Anat., Histol., Embryol., 4, 24—37 (1975)

ISSN 0044-4294/ASTM-Coden: AHEMA5

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The Foramina of the Cervical Vertebrae of the Ox

Part II: Cervical Vertebrae 3—7

By

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With 18 figures

(Received for publication November 19, 1973)

Cervical vertebra No. 3

External surface

The spinous process was clearly bifid in all adult specimens. That of the young ones inclined to be that way, but less so. Pores covered the surface. There was always a number of foramina along the cranial and caudal aspects of the process (medium to very small). They were more numerous and prominent along the cranial aspect (Fig. 20). The dorsal concavity of the spinous process was relatively free of foramina and none were found on its lateral surfaces.

There were always pores and a number of small or very small foramina on the concave dorsal surface of the laminae. They were concentrated in the area just caudal to the cranial articular surface. Pores occurred over the lateral aspects of the cranial articular processes and over the dorsal aspect of the caudal articular processes. A number of medium to very small-sized foramina could occur on the lateral surface of the cranial articular process (Fig. 21).

The "canalis transversarius" measured 27—36 mm. in adult vertebrae, the "cranial transverse foramen" being rounded (6—12 mm.) in diameter and the "caudal transverse foramen" having an oval shape (3—7 mm. × 10—14).

The craniomedial wall of the "transverse canal" was more concave than the caudal part. In the roof of this concavity, 9—16 mm. caudal to the cranial vertebral incisure in the adult, a foramen (1—3 mm. in diameter; 0.25—0.5 mm. in very young specimens) was present which led into the vertebral foramen. This opening will, as in C_2 be referred to as the vertebral opening of the "transverse canal" (Fig. 21 e_3). The connection was mostly direct (lateromedialward). The left vertebral opening might lie more cranially than the right and *vice versa*.

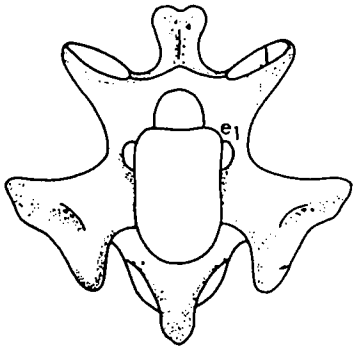


Fig. 20 C3 Cranial

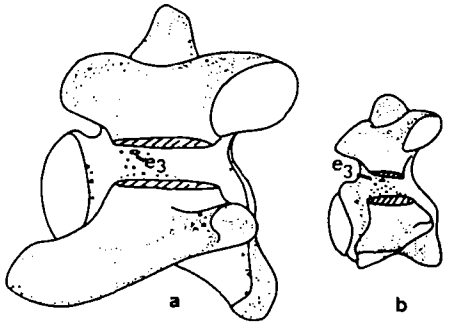
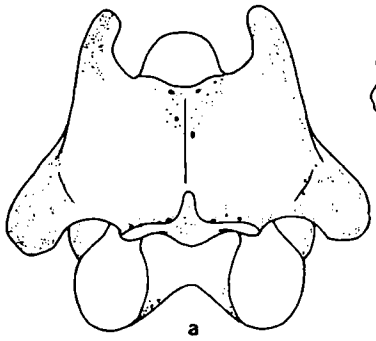


Fig. 21 C3 Lateral a : adult b : very young



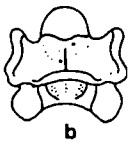


Fig. 22 C3 Ventral a : adult
b : very young

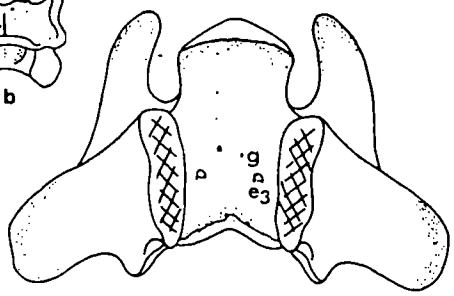


Fig. 23 C3 Dorsal. Laminae removed

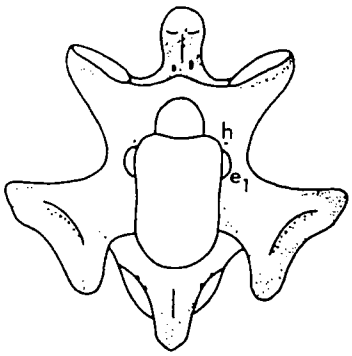


Fig. 24 C4 Cranial

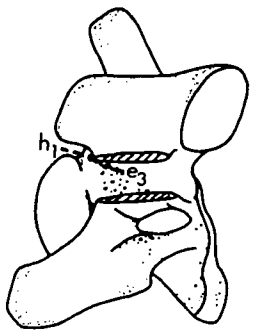


Fig. 25 C4 Lateral

Apart from the above foramen, the most constant and prominent foramina found were those which lead from the "transverse canal" into the pedicles, body and base of the transverse processes (Fig. 21 a & b). They were present in the concavity in the craniomedial wall of the "canal".

