



A CADAVERIC DISSECTION STUDY OF ACCESSORY PHRENIC NERVE

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ABSTRACT Accessory Phrenic Nerve (APN) provides additional nerve fibres to the Phrenic nerve (PN) once the latter crosses the lateral border of Scalenus Anterior muscle. The literature on APN describes many variations in origin, course and termination of this rare nerve. An adequate knowledge of APN can significantly reduce lesions to the nerve supply of diaphragm and prevent dysfunction that may follow. This study focuses on the frequency of Accessory phrenic nerve in 60 dissected heminecks of 30 adult cadavers at the Department of Anatomy, Government Medical College, Kozhikode. An incidence of 30% was recorded. The significant contribution from APN to PN has been of major interest to surgeons and in developing various novel procedures on PN.

KEYWORDS : Phrenic Nerve(PN), Accessory Phrenic Nerve(APN)

INTRODUCTION :

Fibres for the PN from the 5th Cervical ramus often pass in a branch of the Nerve to the Subclavius as the APN. This may also be derived from the fourth or sixth cervical rami or from the Ansa Cervicalis^[1].

Loukas et al. stated that all nerves contributing to the PN after it crosses the Anterior Scalene muscle would be considered as APN^[2].

Initially it descends lateral to the PN, then passes anterior, or posterior to the Subclavian vein. The accessory always joins the main nerve but at different sites. Most commonly joining takes place near the first rib or near the pulmonary hilum or beyond.

When two parts of the PN exist, coursing parallel to each other for a variable distance on the anterior scalene muscle, usually the lower one is called APN^[3].

MATERIALS & METHODS:

Study behaviour and ethics committee acceptance :

The present study was conducted on 60 heminecks of 30 properly embalmed and formalin fixed cadavers in the Department Of Anatomy, Government Medical College, Kozhikode. This research was approved by Institutional Ethics Committee (Ref. no. GMCKKD/RP 2019/IEC/2)

Inclusion/exclusion criteria :

Cadavers for undergraduate teaching and dissection classes were used for the study. As none of the specimens had any gross anomaly or asymmetry, all were included in the study.

Dissection method:

On each half of the neck or hemineck specimen, incisions were made to expose posterior & anterior triangle. Nerve to Subclavius was traced lateral to External Jugular Vein to look for APN. The clavicle was detached to expose 1st rib, Subclavian vessels and Scalenus Anterior. PN and any communicating nerve to it was identified & recorded.

Observation & analysis:

Communicating nerves to PN were dissected & photographed. For statistical analyses, the qualitative data obtained were quantified according to the frequencies.

RESULTS :

APNs were observed arising from nerve to Subclavius and directly from C5 root of Brachial plexus to finally merge with the main trunk of Phrenic nerve.

In 18 out of 60 heminecks, the APNs were recorded with an incidence of 30% in this study. Bilateral presence of APN was noted in 6 cadavers and the frequency of APN was noted to be equal on both sides, 9 on the right and 9 on the left side.

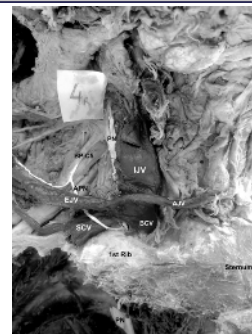


Figure 1: APN passing anterior to Subclavian vein and joining the PN on a right hemineck specimen. [APN: Accessory phrenic nerve, AJV: Anterior Jugular vein, BP-C5: Brachial plexus C5 root, EJV: External jugular vein, IJV: Internal jugular vein, PN : Phrenic nerve, SCV: Subclavian vein]

DISCUSSION:

Studies on APN have shown wide range of incidence, ranging from 5% to 80.9%. This study was conducted in the Malabar region of India, with a 30% incidence of APN.

