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RESEARCH ARTICLE

INCIDENCE AND MORPHOLOGY OF ACCESSORY FORAMEN TRANSVERSARIUM IN TYPICAL CERVICAL VERTEBRAE

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Abstract

Introduction: Cervical vertebrae shows presence of foramen transversarium on transverse process. It is formed by the fusion of the costal element with the true transverse process of cervical vertebrae. the vertebral artery, vertebral vein,and sympathetic nerves passes through the foramen. In seventh cervical vertebrae passes vertebral vein. These foramina shows variations in size, shape and number. Variation of these foramina may lead to many symptom.

Material and Method: Our study include 440 typical cervical vertebrae from various medical collage of Gujarat. All these vertebrae observed macroscopically for variation of foramina transversarium. Findings were noted and photographed.

Result: Accessory foramen transversarium is found in 89 (20.22%) vertebrae. Out of 89 typical cervical vertebrae, 62(14%) vertebrae shows complete Accessory foramen transversarium and 27(6.13) vertebra shows incomplete accessory foramen transversarium. Bilateral complete foramen transversarium is found in 24 vertebrae. 22 vertebrae shows right side complete AFT and 16 vertebra with left side complete AFT. Bilateral incomplete foramen transversarium is found in 8 vertebrae. 8 vertebrae with right side incomplete AFT and 11 vertebra with left side incomplete AFT.

Conclusion: Knowledge of these variation is helpful for the neurosurgeon and radiologist for interpretation of x-ray and planning surgery.

Introduction:-

The Cervical vertebrae are identify by the presence of foramen transversarium in the transverse process. Foramen transversarium is formed by the fusion of the costal element with the transverse element. It contain anterior root, posterior root and costotransverse bar. Anterior and posterior root laterally continue with the anterior and posterior tubercle. Costal element contain the anterior root, anterior tubercle and costotransverse bar connecting the tubercle.Foramen transversarium lies between costal element anteriorly and true transverse element posteriorly[1].

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The foramen transversarium transmits the vertebral artery vertebral vein and sympathetic fiber from the inferior cervical ganglion except the seventh cervical vertebrae which transmit only vertebral vein. The vertebral plexus in upper part of the foramen, in lower part plexus unite to form a single vein which runs in front of the artery[2]

Any deviation of foramen transversium affect the course and Diameter vertebral artery.Presence of one more foramen other than foramen transversarium in the transverse process of cervical vertebrae is called accessory foramen transversarium. Accessory foramen transversarium is smaller in size than foramen transversarium andlies behind the foramen transversarium[2].It is commonly found in the lower typical cervical vertebrae[4].

Variation in size shape number and diameter of Accessory foramen transversarium can affect the circumference of vertebral artery which may result in headache, migraine & fainting attacks.Clinically this type of variation is important for the radiologist, surgeons and neurologist while doing surgeries, CT scan and MRI[4].

Aims and Objective:-

To compare the incidence of Accessory foramen transversarium among the typical, atypical, upper and lower cervical vertebrae and Study the morphology of accessory foramen transversarium and to calculate its incidence in dry cervical vertebrae.

Material and Methods:-

The present study was conducted on 440 dried typical cervicalvertebrae obtained from the various medical colleges of Gujarat. Only complete vertebrae, which were not broken, were included in the study. All these vertebrae were observed macroscopically, for the presence of accessory foramen transversarium. All the vertebrae having accessory foramentransversarium were photographed and the findings were noted.

Result:-

Out of the 440 typical cervical vertebrae, accessory foramen transversarium is found in 89 (20.22%) vertebrae. Out of 89 typicalcervical vertebrae, 62(14%) vertebrae shows complete Accessory foramen transversarium and 27(6.13) vertebra shows incomplete accessory foramen transversarium.Bilateral complete foramen transversarium is found in24 vertebrae. 22 vertebrae shows right side complete AFT and 16 vertebra with left side complete AFT. Bilateral incomplete foramen transversarium is found in 8 vertebrae. 8 vertebrae with right side incomplete AFT and 11 vertebra with left side incomplete AFT. Unilateral AFT is more common on right side.

The accessory foramen transversarium found in typical cervical vertebrae are much smaller in size than the main Foramen Transversarium and they present posterior to the main foramen. A thin bar of bone separates the accessory foramen from the main one.

