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CASE REPORT

BILATERAL ORIGIN OF INTERCOSTOBRACHIAL NERVE FROM FIRST INTERCOSTAL NERVE: CLINICAL IMPLICATIONS

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Abstract. *The intercostobrachial nerve (ICBN) is the undivided lateral cutaneous branch of the second intercostal nerve that communicates with the medial cutaneous nerve of the arm. Iatrogenic intercostobrachial nerve injury may present in the postoperative period as paresthesia and dysesthesia. The probable utilization of the ICBN as a sensory nerve donor has also been proposed. We present a case of aberrant bilateral ICBN emerging from the first intercostal nerves in a 69-year-old male cadaver. The extra thoracic portions of ICBN on both sides were found emerging from the first intercostal spaces. On the right side, it communicated with the medial cutaneous nerve of the arm; on the left side, it communicated with both medial cutaneous nerves of the arm and forearm. Awareness about variant ICBN is clinically important during surgical exploration in the axilla.*

Key words: *axillary block dissection, brachial plexus, intercostobrachial nerve, intercostal nerve*

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INTRODUCTION

The intercostobrachial nerve (ICBN) is classically described as the undivided lateral cutaneous branch of the second intercostal or second thoracic spinal nerve [1]. The trunk of the ICBN pierces the intercostal and serratus anterior muscles near the midaxillary line and then divides into branches innervating the floor and posterior wall of the axilla and the posteromedial aspect of the arm [2]. It frequently communicates with the medial cutaneous nerve of the arm (MCNA) and rarely – with the medial cutaneous nerve of the forearm (MCNF). As a variation, it can have variable contributions from T1, T2 T3 and T4 spinal nerve roots in origin and can communicate with the medial cord or other branches of the brachial plexus [2]. Though classically described as a sensory nerve, few case reports point towards a motor component in its variant communicating twig termed the 'medial pectoral branch' innervating pectoral muscles [10]. Surgically, the ICBN nerve is important for several reasons [3]. One of the notable clinical correlations is the sensory deficit experienced by patients after axillary lymph node dissections (ALND) performed during radical or modified mastectomy. There

is a difference of opinions among surgeons whether or not to sacrifice the ICBN during mastectomy, though the majority of authors suggest to preserve it to avoid postoperative paresthesia and dysesthesia. However, there are fairly good chances of unintentional iatrogenic injuries to the ICBN during mastectomies. The probable utilization of the ICBN as a sensory nerve donor has also been proposed [4]. We present a case of aberrant bilateral ICBN emerging from the first intercostal nerves and its variable communications with both the MCNA and MCNF.

CADAVERIC CASE REPORT

During routine dissection of the axilla for undergraduate students, an unusual variation of ICBN was observed bilaterally in a 69-years-old male cadaver. The axillae of both sides were dissected employing standard methods, which neither revealed any gross pathology nor exhibited any signs of prior surgical procedure. The extrathoracic portions of ICBN on both sides were found emerging from the first intercostal spaces. On the right side, the ICBN trunk was 3.2 cm in length, which divided into two rami, one of them joined with the MCNA and the other supplied posterior wall of the axilla and the posteromedial aspect of arm (Fig. 1).

On the left side, the ICBN trifurcated at its emergence; two rami communicated with MCNA and MCNF, and the third one directly supplied the axilla and the posteromedial aspect of the arm by 2-3 branches. The twig communicating with MCNF also innervated the axilla post communication (Fig. 2). The rest of the adjacent structures, viz. brachial plexus and its branches, axillary artery and its branches, axillary vein and its tributaries, were normal anatomically. We did not trace the intrathoracic connections of the ICBN. A similar description has not been reported in any of the erstwhile reports.