Larkin (1889)^[4] reported a case of bilateral APN and also quoted that specimens of APN had been previously described by Professor Turner in the same Journal, in November 1871 and May 1874, and by Professor D. J. Cunningham in November 1872, thus substantiating the presence of this unique nerve. Kikuchi (1979)^[5] quoted that the APNs incidence displays a great variability ranging between 17.6% to 75% in German population. This figure was based on a study by Felix (1922) as quoted by Bergman (2015), with an incidence of 75% involving 309 cases. Aycock and Habliston (1930) as reported by Kelley (1950), performed the largest cadaveric study at the time, and found a 65% incidence of APNs in 130 cadavers. Locchi (1932)^[6], as quoted by Talbot (1978)^[7], in large series of study recorded a 50% incidence of APNs. Rajanna (1942)^[8], as quoted by Talbot (1978)^[7], discovered an 84% incidence in a large case study. Greenfield and Curtis in 1942, in the largest surgical study, which included 119 operations reported an incidence of 24.4% of APNs, as quoted by Kelley^[9].

Kelley (1950)^[9], gave a universally acceptable definition to APN, that if PN is paralyzed and the ipsilateral diaphragm continues to move, it is assumed that an APN exists and if the second nerve is also severed, resulting in ipsilateral paralysis of the diaphragm, this was a proof that an APN is present. On this basis, in a study of 309 surgical cases, he proved 80.9% incidence of APNs. Ghezzi (1964)^[10], as quoted by Talbot (1978)^[7], in a large case series, recorded a 10% incidence of APNs. Talbot (1978)^[7] conducted a study on 30 adult cadavers and 8 embryos and 27 sides of the cadaveric specimens (a 45% incidence) had an APN. Loukas et al.(2006)^[2] dissected 80 adult formalin-fixed cadavers. The PN was present in all the specimens, and 99 (61.8%) had

an APN joining the main nerve. Nayak et al.(2008)^[11] conducted a study to assess the incidence of APNs in Indian population. 45 formalin-embalmed cadavers were studied and the APN was present on 48 sides (53.3%). Mendelsohn et al.(2011)^[12] in his dissection of 111 cadaveric necks from 56 cadavers, found six (5%) specimens with APNs. These were seen arising from the C3, C4, or C5 anterior rami.

Graves et al.(2017)^[13] observed that although the APN was a common anatomical variant, its prevalence was reported to be highly varying in literature. He attempted to establish the origin and prevalence of the APN by including a total of 17 studies to a meta-analysis study. Only fourteen studies (n=1,941 heminecks) reported data on APN prevalence. The overall prevalence was estimated as 36.5% from all the pooled data. APN prevalence also differed across geographic regions. Its prevalence in Asia, Europe, and North America was 43.8%, 12.2%, and 72.9%, respectively. Golarz & White (2020)^[14] conducted a study in 100 surgical patients undergoing Supraclavicular decompression for Neurogenic Thoracic outlet syndrome. Six-Lateral or Accessory Phrenic nerves, defined as a smaller nerve running lateral to the main PN, noted to stimulate the diaphragm with direct nerve stimulation were also recorded.

Brachial Plexus Encountered during 100 Supraclavicular Decompressions for Neurogenic Thoracic Outlet Syndrome with Associated Postoperative Neurologic Complications. *Annals of vascular surgery*, 62, 70–75. <https://doi.org/10.1016/j.avsg.2019.04.010>

Table 1 : Presence Of Accessory Phrenic Nerve : Comparison Of Present Study With Previous Studies

Year of study	Author	Total specimens	Presence of APN (%)
1922	Felix ^[5]	309	75
1930	Aycock and Habliston ^[9]	130	65
1932	Locchi ^[6]	-	50
1942	Rajanna ^[8]	-	84
1942	Greenfield and Curtis ^[9]	119	24.4
1950	Kelley ^[9]	309	80.9
1964	Ghezzi ^[10]	-	10
1978	Talbot ^[7]	76	45
2006	Loukas et al. ^[2]	160	61.8
2008	Nayak et al. ^[11]	90	53.3
2011	Mendelsohn et al. ^[12]	111	5
2017	Graves et al. ^[13]	1,941	36.5
2020	Golarz & White ^[14]	100	6
2020	Present study	60	30

In the current study, the results are similar to Greenfield and Curtis(1942)^[9], 24.4% incidence and Graves et al.(2017)^[13], 36.5% incidence. The work of Graves et al. is a meta-analysis study, involving 17 other studies.

CONCLUSION:

The Phrenic Nerve and Accessory Phrenic Nerve supply the diaphragm and to avoid its impairment, one must have good knowledge of both the nerves. This will reduce injuries to APN during surgeries at the root of neck or in thorax and also while performing Subclavian catheterisation in critical care units.

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