In all the young specimens the above area was cribriform, covering the cranial three quarters of the "transverse canal". It gradually disappeared caudalward. The openings varied in size from medium to very small (Fig. 21 b). In the adult this same cribriform arrangement of foramina occurred in half the number of specimens, although occupying a smaller area. The remaining adults had a variable number of mostly medium-sized openings, most numerous cranially, with a few occurring caudally and ventrally along the floor of the canal (Fig. 21 a).

The transverse processes had a number of foramina (medium to small) laterally in the fossa between the dorsal and ventral tubercles (Fig. 21 a). In the very young specimens these foramina were not prominent and appeared as part of porous areas (Fig. 21 b). In half the adults (none of the young ones) the ventral surface of the transverse process contained small to very small openings, uni- or bilaterally, along a line connecting the ventral tubercle with the body (Fig. 22 a). Pores were present over most of the surface of the dorsal tubercle. The lateral fossa between dorsal and ventral tubercles was always porous with an area extending cranialward to the free surface of the transverse process and along the ventral border of the latter (Fig. 21) as well as extending over the ventral aspect of the ventral tubercle (Fig. 22 a). In very young specimens these surfaces were well covered with pores, foramina being absent (Figs. 21 b & 22 b).

On the ventral surface of the body in the young specimens a medium to small foramen could be present on either side of the ventral spine, with one or two very small foramina placed a little more caudally (Fig. 22 b). This transverse row of openings could be augmented by a couple of small to very small ones. About 10 mm. caudal to the cranial epiphyseal line a large or medium-sized foramen was usually present in the depression bordering the ventral spine. In 65 % of cases it occurred bilaterally, and could be double on one or both sides. Only one specimen had no foramina in this position. Smaller openings could occur in the vicinity.

In the adult the ventral surface of the body constantly had a large to medium-sized foramen along the caudal aspect of the cranial epiphyseal line (Fig. 22 a). In most cases there were at least two openings of this calibre.

Along the caudal epiphyseal line of the adult there were always foramina — medium to very small — on either side or on both sides of the line (Fig. 22 a). In young specimens there were markedly fewer foramina here. In those six months of age and less, they were very small or absent (Fig. 22 b).

Internal Surface

The "basivertebral foramina" on the dorsal face of the body were smaller and less regular than in C 2. When present, they occurred approximately halfway between the cranial and caudal extremities of the body, on either or on both sides of the dorsal ridge (Fig. 23 g). They averaged 0.75 mm. in diameter. Although foramina occurred bilaterally in 65 % of cases, only 25 % could be described as possessing equal bilateral foramina.

A few medium to small openings (in some cases pores only) occurred along a line cranial and parallel to the caudal epiphysis.

Foramina occurred inconstantly caudally to the cranial epiphysis. Usually one to four of the small to very small calibre foramina were present, or the internal surface in that region was beset by pores.

The vertebral opening of the "transverse canal" (Fig. 23 e_3) was always larger than the "basivertebral foramina" and varied between 1—2 mm. in all

