



Review Article

Review of Thyroid Cartilage Compression of the Vertebral Artery

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Abstract

Thyroid cartilage compression of the Vertebral Artery (VA) has been implicated as a rare cause of Rotational Vertebral Artery Occlusion (RVAO). 10 cases have been reported in the literature. This has a higher tendency to affect males and younger patients than other forms of stroke. Patients present with multiple episodes prior to diagnosis. Radiologic studies prove crucial for confirming this condition. An aberrant VA course appears to be a necessary factor. All cases suffer from right side VA compression by the superior thyroid cornu. Conservative therapy with antiplatelet treatment is employed commonly. Most patients have definitive treatment with surgical resection of the right superior thyroid cornu. Theories proposed for these characteristics include VA dominance, structural variability in the thyroid cartilage between genders and also variable thyroid cartilage ossification. Given these findings, we propose the term “thyro-vertebral artery syndrome” for this condition.

Keywords: Vertebrobasilar Insufficiency; Stroke; Rotational Vertebral Artery Occlusion; Thyroid Cartilage

Introduction

Rotational Vertebral Artery Occlusion (RVAO), also known as Bow Hunter’s syndrome, refers to mechanical occlusion of the Vertebral Artery (VA) causing symptomatic Vertebrobasilar Insufficiency (VBI) [1]. This compromises blood flow into the posterior cerebral circulation and can lead to recurrent stroke. Due to its rarity, there are no established guidelines for diagnosis and treatment.

There is a wide range of aetiologies which can be divided into intrinsic (eg atherosclerosis, aneurysm) and extrinsic (external compression) causes of vascular occlusion. The most prevalent cause is degenerative vertebral disease (osteophytes, spondylosis, disc herniation) in over 50% of cases [1]. A review by Schulz involving 194 cases showed thyroid cartilage impingement accounted for 3 (1.5%) of the reported cases [1]. Previously identified epidemiological features include a slightly higher prevalence in men and relatively younger age category (50-70 years old) than other stroke patients [1,2]. The vertebral arteries are paired vessels that ultimately perfuse the posterior cerebrum. Insufficient flow through the VAs can cause Vertebrobasilar Insufficiency (VBI) [3,4]. Symptoms of VBI include syncope, dizziness, vertigo, nausea, vomiting, ataxia, visual disturbance and headache [4-6].

Methods

An extensive review of the literature was conducted based on Medline. A search was performed for articles in the English language without time restrictions. The keywords used were: thyroid cartilage, rotational, vertebral artery occlusion, vertebrobasilar insufficiency, Bow hunter’s syndrome, stroke.

Results

A literature review found 8 papers describing 10 patients [2-9]. The earliest work is from 2008. Five papers were published in 2023.

The mean age of presentation was 43 years old (range 18-79) and 6/10 were younger than 50 years old. 8/10 were in male patients. 7/10 cases were triggered by head rotation to the right side. 9/10 had >1 presentations to the hospital prior to diagnosis. Duration between onset and diagnosis ranged between 1 day to 6 years (median duration 4 months) (Table 1).

Symptoms were reported for 8 cases. Common symptoms include vertigo (5/8), headache (4/8), vision change (3/8) and nausea and vomiting (3/8) (Table 2).

All patients had multiple radiologic modalities employed as part of diagnostic workup, ranging between 2-4. 70% had CT, 70% had CTA, 70% had MRI, 70% had DSA, 20% had USS. The most common combination was CT or CTA +/- MRI or DSA.

All 10 cases had an aberrant extraforaminal course of the right Vertebral Artery (aVA).

6 out of 7 reported cases had a left VA abnormality with either aberrant course or anatomical pathology (hypoplasia, stenosis, compression). All cases involved compression of the right VA. 9/10 had dynamic radiologic imaging confirming VA compression by the thyroid cartilage (Table 3). Surprisingly, a case by Suhs had resection of the right superior cornu as a last resort treatment with a successful outcome despite no VA compression seen on radiological imaging at any point [3].

8/10 had a trial of medical therapy with antiplatelet or anticoagulant medication and 7/10 had recurrent symptoms despite medication. 9/10 had surgical treatment. 8/10 involving resection of the right superior cornu of thyroid cartilage. 7 cases were successful while 1 case required a revision surgery. 6 cases required additional surgical procedures for multifocal abnormality (Table 4).

