



## Case report

# Variation in the formation of the retromandibular and the external jugular veins with embryological overview: A case report

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## ABSTRACT

Awareness of the formation and termination of the head & neck's superficial vein, such as jugular veins, are imperative for anatomists, surgeons, and radiologists during interventional procedures. We report an uncommon variation in the formation of the retromandibular vein and external jugular vein (EJV) in an embalmed male cadaver's right side. The joining of the facial vein and superficial temporal vein within the parotid gland formed the retromandibular vein (RMV). The anterior division joined with the submental vein forming an anomalous venous trunk. The anomalous vein united with the EJV forming a common trunk in the lower third of the neck and terminated into the subclavian vein. We compared the available literature and justified the embryological development of this rare variation.

## 1. Introduction

The 'external jugular vein' (EJV) opens into the subclavian vein (SV) just above the midpoint of the clavicle. It is a major vein collecting blood from the head and neck region. Additionally, the retromandibular vein (RMV) is formed by the union of the 'superficial temporal vein' (STV) and the maxillary vein (MV) inside parotid gland. The anterior division of the RMV joins with the facial vein (FV) to form the common facial vein. The posterior division of RMV joins the posterior auricular vein (PAV) to form EJV. These veins could vary in their commencement, course, and termination, which is clinically significant [1].

Awareness of the variations of venous pattern of the head and neck region is important for the surgeons, as these veins are used in oral reconstruction surgeries and the FV is used for microvascular anastomosis. In parotid surgeries and mandibular condylar fracture reduction, the RMV and its tributaries are identified and ligated to prevent excessive bleeding [2]. During CT and MRI imaging, healthy veins may appear to be diseased. In this regard, a detailed understanding of normal as well as variant patterns of venous anatomy is important [3]. Variations of EJV are considered clinically relevant during the cut down approach as an alternative to cephalic vein [4].

The literature reveals several types of variations of RMV and EJV [5–8]. Variations are often seen in the formation and course of EJV and RMV that is described the literature [9]. However, the authors here report an unusual right-sided variation in the formation of RMV, the EJV, and their tributaries that have not been reported in the literature earlier.

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### 1.1. Case presentation

During regular dissection of the neck anatomy of a male cadaver aged 60-years at the medical school in South India, we observed variations in the formation and tributaries of right RMV and the EJV. The cadaver was procured through the voluntary body donation program of the institute with written informed consent from the donor with two witnesses. The body was donated after the consent granted from the donor's next of kin. A written informed consent was obtained from the next of kin for utilizing the data in the form of observation and image that were procured from the cadaver. Since it is a single cadaveric case report, the Institutional Ethics committee (IEC) did not recommend taking a separate clearance.

In the cadaver, we observed that the FV joined with the STV inside the parotid gland to form the RMV. The MV drained into RMV as a tributary. The anterior division of RMV joined with the 'submental vein' (SMV) to form an anomalous venous trunk, and the posterior division joined with the PAV to form the EJV. This EJV had a narrower caliber than that of the anomalous trunk and passed anterior to the great auricular nerve on the sternocleidomastoid muscle. The anomalous vein united with the EJV forming a common trunk in the lower third of the neck. The common trunk then traversed superficial to the 'sternocleidomastoid muscle' and terminated into the SV. (Fig. 1). There was no common facial vein on the right side. Facial nerve and the external carotid artery within the parotid gland had a normal course. All the veins had a usual course on the left side, and they did not show any variation in their pattern.

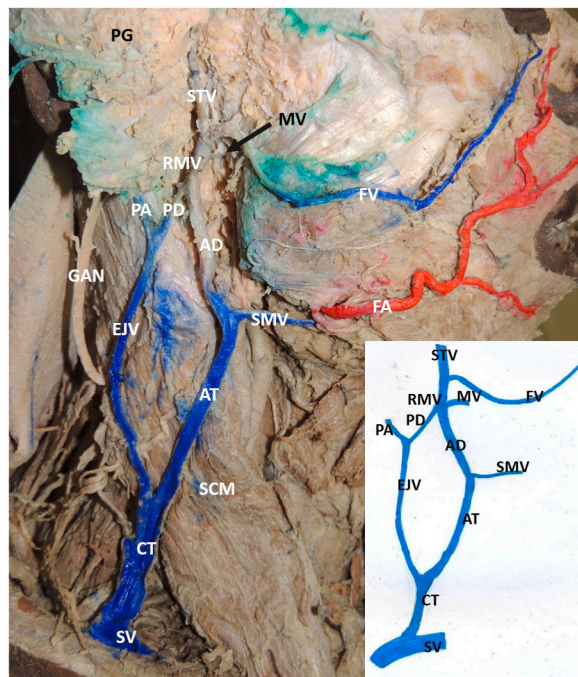
## 2. Discussion

The authors have reported a unilateral unusual variation in the formation of RMV and the EJV.