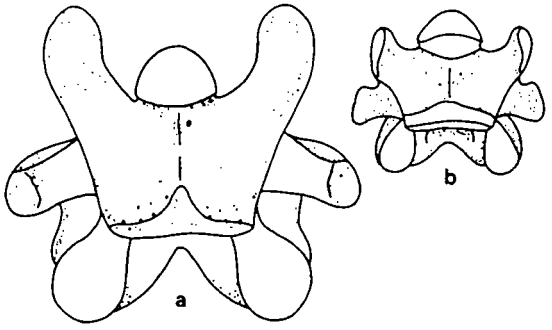


Fig. 26 C4 Ventral

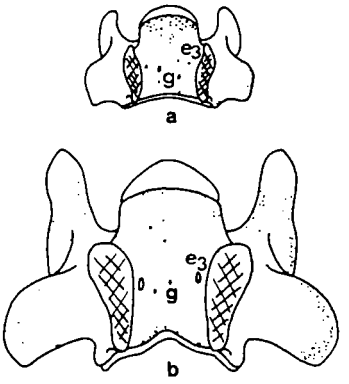


Fig. 27 C4 Dorsal. Laminae removed a : very young b : adult

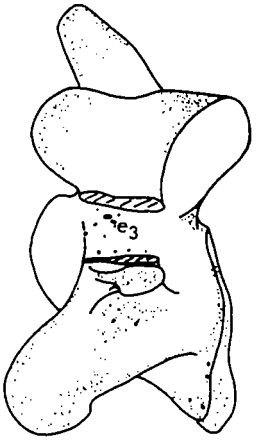


Fig. 28 C5 Lateral

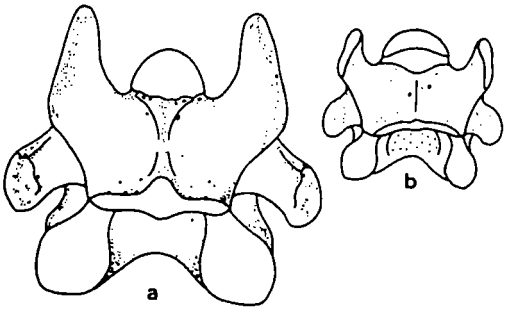


Fig. 29 C5 Ventral a : adult b : very young

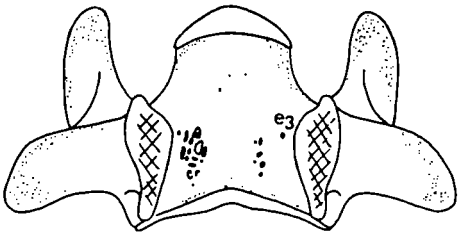


Fig. 30 C5 Dorsal. Laminae removed. Fossae with or without foramina in position of "basi-vertebral foramina"

specimens of 12 months and older. The left and right foramina occurred mostly on different transverse planes.

In three very young specimens the roof and sides of the laminae were covered by small to very small foramina and pores.

In older and adult vertebrae the laminae were usually free of foramina. Pores did mostly occur along the caudal edge and in three cases there were small to very small foramina in addition.

Cervical vertebra No. 4

External surface

Generally in specimens up to twelve months of age, definite foramina were rare and practically absent on the exterior (Figs. 26 b; 27 a). Pores covered almost the entire surface of the vertebra except the epiphyseal lines, which were covered by cartilage. When foramina did occur they were found in the following areas:

1. *Dorsally* along the cranial and caudal aspects of the spinous process (small to very small; absent in specimens 5 months and younger). A variable number of small to very small openings were constantly found in the concavity between the cranial and caudal articular processes in specimens aged six months and older.
2. *Laterally* along the cranial epiphyseal line (medium to small).
3. *Ventrally* on the body, caudal to the cranial epiphysis, on either side of the ventral spine (medium to small).

Except when specially mentioned, the description which follows will therefore apply to adult specimens including those over twelve months of age.

Along the cranial surface of the spinous process three to six large to small foramina occurred in the adult (Fig. 24). They were considerably larger than in the preceding vertebra (Fig. 20). They occurred either at the base of the spinous process or below the proximal expansion.

Dorsally in the concavity between the cranial and caudal articular process a variable number of small to very small openings were constantly found. The lateral surface of the laminae was strikingly free of perforations.

The length of the "transverse canal" measured 25—34 mm. The diameter of the "cranial transverse foramen" varied between 5—10 mm.; that of the "caudal transverse foramen" between 6—16 mm.

As in C 3 the greatest concentration of foramina occurred along the cranial half to three quarters of the medial wall of the "transverse canal" (Fig. 25). As in C 3 they produced a cribriform pattern and were distributed over a larger area in the very young. The vertebral opening of the "transverse canal" (Fig. 25 e_3) was constantly present and varied between 0.5—3 mm. in diameter. Medium to small-sized openings entered the pedicle, body and base of the transverse process. There could also be a few which entered the lateral wall of the canal.

In 60 % of cases a foramen occurred in the cranial aspect of the pedicle (Fig. 24 h). It was located either laterally, medially or centrally in the cranial vertebral incisure. In 30 % of the specimens it was present bilaterally. The two foramina were not necessarily of the same diameter or position. The diameter varied between 0.2 and 2.0 mm. By inserting a bristle, a connection was demonstrated in four specimens between this foramen and the roof of the vertebral opening of the "transverse canal" (Fig. 25). It seemed possible that the narrow passage was either blocked in the remaining cases or that it ended in the spongy bone.