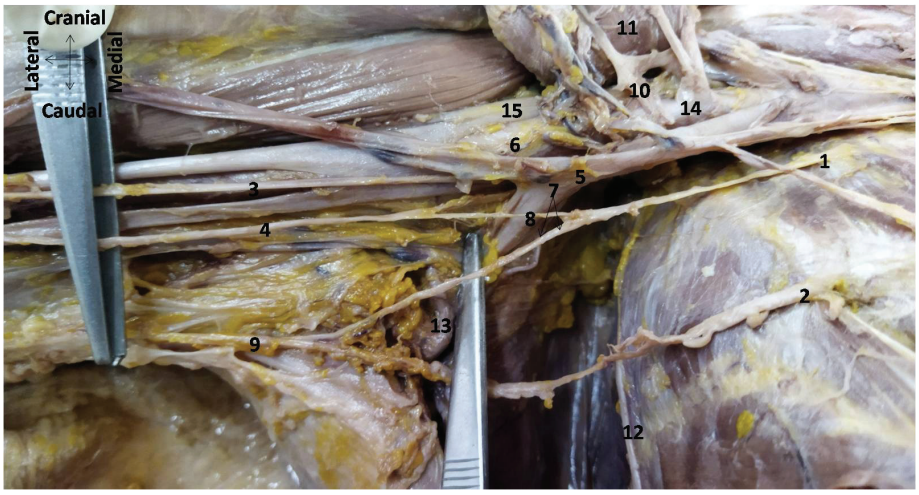

Fig. 1. Dissected right axilla showing the right intercostobrachial nerve (ICBN) and related structures in a supine cadaver with abducted limb; 1 – main trunk of ICBN, 2 – the 2nd intercostal nerve, 3 – medial cutaneous nerve of forearm (MCNF); 4 – medial cutaneous nerve of arm (MCNA), 5 – axillary vein, 6 – axillary artery (distal), 7 – cutaneous branch to axilla (from the 1st intercostals nerve), 8 – ICBN communicating with MCNA, 8 – ICBN communicating with MCNA; 9 – cutaneous branch to axilla (from the 2nd intercostal nerve); 10 – medial pectoral nerve; 11 – pectoralis minor muscle; 12 – long thoracic nerve; 13 – subscapular artery; 14 – axillary artery (proximal); 15 – lateral cord of brachial plexus with origin of musculocutaneous nerve

Fig. 2. Dissected left axilla showing the left intercostobrachial nerve (ICBN) and related structures in a supine cadaver with abducted limb; 1 – trifurcated ICBN; 2 – the 2nd intercostal nerve; 3 – medial cutaneous nerve of forearm (MCNF); 4 – medial cutaneous nerve of arm (MCNA); 5 – axillary vein (distal), 6 – axillary artery; 7 – ICBN communicating with MCNF; 8 – ICBN communicating with MCNA; 9 – ICBN branches supplying the axilla; 10 – medial pectoral nerve; 11 – pectoralis minor muscle; 12 – long thoracic nerve; 13 – subscapular artery; 14 – axillary vein (proximal); 15 – lateral cord of brachial plexus

DISCUSSION

The origin of the ICBN is usually from the ventral ramus of the second intercostal nerve, with variable contribution from the third and fourth intercostal nerves at times. The ventral ramus of T1 spinal nerve is unique in that it contributes largely to the lower trunk of the brachial plexus and only a minor contribution follows in the first intercostal nerve, which may occasionally be involved in ICBN formation. The usual midaxillary line of emergence of the ICBN and its further course may also have considerable variation. Several patterns of the course and distribution of ICBN in the axilla, including few unique aberrations with potential clinical implication, are reported [5]. Nevertheless, there are only few reports that mention formation of ICBN from the first intercostal nerve [2, 6]. An extensive study by Lokusa et al. (2006) did not reveal any communication with the first intercostal nerve [1]. However Nayak S R et al. (2018) reported additional extra thoracic ICBN originating from the first intercostal spaces in 3.8% of studied specimens [7]. Cunnick G H et al. reported ICBN origin both from T1 and T2 in 9% of patients, which they classified as type 4 variety of ICBN [2]. Kumar P et al. had a similar opinion like Cunnick G H et al. and observed type 4 varieties in 4% of the studied patients [3]. Deshmukh V R et al. reported ICBN forming nerve loops with third intercostal nerve. They also highlighted that improper cell signalling during the fifth week of intrauterine life, when the axons of nerve make critical contact with developing limb buds may be responsible for aberrant connections of ICBN [8]. In an extensive study of the extrathoracic course of the ICBN, Loukas et al. classified them into eight types, viz. type I to type VIII. The most common type described by them was type 1, which had communications with MCNA and MCNF. Therefore, our report resembles type 1 according to Loukas's classification system. However, this report is different from all previous reports (listed in table 1) in having bilateral origin from first intercostal nerves without any visible contribution from second intercostal nerves.