Author (year)	Age	Gender	Head Trigger	Episodes of Insult	Comorbidities
Dabus (2008)	41	Male	Right rotation	1x	Fit and well
Karle (2019)	54	Female	Flexion	2x in 1 year	Obesity, iron deficiency anaemia, uterine fibroids
Rendon (2019)	79	Female	Right rotation	2x in 4 month	Type 2 diabetes mellitus, hypercholesterolemia, hypertension, osteoarthritis
Jongbloed (2023)	18	Male	Right rotation	2x in 2 month	Anxiety
Hong (2023)	29	Male	Right rotation. Neck extension	Multiple over 6 years	Fit and well
Spence (2023)	42	Male	Mouth opening	4x over 5 year	Ex-smoker
Haertl (2023) A	50-60	Male	NA	6x over 23 months	NA
Haertl (2023) B	50-60	Male	Right rotation	3x over 3 months	NA
Suhs (2023) A	36	Male	Right rotation	6x over 1 month	NA
Suhs (2023) B	28	Male	Right rotation	11x over 4 months	Epilepsy

Table 1: Demographic data (NA: not reported).

Symptoms	Vertigo	Headache	Vision Change	Nausea and Vomiting	Neck pain	Dizzy	Other
Dabus (2008)						X	
Karle (2019)	X		X	X			Confusion, dysarthria
Rendon (2019)						X	
Jongbloed (2023)		X	X	X	X		Photophobia, phonophobia
Hong (2023)	X						Syncope
Spence (2023)	X	X			X		
Suhs (2023) A	X	X	X				Ataxia
Suhs (2023) B	X	X		X			
Haertl (2023)							Not reported

Table 2: Presenting symptoms.

Vertebral Artery Anatomy	Right Side	Left Side	Thyroid Cartilage Compression	Compression Seen on Radiology
Dabus (2008)	Right aVA-C4.	Left VA compression at C1-2.	Right side	Yes
Karle (2019)	Right aVA-C3.	Left aVA-C5.	Right side	Yes
Rendon (2019)	Right aVA-C2.	Left hypoplastic VA.	Right side	Yes
Jongbloed (2023)	Right aVA-C4.	Left VA-C6 (normal).	Right side	Yes
Hong (2023)	Right aVA-C4.	Left VA hypoplastic.	Right side	Yes
Spence (2023)	Right aVA-C5.	Left aVA-C3. Left VA small with stenosis.	Right side	Yes
Haertl (2023) A	Right aVA-C4.	NA	Right side	Yes
Haertl (2023) B	Right aVA-C4.	NA	Right side	Yes
Suhs (2023) A	Right aVA-C4.	NA	Right side	Yes
Suhs (2023) B	Right aVA-C4.	Left aVA-C5.	Right side (presumed)	No

Table 3: Vertebral artery appearance on radiology (aVA-C4: aberrant vertebral artery with entry at C4 level; NA: not reported).

Author (year)	Pre-op Medication	Surgery	Post-op Medication
Dabus (2008)	Aspirin	Not done	Aspirin indefinitely
Karle (2019)	Aspirin	Resection of superior cornu of thyroid cartilage.	Aspirin 2 months.
Rendon (2019)	NA	Resection of superior cornu of thyroid cartilage. Division of levator scapulae.	NA
Jongbloed (2023)	NA	Resection of superior cornu of thyroid cartilage.	NA
Hong (2023)	Aspirin	Removal of C6 anterior tubercle- failed. Resection of lateral thyroid cartilage and superior cornu.	NA
Spence (2023)	“Various antiplatelet and anticoagulant”	Resection of superior cornu of thyroid cartilage.	NA
Haertl (2023) A	Aspirin	Previous VA endovascular stent- failed due to stent fracture. Surgical bypass of VA from anterior occipitalis to V3 segment.	Aspirin for 12 months.
Haertl (2023) B	Heparin	VA Endovascular stent and resection of thyroid cartilage. Revision procedure 3 months later.	Aspirin, Clopidogrel.
Suhs (2023) A	Aspirin.	Resection of superior cornu of thyroid cartilage and C5 transverse process tubercle.	Dabigatran 6 months.
Suhs (2023) B	Aspirin, then Dabigatran.	Resection of superior cornu of thyroid cartilage and C5 transverse process tubercle.	Phenprocoumon and Aspirin for 6 months, then Aspirin only.

Table 4: Treatment (NA: Not reported).

Discussion

This review of case reports demonstrates emerging trends for this disease. This will assist identification of future cases and direct future research for this rare condition.