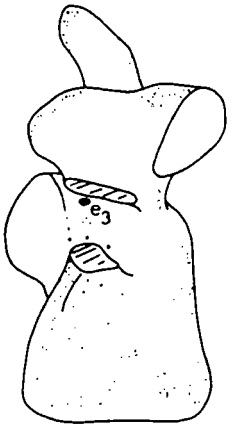


Fig. 31 C6 Lateral

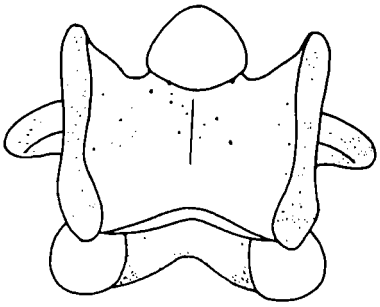


Fig. 32 C6 Ventral

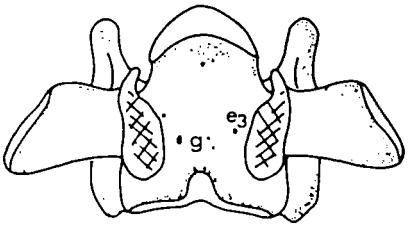


Fig. 33 C6 Dorsal. Laminae removed

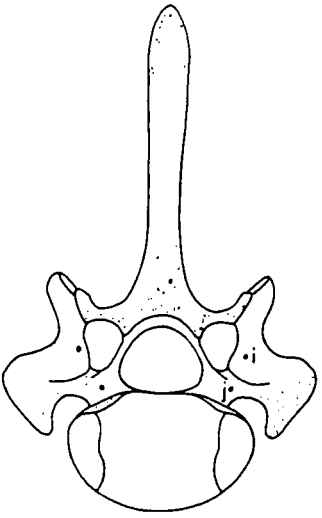
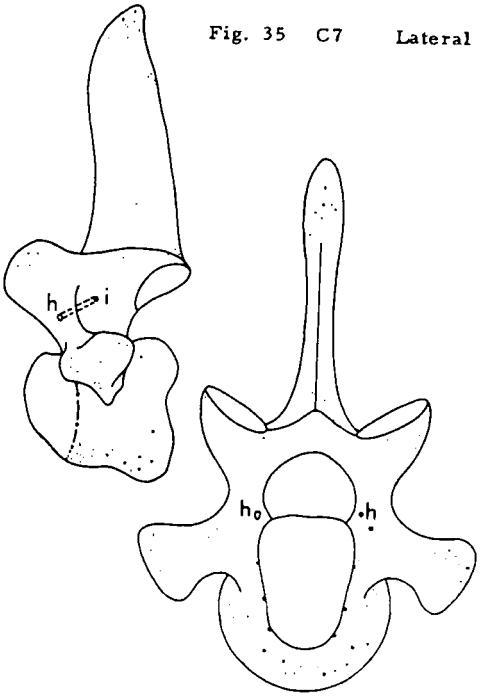


Fig. 34 C7 Caudal

Fig. 35 C7 Lateral



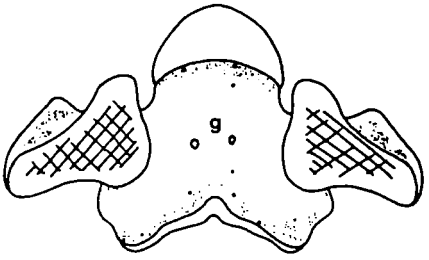


Fig. 37 C7 Dorsal.
Laminae removed.

Fig. 36 C7 Cranial

There was a concentration of foramina in the fossa between the dorsal and ventral tubercles of the transverse process (Figs. 24 & 25). Intermingled with pores, the foramina were mostly of small calibre, although medium and very small ones were scattered in between.

In adults large, medium and small openings occurred along and caudal to the cranial epiphyseal lines (Fig. 26 a). A variable number of medium and small-sized openings were present along and cranial to the caudal epiphyseal line.

The large to medium-sized foramina which featured so prominently on either side of the ventral ridge in C 3, were fewer and smaller in C 4 (Fig. 26 a & b). They were frequently (40 %) of very small calibre on one or both sides, while the remaining foramina were rarely (10 %) larger than medium-sized.

Internal surface

The "basivertebral foramina" were situated in the same position as in C 3, but were of smaller calibre (Fig. 27 g). In 18 cases (90 %) they were present bilaterally and in two specimens (10 %) unilaterally. In fourteen cases one or both of the pair were small to very small, while in four cases only, they exceeded 0.75 mm. In eight cases (40 %) double foramina, arranged craniocaudally, occurred uni- or bilaterally. The additional foramen was always small or very small.