Hollinshed describes that the neck's veins vary significantly in their connections with each other, in their size and course, both unilaterally or bilaterally [10].

Literature review suggests that undivided RMV is the most typical variation [11]. When undivided, it had continued as EJV or contributed to form EJV by uniting with the posterior auricular vein. In such a situation, it was reported that the FV drained into the EJV in the neck [12]. In the present case report, we observed an unusual formation of RMV by the union of superficial temporal. The facial vein and MV joined it as a tributary inside parotid gland. The formation of RMV presented in the current report is unique and is rarely reported in the literature. Such variations are of clinical significance while performing interventional radiologic procedures such as direct puncture venography for done for evaluation of hemodynamics in case of venous malformations [13].

The studies reporting the undivided RMV have also reported the variations in the EJV [8,11]. When undivided it may join with the FV [14]. At times, there would be a communicating venous channel between EJV and the LJV. The jugular veins could be duplicated or fenestrated in their course in the neck region [5,6,15,16]. However, the fenestrated vein is the one, which has a single trunk at its



**Fig. 1.** Cadaveric specimen and its schematic representation showing the facial vein (FV) joining with the superficial temporal vein (STV) forming the retromandibular vein (RMV). Maxillary vein (MV) drains into RMV. Anterior division (AD) of RMV joins with the submental vein (SMV) to form an anomalous trunk (AT), which joins later with the external jugular vein (EJV) and forms a common trunk (CT) that drain into the subclavian vein (SV). Posterior division (PD) of RMV joins with the posterior auricular vein (PA) to form EJV. SCM: Sternocleidomastoid, PG: Parotid gland, FA: Facial artery, GAN: Great auricular nerve.

formation and termination but split in its course. In contrast, a duplicated vein will have double venous trunks throughout its course [5, 17]. The case, which we have reported, does not fit both the above criteria because the EJV and the anomalous venous trunk united in the lower neck and drained into the SV.

In the current case report, we consider the vein, which accompanied the great auricular nerve as EJV because it had the usual formation and course. However, we considered the venous channel formed by the union of the anterior division of the RMV and the submental vein as an anomalous venous trunk because it had an unusual origin, course, and termination.

Right-sided venous variations show a higher prevalence than those on the left [18]. Even the present case report revealed normal venous pattern on the left with variation only in the right side.

The veins of the head and neck start developing embryo (5 mm stage), wherein the first and second pharyngeal arch veins drain into the common cardinal vein through the 'ventral pharyngeal vein' (VPV). The termination of VPV shifts cranially due to the neck's elongation and gives rise to the IJV. Blood of the head and neck area is drained into the 'primitive maxillary vein' (PMV). Later, a 'linguofacial vein' (LFV) drains the face and tongue and terminates into VPV. PMV decreases in size, and tributaries of PMV and LFV anastomose with each other. At the 18 mm, stage of the embryo, the LFV becomes the FV and receives the RMV from the temporal region. The stem of FV beyond the union of RMV forms the common facial vein (CFV) and drains into IJV [19]. In our case report, the primitive connection between the FV and the RMV is persistent, and the PMV joined the trunk of RMV as a tributary. In the present case report, the stem of the FV beyond the drainage of RMV disappeared, and therefore, there was no CFV.

Simultaneously a venous plexus formed by the 'primitive cephalic vein' and 'jugulocephalic vein' (JCV) will surround the developing clavicle. At the 22 mm stage of the embryo, the JCV disappears. The craniodorsal part of the venous plexus forms the trunk of the EJV [19]. In the present case report, the persistent JCV has formed the anomalous venous trunk.

This type of variable pattern of veins in the neck is scarce. The surgeons need to be aware of such variations to avoid intraoperative vascular injury during surgical procedures.

Variation in the formation of the RMV is scarce. There was an anomalous venous trunk in the neck, which united with the EJV. Such variations are clinically significant for surgeons and intervention radiologists during the surgical procedures in this region.

#### Author contribution statement

All authors listed have significantly contributed to the investigation, development and writing of this article.

#### Data availability statement

No data was used for the research described in the article.

#### Additional information

No additional information is available for this paper.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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