Aberrant neural connections of the ICBN with the medial cord of the brachial plexus and medial pectoral nerve, which probably innervate the pectoral muscles, have also been reported [9, 10]. In such cases of ICBN injury, motor loss can be an additional clinical finding. Iatrogenic damage to ICBN during sentinel lymph node biopsy and ALND performed for diagnostic staging and therapeutic reasons in cases of breast carcinoma has a considerable morbidity in the form of paresthesia and dysesthesia following such procedure, wherein ICBN preservation is strongly recommended [11]. A recent meta-analysis provided sufficient evidence that surgical division of the ICBN during mastectomies carries higher risk of sensory impairment and postprocedural pain perception [12, 13]. Whenever axillary arch muscle, a recognised muscular anomaly, is present, ICBN passes beneath the arch, where it can get compressed [14]. All these complications reduce the overall quality of life, and, hence, ICBN preservation should be attempted in all possible cases. ICBN preservation may also be targeted during trans-axillary breast augmentation surgery, which is becoming popular these days [16]. Another potential area currently being focussed and investigated is transfer of ICBN to the median nerve and its potential utility for neurotization in patients with brachial plexus injury to restore hand sensation [4, 17].

Table 1. Cadaveric and clinical studies focussed at ICBN and their significant findings

Authors	Population	Study type	Sample size	Findings
Özşahin M K et al., 2023[16]	Turkish	Autopsy	16	ICBN could be a possible graft to median nerve for neurotization and sensory restoration.
Van Tonder D J et al., 2021 [10]	Saudi	Autopsy	2	'Medial pectoral nerve', a motor branch arising from right-sided ICBN.
Samerchua A et al., 2020 [17]	Thai	Combined autopsy and sonography	6	34.6% ICBN received a contribution from the first or third intercostal nerve.
Siddiqui A U et al., 2019.[5]	Indian	Autopsy	1	Aberrant bifurcation of ICBN in axilla.
Nayak S R et al., 2018.[7]	Indian	Autopsy	130	3.8% ICBN originated from T1 and 20.7% ICBN originated from T3.
Deshmukh V R et al., 2017.[8]	Indian	Autopsy	1	ICBN and T3 making an aberrant nerve loop.
Foroni L et al., 2017 [4]	Brazilian	Autopsy	20	ICBN as a sensory donor for hand reinnervation procedures.
Warrier S et al., 2014 [12]	Metaanalysis	Systematic review	-	Surgical division of the ICBN found associated with increased risk of sensory deficit.

Continuation of Table. 1

Authors	Population	Study type	Sample size	Findings
Hwang K at al., 2014 [14]	Korean	Autopsy	30	Undersurface of the pectoralis minor at second intercostal space is very closely related to ICBN.
Kumar P et al., 2013 [3]	Indian	Clinical surgical	50	Surgical division of ICBN is associated with significant morbidity.
Loukas M at al., 2006 [1]	American	Autopsy	200	No cases exhibited ICBN contribution from T1.
Cunnick G H et al., 2000 [2]	British	Clinical surgical	50	Recommended ICBN preservation whenever possible during ALND.
O'Rourke M G E et al., 1999 [6]	Australian	Autopsy	28	Connections from the T1 and T3.
Temple W J et al., 1985 [11]	American	Clinical surgical	50	ICBN preservation kind of ALND significantly improves sensory functions in the postoperative period.

CONCLUSIONS

The anatomic variations of ICBN with involvement of the 1st intercostal nerve should be borne in mind during ALND exploration. Such aberrant ICBN has manifold clinical implications in interpreting pain and paresthesia especially in cases of intercostal neuralgia due to entrapment, trauma or herpes zoster infection. Furthermore, owing to the close approximation with the axillary vessel than its normal counterpart, it is also prone for compression from vascular lesions in the region. Awareness of such variants is imperative and should be borne in mind by surgeons and physicians.

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Authors' contributions:

D. Borthakur – Protocol development, review of literature, cadaveric dissection, manuscript writing.

R. Kumar – Protocol development, review of literature, photography, manuscript writing.

S. Singh – Protocol development, review of literature, manuscript writing.

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