The majority of RVAO can be attributed to bony vertebral disease. The most common location for RVAO is C1-2 due to the relative immobilisation of the VA at the transverse foramen [6,8]. However, Schulz showed that 54% of cases occur at a subaxial level (below C2 vertebrae) [1]. Compared to RVAO due to cervical vertebrae disease, cases due to thyroid cartilage have a stronger predilection to affect males and younger patients (<50 years old).

The normal VA enters the cervical spine at the level of C6 via the transverse foramen, occurring in 90% [9]. At this point, the artery travels superiorly and is protected by the cervical spine. Aberrant variations in entry between C2-C6 have been reported at low rates (4-7%) [4,9] Entry at a level higher than C6 allows for extrinsic compression by structures within the neck [5]. This is confirmed by our review showing all cases had an aberrant extraforaminal course of the affected VA.

Another area of interest is the apparent vulnerability of the right VA to compression (all cases reported thus far) and whether this relates to the well-known phenomenon of VA dominance which hitherto has not been attributed to any clinical significance. This refers to asymmetry of the vessel size and blood flow. The left VA shows dominance 50% of the time and the right VA in

25% [10]. It is well known that blood flow in the vertebrobasilar system can be preserved with unilateral VA [8]. It is argued that VA compression becomes symptomatic when the dominant VA is compressed in the presence of a hypoplastic contralateral VA [7]. This would be supported by our review where the majority of cases also had an abnormal contralateral VA.

There are a number of factors that may explain thyroid cartilage involvement in these cases. The male predominance may relate to men having larger thyroid cartilage dimensions including horizontal length of the laminae than women [11]. Men have a smaller thyroid angle leading to a prominent Adam's apple anteriorly, but also a relatively more posterior extension compared to woman [11]. Combined with the anterior displacement of an aberrant VA, this proximity increases the risk of VA compression.

Thyroid cartilage ossification is variable but usually begins in early adulthood [12]. The posterior aspect ossifies first. Local factors such as pattern of voice use and/or irritation from a nearby vascular structure may influence ossification. Ossification of the thyroid cartilage and superior cornu specifically have been implicated in another condition, called superior thyroid cornu syndrome [13]. Displacement either congenital or acquired (likely trauma) or elongation from ossification can lead to superior cornu protrusion into the pharyngeal lumen. This may be visible on endoscopy. Symptoms may range from globus to odynophagia [13]. This is a benign condition and can be managed conservatively. Surgical excision can be considered for symptomatic cases.

As a conceptual framework, similarities can be found between the pathology affecting the superior thyroid cornu and the styloid process. Eagle syndrome is associated with elongation of the styloid process or calcification of the stylohyoid ligament [14]. This most commonly presents with globus, dysphagia and odynophagia. A rare variant is stylocarotid artery syndrome where the styloid process impinges on the carotid artery which may also lead to stroke [14].

In similar fashion, one could hypothesise that superior thyroid cornu syndrome has a vascular variant leading to risk of stroke, a so-called "thyro-vertebral artery syndrome". The hypothesis put forward posits that abnormal enlargement, deflection or ossification of the superior cornu results in compression of an already vulnerable aberrant VA. Further research should interrogate whether anatomical structure of the thyroid cartilage and superior cornu is significantly abnormal as a contributing risk factor for development of RVAO.

Treatment options for this condition include conservative and surgical. Conservative treatment includes education and avoidance of prolonged head rotation, use of cervical orthosis and preventative antiplatelet or anticoagulant therapy [1,6]. Choi, et al., pushed a series of 21 patients with RVAO and 19 of them were managed conservatively with good outcome [15]. In contrast, our review shows that the majority of cases where the thyroid cartilage is involved have recurrence with conservative treatment.

Surgical treatment of the offending structure is commonly employed (79%) in RVAO [1]. This may either be a decompression or fusion procedure or combined. In thyroid cartilage cases, resection of the superior thyroid cornu appears sufficient with a high rate of success. The advantage of surgery includes the ability to resume normal activity and avoidance of long-term medication [5,7].

Conclusion

The analysis of relevant case reports provides information on common features of this condition which will help direct future research. Thyroid cartilage compression of the VA is a rare cause of RVAO. Interesting features include the presence of an aberrant VA course in these cases and also the unilaterality of affected cases. Surgical treatment with resection of the superior thyroid cornu is effective. Increasing awareness of the possibility of thyroid cartilage being implicated in cases of recurrent posterior circulation stroke is necessary given its tendency to affect young patients who may suffer long-term sequelae amid delays in diagnosis.

Conflict of Interest

The author has no conflict of interest to declare.

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