/5, wrist and finger extensors 0/5, pronator teres 4/5, finger flexors (med.) 3–4/5, finger flexors (uln.) 2–3/5, thenar muscles 2/5, hypothenar muscle 1/5, and interossei 1–2/5. There was atrophy in radial-innervated muscles and decreased sensation in the radial nerve distribution. The left triceps reflex was absent, the biceps reflex was normal.

### 2.3. Evaluation

EMG testing revealed a left brachial plexopathy that most severely involved the posterior cord with dense fibrillation potentials and no activation in the extensor digitorum communis, deltoid and brachioradialis muscles. Thermoregulatory sweat tests showed focal anhidrosis in the left dorsal forearm (distribution of radial cutaneous branches).

### 2.4. Imaging

High resolution MRI revealed enlarged, T2 hyperintense C5-T1 spinal nerves (Fig. 1C) and medial and posterior cords, which avidly enhanced on gadolinium images (Fig. 1D and E). An enlarged radial nerve demonstrated perifascicular enhancement, which could be followed in continuity to the lower arm. In the area of the resection of the subcutaneous lesion, the subcutaneous fat demonstrated reticular enhancement merging with the radial nerve (Fig. 1F–H). The enlarged axillary nerve demonstrated a similar pattern as the radial nerve. In the upper arm a peripherally enhancing 18 mm × 13 mm mass continuous with the axillary nerve was observed (Fig. 2A and B). Increased linear T2 signal and post-gadolinium enhancement was observed running from this tumor mass upwards to the subcutaneous fat, piercing the posterior part of the deltoid muscle in the area where the posterior branch of the axillary nerve is predicted (Fig. 2B–E). The median nerve in the upper arm was atypically bright on T2 sequences (Fig. 1F). The deltoid muscle demonstrated atrophy associated with chronic denervation and intramuscular edema consistent with ongoing denervation. The lateral portion of the brachialis and brachioradialis muscles demonstrated chronic denervation with muscle atrophy and fatty replacement. The $^{18}$FDG PET/CT demonstrated visually increased uptake in the upper arm mass and slightly increased uptake in the brachial plexus, below the definitive SUV value (Fig. 2F).

### 2.5. Procedures

Initially, the patient underwent a non-diagnostic biopsy of the superficial radial nerve in the forearm that showed severe loss of myelinated nerve fibers and active axonal degeneration (79%). After completing the FDG PET/CT scan, he underwent a biopsy of the upper arm soft tissue mass located deep to the deltoid muscle,

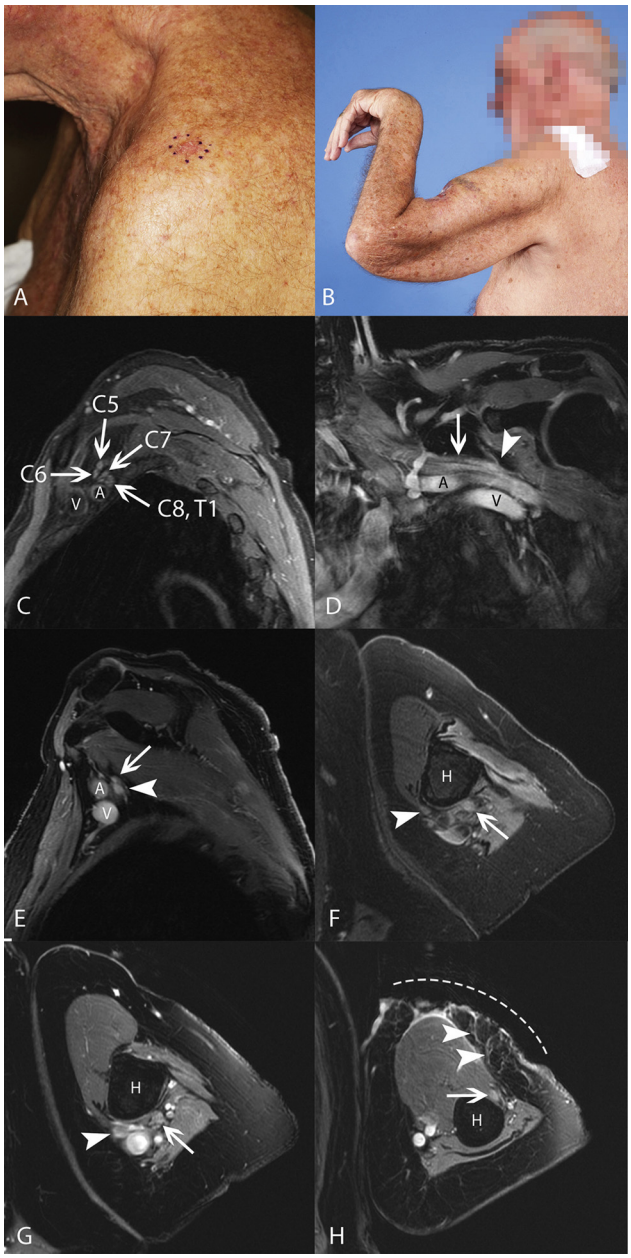


**Fig. 1.** Clinical presentation and tumor perineural spread to the brachial plexus. The photographs of the patient (A and B) demonstrating the wrist drop, weakness and atrophy of the triceps muscle and weakness of the deltoid muscle. The post resection wound in the anterolateral arm is visible (B). The photograph of the left shoulder (A) shows a 1 cm × 1 cm large skin lesion diagnosed as squamous cell carcinoma on biopsy. The sagittal fat saturated T2-weighted FSE image (C) reveals the C5-T1 spinal nerves demonstrating increased signal; the subclavian artery and vein are seen (C – letter "A", letter "V"). The coronal gadolinium enhanced spoiled gradient recall echo (SPGR) image (D) of the left brachial plexus demonstrates the enhancing and enlarged posterior cord (D – arrowhead) and the enhancing posterior division to the medial cord (D – arrow) highly worrisome for perineural tumor spread, the subclavian artery and vein are visible (D – letter "A", letter "V"). The sagittal gadolinium enhanced SPGR image (E) demonstrates enhancement and enlargement of the radial (E – arrowhead) and axillary nerves (E – arrow), the axillary artery and vein are visible (E – letter "A", letter "V"). The axial fat saturated T2 FSE image of the left arm (F) shows increased signal in the radial (F – arrow) and median (F – arrowhead) nerves and the post contrast SPGR image (G) at the same level demonstrates perifascicular enhancement of the radial (G – arrow) and to lesser degree the median nerves (G – arrowhead), which is typical for perineural tumor spread. The humerus is in the center (F–H – letter "H"). The axial post contrast SPGR image (H) of the left midarm demonstrates the site of the resection (H – dashed line) and reticular enhancement in the subcutaneous fat (H – arrowheads) interpreted as perineural tumor spread from the original tumor site to the radial nerve (H – arrow) along the fine branches of the inferior lateral cutaneous nerve.