Foramina ranging from medium to small calibre were always seen along the caudal epiphyseal line.

In young specimens the area between the "basivertebral foramina" and cranial epiphysis was distinctly porous and almost cribriform (Fig. 27 a). The openings were mostly of small to very small calibre.

In adult specimens (Fig. 27 b) all except one had one to four small to very small openings in this area; four had a few small ones along or directly caudal to the cranial epiphyseal line.

The vertebral opening of the "transverse canal" was situated in the base of the pedicle as in C 3 and 12—18 mm. caudal to the cranial vertebral incisure.

In young specimens there was a tendency towards a cribriform transverse band covering the middle third of the surface of the laminae. In the two youngest specimens, however, there was no evidence of this: Only isolated pores and very small foramina were present. The same was true for a twelve-month-old specimen.

In adults the internal surface of the laminae was smooth, except for one to four pores in the roof or lateral aspects of the caudal two thirds of the surface and along the caudal edge, which always contained pores and a number of medium to very small-sized foramina (Fig. 26 a).

Cervical vertebra No. 5

External surface

The distribution of foramina along the cranial aspect of the spinous process corresponded to the preceding vertebra i. e. in the area between the base and the expansion. In five cases (25 %) they were slightly smaller in diameter than in C 4. The remainder had the same pattern as C 4. In all the specimens the distribution and size of foramina on the caudal surface of the spinous process corresponded to that of C 4.

Dorsally a number of small to very small openings were found in the concavity between the cranial and caudal articular processes in all specimens aged six months and older.

The lateral surface of the laminae was free of perforations as was the case in C 4.

In the adult the length of the "transverse canal" varied between 23—27 mm. The "cranial transverse foramen" measured 9—15 mm. in diameter and the "caudal transverse foramen" 9—14 mm. × 5—9 mm. Compared to C 4 the "canal" was shorter and the cranial and caudal foramina were larger.

In nine cases (45 %) the medial wall of the "transverse canal" contained fewer foramina than in C4, especially as far as foramina leading to the body and transverse process were concerned (Fig. 28).

In two cases there was a slight decrease in number. In a further nine specimens (45 %), of which five were under sixteen months of age, the pattern was similar to C 4.

A foramen in the cranial aspect of the pedicle occurred in 15 cases (75 %). In six of these (30 %) they were present bilaterally, in six cases (30 %) on the left side only and in three cases (15 %) on the right side only. In six cases the foramen was placed laterally to the cranial vertebral incisure, in eight cases centrally in the incisure and in one case it was medial thereto. The opening varied from 0.2—1.0 mm. In five cases a connection could be demonstrated between this foramen and the craniodorsal aspect of the vertebral opening of the "transverse canal". As in C 4, however, the connection might either have been blocked in the other cases or the canal could have terminated in spongy bone.

Viewed laterally, the fossa between the dorsal and ventral tubercles was larger than in C 4. The foramina accordingly were more spread out, but corresponded in calibre and number to C 4 in 75 % of cases (Fig. 28). In four specimens (20 %) they were smaller and fewer and in one case (5 %) larger and more numerous compared to the previous vertebra. In specimens aged six months and under pores occurred, as in C4. In the adult, the ventral surface was similar to C 4.

In ventral view the epiphyseal lines of the young specimens (Fig. 29 b) were covered by cartilage and was smooth, as in C 4. Pores and one to four very small openings were found caudal to the cranial line. Pores were concentrated along the cranial two-thirds of the ventral surface in the very young specimens.

In those aged 6—15 months, one or two medium to very small-sized foramina occurred in the concavity on either side of the ventral spine, with one or two medium foramina cranial to the caudal line on either side of the ventral spine. Pores occurred here in all specimens.

In ten to thirteen adults the foramina on either side of the ventral spine were smaller and often fewer than in C 4. They were of medium to small calibre. The foramina cranial and caudal to the caudal epiphyseal line were more numerous than in C 4 (Fig. 29 a). There were one to three large to medium-sized foramina on either side of the ventral spine in an area up to 10 mm. cranial to the line. Only occasionally were these foramina small to very small in size.

Internal suface

In only nine cases (45 %) did "basivertebral foramina" occur as described in the previous vertebra. In one specimen (5 %) no foramina were present, with the exception of two pore-sized openings on the right side of the body. The other ten specimens (50 %) had irregularly shaped fossae, measuring up to 3.5 × 2.5 mm., arranged on one side or on both sides of the dorsal ridge

(Fig. 30). Along the edges of the floor of the fossae, large to very small openings could occur. Often the fossae appeared more like eroded spaces.