Discussion:-

Embryologicalyin the cervical region somatic intersegmental artery link up with oneanother and form the longitudinal anastomotic channel. It is a precostal, postcostal and post transverse anastomosis. Postcostal anastomosis form the major part of the vertebral artery. Intersegmental artery regress and persistant of part of seventh intersegmental artery forms subclavian artery and beginning of vertebral artery. Persistant of intersegmental artery lead to duplication of vertebral artery. Vertebral artery traverses through the foramen, it leads to duplication of foramen transversarium.[3]

We found AFT in 89(20.22%) of typical cervical vertebrae which is nearer to the finding of Esakkiammal N et al,Kaur S et al and shubhas et al. We found complete AFT in 62 vertebra,bilateral AFT is in 24 vertebrae and unilateral complete AFT in right side 22 and 16 AFT found in left side. Study of AFT in typical cervical vertebrae is given in table 3.

We found complete AFT more common on right side that goes with the study of Rakesh Ranjan et al and Kaur S et al.

Rakesh Ranjan et al observed Accessory foramen transversarium found in 24(14.12%) out of 170 cervical vertebrae.Among these 24 vertebrae, 16 (9.41%) are typical and 8 (4.71%) are atypical cervical vertebrae. Bilateral

AFT is present in 3 typical and 1 atypical vertebrae.More common on the right side in typical and atypical vertebrae**.4**

Sarita Behera et al,observed 367 vertebrae. AFT found in 11.44% of vertebrae. Among these 18 (4.9%) was bilateral and 22 (6.0%) was unilateral 2 (0.54%) vertebrae there was triplication of foramen transversarium. In 261 (71.1%) of vertebrae the foramen transversarium was symmetrical in both sides but in 106 (28.9%) it was asymmetrical. In 34 vertebrae (9.26%) there was incomplete duplication out of which 9 (2.45%) was bilateral and 25 (6.81%) was unilateral. Osteophytic encroachment was found in 14 (3.81%) vertebrae. identified accessory foramen transversarium variations, including double (10.9%), triplication (0.54%)[5.]

Esakkiammal N et al observe 134 typical cervical vertebrae, Accessory FT was seen in 37 (27.6%) vertebrae. Bilateral complete AFT in 4 (2.9%). Incomplete AFT 9 (6.7%), unilateral complete 6 (4.5%) and unilateral incomplete12 (8.9%) were observed. Six (4.5%) typical cervical shows unilateral complete AFT and incomplete AFT on otherside of the same vertebrae[6].

Motagi Vishwanath et al,. The incidence of AFT was 20% in the cervical vertebrae including both typical and atypical vertebrae. The presence of AFT was more common in typical cervical vertebrae as compared to atypical vertebrae. Unilateral AFT was more commonly seen[7].

Md. Jawed, Akhtar et al observe 174 cervical vertebrae, accessory foramen transversarium is found in 25 (14.36%) vertebrae. Among these 25 vertebrae, 16 (9.19%) are typical and 9 (5.17%) are atypical cervical vertebrae shows AFT[8].

Shital T Shah et al found 34 (16.19%) out of total 210 vertebrae studiedpresented accessory foramen transversarium.complete accessory foramen transversaria on both sides were found in 10 cases and unilateral in 12 vertebrae[9].

Chaudhari et al observe 133cervical vertebrae, accessory foramen transversarium was found in 22(23.15%) vertebrae. Among 14 vertebrae with unilateral accessory foramen transversarium and 8 vertebrae with bilateral AFT.They found AFT 12(16.19%) in typical cervical vertebrae and in 10 (14%) atypical cervical vertebrae[10].

Chandravadiya Laxmi et al observed 210 cervical vertebra, accessory foramen transversarium are present in 10 vertebrae (4.76%). Unilateral in 8 vertebrae and bilateral in 2 vertebrae[11].

Subhas et al observe 150cervical vertebrae, accessory foramen transversarium was found in 41(27.33%) vertebrae. Among 41 vertebrae unilateral accessory foramen transversarium was found in 27(18%) vertebrae and bilateral was found in 14(9.33%) vertebrae[12].

Ambali MP et al observe accessary foramen transversarium in 24 (14.72%) vertebrae. Among these 16 (9.81%) vertebrae were having bilateral and 8 (4.90%) vertebrae had unilateral accessary foramen transversarium[13].

Rachna Magotra et al found Out of 150 vertebrae 24 cervical vertebrae with accessoryforamen transversarium. Amongst them 14 (58%) bilateral accessory foramen transversarium and9 (42%) had unilateral accessory foramentransversarium. Accessory Foramen transversarium present in third, fourth, fifth and sixth cervicalvertebrae, only intypical cervical vertebrae[14].

Gyata Mehta et al observe 750 cervical vertebra. Accessory FT was seen in 113 (15%) vertebrae and it varied with the level of cervical vertebrae. Maximum number of accessory FT was seen in typical cervical vertebrae 73 (64.6%). Bilateral Accessory foramen transversarium present in 30 (4%), unilateral AFT present in 83 (11%) of vertebrae[15].

Apurba PATRA et alfound Accessory foramina were found in 40 cervical vertebrae out of 200 cervical vertebrae. Bilateral accessory foramina were slightly more common than a unilateral accessory foramen. Accessory foramina occurred in a particular pattern, with incidence increasing with descending order of cervical vertebrae, and were most commonly found in C7[16].

Mishra et al observe 6th cervical vertebrae with bilateral double foramen transversarium and nonbifid spine[17].

Kaur S et al, studied 100 typical cervical vertebrae for shape and number of foramen transversarium. The oval shape was mostly observed in 45% and 44% on the right and left sides. The accessory foramen transversarium seen in 22 vertebrae which is 22%. The AFT was mostly observed on the right side[18].

Poonam Verma et al, observed 16(8%) of vertebra with accessory foramen transversarium out of 200 cervical vertebrae. Accessory foramen transversarium found in 2 atlas vertebra, 8 typical cervical vertebrae and 6 in 7th cervical vertebrae[19].

Table 1:- Incidence of accessory foramen transversarium in typical cervical vertebrae.

Type of accessory foramen transversarium	Bilateral	Unilateral		Total number accessory foramen transversarium	Percentage of accessory foramen transversarium
		Right	Left		
Complete	24	22	16	62	14%
Incomplete	8	8	11	27	6.13%
Total	32	30	27	89	20.22%

Table 2:- The comparison of the no. of AFT and incidence of AFT.

Authors	No. of vertebrae examined	B/L AFT	U/L AFT	Total	Incidence (%)
Rakesh Ranjan et al[4]	170	4	20	24	14.12%
Esakkiammal N et al[6]	241	10	27	37	27.6%
Chaudhari ML et al[10]	133	8	14	22	23.15%
Subhas et al[12]	150	14	27	41	27.33%
Rachna Magotra et al[14]	150	14	09	24	16%
Gyata Mehta et al[15]	750	30	83	113	15%
Apurba Patra et al[16]	160	14	12	26	16.25%
Kaur S et al[18]	100	14	09	22	22%
Sarita behera et al[5]	367	18	22	40	10.9%
Md Jawed Akhtar et al[8]	174	5	20	25	14.36%
Monica Gupta et al	161	17	25	42	26.09%
Poonam Verma et al[19]	200	13	03	16	8%
Present study	440	32	57	89	20.22%

Table 3:- The comparison of complete and incomplete accessory foramen transversarium.

Authors	Complete AFT	Incomplete AFT
Esakkiammal N et al[6] (134)	13	18
Sarita Behera et al[5] (367)	6	34
Kaur S et al[18] (100)	15	8
Subhas et al[12] (150)	33	8
Present study	62	27

Table 4:- Comparision of accessory FT in typical Cervical Vertebrae.

Authors Total number of CV	Percentage of accessory FT in typical CV
Md jawed akthar et al[8](126)	16 (9.19%)
Rakesh ranjan et al[4](123)	24 (14.72%)
Manoj P Ambali et al[13](163)	16 (9.81%)
Gyata Mehta[15](265)	73(2.54%)
Rachna Magotra et al[14] (150)	24(16%)

Motagi Vishwanath et al[7] (55)	16(29.09%)
Kaur S et al[18] (100)	22(22%)
Esakkimal N et al[6] (134)	37 (27.6%)
Monica Gupta et al[20](92)	33(35.8%)
Poonam Verma et al[19] (160)	10(6.25)
Present (440)	(20.22%)

Fig 1:- Bilateral complete Accessory foramen transversarium.

Fig 2:- Unilateral complete accessory foramen transversarium.

Fig 3:- Bilateral incomplete accessory foramen transversarium.

Fig 4:- Unilateral incomplete accessory foramen transversarium.

Conclusion:-

We found accessory foramen transversarium in 22% of vertebra from 440 atypical cervical vertebrae. Presence of AFT is important because it affect the course of vertebral artery. It is helpful to Radiologist to interpret xray, and to spine surgeon for planning surgery. It is also helpful to the clinician, anthropologist, surgeons, and forensic expert.

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