Medium to very small openings, accompanied by pores, were present along the caudal epiphyseal line. A few small to very small foramina were present on the surface cranial to the "basivertebral foramina" or in the fossae and along the cranial epiphyseal line. In young specimens pores formed a 10 mm.-wide transverse band caudal to the line. In adults, pores were more numerous along the lateral region of the cranial epiphyseal line.

The vertebral opening of the "transverse canal" occurred in the base of the pedicle, 8—18 mm. from the cranial vertebral incisure. It measured 0.75—3 mm. in the adult and 0.25—2.0 mm. in the young specimens. In one case it was absent on the left side and in another it was double and of medium size on that side. The two ipselateral openings communicated.

In the young specimens there was a tendency towards a cribriform transverse band covering the middle third of the laminae, with the same three exceptions as in C 4.

In the adult, the laminae were free of openings or up to three small to very small ones occurred on either side of the dorsal line. They occurred anywhere along the caudal two-thirds of the surface. Three specimens had no foramina here.

The caudal edge of the laminae was always porous, with two to seven small to very small openings on either side, they tended to be concentrated towards the caudal articular surfaces as in C 4.

Cervical vertebra No. 6

External surface

The spinous process was well covered with pores along the cranial and caudal aspects and over the distal parts of the lateral surfaces (Fig. 31). Foramina were not prominent. When they did occur, they were situated along the cranial and caudal edges of the spinous process. In nine cases, one or two small to very small openings were present cranially in the base of the process; twelve specimens had one or two foramina between the base and the distal expansion and all the adults had one or more openings in the cranial face of the expansion. They were small to very small in size in all except one case, in which a medium-sized foramen occurred. Amongst the young specimens the expansion was smooth. In most cases, one to five medium to very small foramina occurred caudally on the base of the spinous process. In seven specimens there were one or more foramina along the caudal aspect of the spine between the base and the expansion; in five cases one or more medium to very small openings were present in the caudal aspect of the expansion.

On the concave dorsal surface of the laminae only pores occurred in young specimens. In adults a number of small to very small foramina were constantly present in this area.

This was the only vertebra in the series with a transverse foramen instead of a canal. It was a large, oval or round opening. In the young specimens it measured 5.5—14 mm.; in the adult it varied from 12—20 mm. The craniomedial wall of the foramen contained a round or oval fossa measuring 1—4 mm. in the young vertebrae and 2—4 mm. in adults (Fig. 31). It was often the sole focus of foramina in this region. The lateral vertebral foramen was situated in the roof of this fossa and connected with the vertebral foramen in a transverse or slightly mediocranial direction. The other foramina in the fossa were all directed towards the pedicles. On the whole, the medial edge of the foramen was much smoother than in the previous vertebra.

Foramina directed towards the body were very small and few or absent.

On the floor of the transverse foramen a cribriform area occurred in specimens aged 12 months and less. In adults there was a varying number of small to very small openings leading to the base of the transverse process (Fig. 31).

In 18 cases (90 %), a large, medium or small foramen occurred in the cranial face of the pedicle. In 12 cases (60 %) it occurred bilaterally; in five cases (25 %) on one side only. Double foramina were found in ten specimens (50 %), bilaterally in one case (5 %), on the left side in three cases (15 %) and on the right in six cases (30 %).

The foramen was mostly situated in the cranial vertebral incisure. In three cases it occurred laterally and in one case medially thereto. When the canal leading into the pedicle from this foramen was probed with a bristle, a connection could be demonstrated with the vertebral opening of the transverse foramen in three cases. In all other specimens the canal could be probed for 5—20 mm. and appeared to be ending blindly. On opening up the lateral wall in one such case, the canal was actually found to end in the spongy bone of the pedicle.

The area between the dorsal tubercle and the ventral lamina of the transverse process was only slightly concave. In the very young (up to five months), the ventral lamina was entirely cartilagious. At six months the bony part was porous. In all the remaining specimens pores and a number of small to very small foramina occurred on the lateral surface of the lamina. On the medial aspects of the laminae four to eight foramina were scattered over the entire area up to the level of the epiphyseal line. The epiphysis was very porous.

The ventral surface of the body was well supplied with foramina. In the young specimens the entire surface was porous; the epiphyseal lines were covered by cartilage and foramina were scarce and of small or very small calibre when present.

In adults the ventral surface was well supplied with foramina (Fig. 32). There were one to three large to small-sized openings on either side of the ventral spine along the cranial epiphyseal line. In the area between the epiphyseal lines a large foramen was found bilaterally in three adults and unilaterally in four. One to six medium to very small openings could also occur on one or on both sides. Pores were constantly present.

In 50 % of cases the openings situated along the caudal epiphyseal line were larger and more numerous than in C 5. The others resembled the latter in size and distribution.

Internal surface

Only three specimens (15 %) had shallow fossae or eroded areas on the surface of the body as described for C 5. The normal pattern seemed to be single bilateral "basivertebral foramina", mostly of unequal size (Fig. 33). Double foramina were present bilaterally in 15 % of cases and unilaterally in 35 %. They varied in diameter between large to very small. The area cranial to the "basivertebral foramina" corresponded to C 5.

The vertebral opening of the transverse foramen opened in the base of the pedicle (Fig. 33 e_3). In young specimens it occurred 4—6 mm. and in the adult 9—12 mm. caudally to the cranial vertebral incisure. It was absent on the left side in two specimens (10 %) and on the right side in four (20 %). It varied in diameter from large to very small.

The foramina in the laminae corresponded to C 5 in distribution and size.

Cervical vertebra No. 7

External surface

In young vertebrae, foramina were strikingly absent and only pores occurred on the surface of the spinous process. In only one case a single very small foramen was present to the left of the median plane. In adults pores constantly occurred along the distal expansion of the spinous process, often accompanied by a number of small to very small openings. The lateral aspects were smooth except where porous muscular ridges were present. In the adult the caudal, sharp-edged surface was smooth. The triangular base contained foramina in 95 % of cases. There were mostly very small openings, numbering one to four on either side of the median plane. Occasionally also a single bigger foramen of medium or small size was present. In one case a large foramen was found to the right of the median plane (Fig. 34).

The dorsal surface of the laminae always contained pores. Of the very young, two cases only had pores but no foramina. In older specimens pores were especially numerous along the free edges and caudal articular processes. Occasionally a small number of very small openings was found along the borders of the cranial articular surfaces or in the porous areas. Laterally, in the fossa caudal to the connecting ridge between the cranial articular process and the transverse process a single, well defined foramen, 0.5—3.0 mm. in diameter was almost always present (Fig. 35_1). Amongst adult vertebrae only one specimen lacked a definite foramen, and that on the left side. Instead, a number of pores were present.

In the cranial surface of the pedicle a foramen of medium size normally occurred bilaterally (Fig. 36 h), which could be double on one or both sides. Rarely the left or the right foramen was absent. In three cases (15 %) a connection was demonstrated between this foramen and the foramen in the lateral fossa of the pedicle (Fig. 35). In one case (5 %) the foramen on each side communicated with a foramen situated on the external aspect of the vertebral foramen; it measured 0.75 mm. on the left and 0.2 mm. on the right side. In one specimen the single, medium-sized foramen in the cranial face of the left pedicle communicated with a pair of foramina (large and medium-sized respectively) on the caudal face of the pedicle (Fig. 34 j).

On the caudal face of the pedicles foramina occurred in twelve specimens (60 %) (Fig. 34 j). In eight of these they were present bilaterally and could be paired. In one specimen each pair was found to inter-communicate. The pair on the left side also communicated with the opening on the cranial face of the pedicle (Fig. 36 h) as described. In two cases the foramen was present on the left side only and in two cases on the right. It measured 0.25—3.0 mm. in diameter and was often flattened lateromedially.

The transverse process was porous with occasional small to very small foramina.

On the ventral surface of the body in the young specimens, pores were conspicuous, but foramina were very small or absent. A few medium or small-sized openings were present along the epiphyseal lines; isolated, small-sized foramina occurring on the rest of the surface.

The ventral surface of the body of the adult vertebra was well supplied with large to very small foramina. Two to five occurred on either side along the cranial epiphyseal line and along and caudal to the caudal epiphyseal line. Medium to very small openings were scattered over the remaining area, with in addition a large foramen in one specimen. Pores were conspicuous.

Internal surface

Paired "basivertebral foramina" were present in fifteen specimens (75 %) (Fig. 37). In three cases (15 %) there was a single foramen on the left only, and in one case (15 %) on the right only. One specimen had no "basivertebral foramina". In six cases (30 %) the foramina were double on one or both sides. It varied from 0.25—2.0 mm. in diameter, with 0.75—1.0 mm. being the average size.

Along the caudal epiphyseal line pores and foramina of large and small calibre occurred. A few medium to very small-sized openings were found between the cranial epiphysis and the "basivertebral foramina". Only eight specimens had foramina along the cranial epiphyseal lines and they were of medium to small calibre.

In specimens aged six months and less, the lateral face of the vertebral foramen was porous.

In adults one medium to small-sized foramen usually occurred along the dorsal median line of the laminae. Alternatively, or additionally, a foramen occurred on the lateral surface of both laminae.

Disscussion

The third to the fifth cervical vertebrae are also characterised by "transverse canals", a typical transverse foramen being present only in the sixth vertebra. Foramina feature prominently in the craniomedial walls of the "transverse canals"; together with the "basivertebral foramina" on the vertebral surface and the foramina present in the pedicles, they are undoubtedly indicative of the pattern of transvertebral, perivertebral and intravertebral vascularisation.

Taken as a whole, the present study provides information regarding the presence and distribution of nutrient and other foramina in the cervical vertebral column. A definite pattern evolved, indicating a) the regions where bloodvessels can be expected to enter or leave; b) vascular pathways; c) the size of the vessels involved and d) age differences. In regard to the latter there seems to be two opposing patterns: on the external surface foramina seem to increase in size and distribution with increasing age; on the internal surface (including that of the "transverse canal") the opposite pattern prevails.

The information gained on the cervical series provides a basis for comparing the pattern in succeeding series and highlighting the differences. The question arises whether foramina less than 0.25 mm. in diameter harbour bloodvessels, fibres of SHARPEY or canals of VOLKMANN. The matter will be resolved by employing bloodvessel injection and corrosion techniques, as well as critical study of exact areas of muscular, tendinous and capsular attachments.

Summary

The position, size and connections of all the macroscopically visible foramina of Cervical vertebrae 3—7 in 20 oxen are described. The nomenclature of various structures is discussed. A definite pattern evolves, indicating vascular pathways, regions where bloodvessels can be expected to enter or leave, the size of vessels involved and age differences. In regard to the latter there seems to be two opposing patterns: on the external surface foramina seem to increase in size and distribution with increasing age; on the internal surface (including that of the "transverse canal") the opposite pattern prevails.

Zusammenfassung

Die Löcher der Halswirbel des Rindes
II. Halswirbel 3—7

Lage, Größe und Verbindungen aller makroskopisch sichtbaren Löcher der Halswirbel 3—7 von 20 Rindern werden beschrieben. Die Nomenklatur verschiedener Strukturen wird diskutiert. Man kann Gegenden unterscheiden, welche die Ein- und Austrittsstellen von Blutgefäßen anzeigen. Kaliber- und Altersunterschiede scheinen dabei 2 entgegengesetzte Muster zu bilden: an der äußeren Oberfläche scheinen die Löcher mit zunehmendem Alter größer und zahlreicher zu werden; an der inneren Oberfläche (einschließlich der des „Can. transversarius") herrschen entgegengesetzte Verhältnisse.

Résumé

Les trous des vertèbres cervicales du Boeuf
II. Vértebres cervicales 3—7

On décrit la situation, les dimensions et les connexions de tous les trous macroscopiquement visibles sur les vertèbres cervicales 3 à 7 de 20 bovins. On discute de la nomenclature des différentes structures. On peut distingeur des territoires caractéristiques des lieux d'afférence et des lieux d'efference des vaisseaux sanguins. L'examen des variations du calibre en fonction de l'âge semble aboutir à 2 modèles opposés: sur la face externe, les trous semblent croître en nombre et en dimension avec l'âge; sur la face interne (y compris celle du "Can. transversarius"), on observe, au contraire, l'évolution inverse.

Resumen

Los agujeros en la columna cervical del buey
II. Vertèbres cervicales 3—7

Se describen situación, tamaño y comunicaciones de todos los agujeros macroscopicamente visibles en las vértebras cerviales 3 a 7 de 20 bueyes, discutiéndose la nomenclatura de varias estructuras correspondientes. Se destacan diferentes regiones y tipos de distribución de acuerdo con la trayectoria de los vasos, su entrada y su salida. Diferencias del calibre de los vasos y de la edad, permiten observar dos dechados típicos: en la superficie externa del hueso, parece que con la edad aumentan también el número y tamaño de los agujeros vasculares; en la superficie interna (incluyendo la del "Canalis transversarius") prevalecen características opuestas.

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Key to figure annotations

Distribution of foramina and pores is indicated. All figures refer to adults unless specified as "very young" (up to six months) or "young" (12—16 months)

c_1: "cranial transverse foramen"
c_3: vertebral opening of "transverse canal"
g: "basivertebral foramen"
h: foramen in cranial aspect of pedicle
i: foramen in lateral aspect of pedicle
j: foramen in caudal aspect of pedicle