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PECULIARITIES OF THORAX INTERVERTEBRAL JOINTS IN MUSKRAT (*ONDATRA ZIBETHICA*)

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ABSTRACT *- The transverse process of thorax vertebra had a different conformation in the muskrat's case. This process was completely formed in the first three and the last two thoracic vertebra (the lamina separated from the body is knitted with the one separated from the arch). Starting with the fourth vertebra until the eleventh one, the transverse process was incomplete. Between the two laminas, a deep incision was created. The lamina separated from the body was changed in an articulatory process, made up of two surfaces: a lateral (ventral) one, of articulation with the tubercle of the rib, and a medial (dorsal) one. The transverse incision was used for sliding like on a trochlea of the costal-transverse intraarticular ligament, which was specific to the muskrat, for the insertion in the back of the incision.*

Key Words: muskrat, anatomical process, thorax

REZUMAT – Aspecte particulare ale articulațiilor intervertebrale toracale la bizam (Ondatra zibethica). *Procesul transvers al vertebrelor toracale are o conformație diferită la bizam. Astfel, la primele trei şi la ultimele două vertebre toracale, procesul transvers este complet format (lama desprinsă de pe corp este sudată cu cea desprinsă de pe arc). Începând cu a patra vertebră, până la a XI-a, procesul transvers este incomplet constituit, între cele două lame se formează o incizură adâncă. Lama desprinsă de pe corp este transformată într-un proces articular compus din două suprafețe: una laterală (ventrală) de articulare cu tuberculul coastei şi una medială (dorsală), înspre incizura transversă, folosită pentru alunecarea, ca peste o trohlee a ligamentului costo-transversar intraarticular, specific bizamului, pentru a se insera în fundul incizurii.*

Cuvinte cheie: bizam, proces anatomic, vertebre toracale

INTRODUCTION

Muskrat is a rodent mammal, which lives both on earth and in water. The locomotor system is consequently adapted to the conditions of the two types of

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habitat. In comparison with other rodents living under similar conditions as muskrat (such as nutria), the muskrat locomotor system has significant differences related to the configuration of osteo-articular structures.

MATERIALS AND METHODS

For the study of the thorax articulations in muskrat, we have used regional and stratigraphic dissection, underlining the participating formations, examining the freshly prepared pieces, the shape and size of the tangent articulatory surfaces, the amplitude of the articulatory cavity and of the place of inserting the articulate capsule. We have identified the capsular ligaments, determining the type of joint and the type of movement. By taking photos and making descriptive schematics, we understood and described the mechanism of action for every joint. The prepared articulations were conserved through drying out and formolating technique.

RESULTS AND DISCUSSION

1. The rib-vertebral articulation. Articulating the head of the rib with the vertebras was done as in case of the other species, through an articulation of sinovial type, to which the two rib foveae corresponding to the two-articulatar surfaces, took part. They were separated by a small tubercle or a ligament insertion crest (Coțofan et al., 1998; Hriţcu, Coțofan , 2000).

The caudal foveae, on the anterior vertebra, had a wider surface than the cranial one; it has increased as size, reaching the tenth rib (the last asternal one), and then at the last thoracic vertebras, it has diminished until disappearing (Coțofan et al., 1998).

The articulate capsule was narrow and the capsular ligament on the ventral face presented a strong radial ligament. The fascicle that was inserted on the intervertebral disk, which fibers merged with the ventral vertebral ligament, and the fascicle that was inserted on the homonym vertebrae were more developed. This fascicle had the fibers between the head of the rib, the neck of the rib and the tubercle of the rib, merging with the capsular ligament of the rib-transverse articulation. The ligament was very strong and enriched with elastic fibers.

A particularity of the rib-vertebrae articulation of the muskrat was the lack of conjugated ligament (between the two symmetric ribs); the ligament of the head of the rib was inserted on o crest that separated the two articulate surfaces of the head of the rib. The fibers converged in a ligament that was partially inserted together with the yellow ligaments on the circumference of the lateral vertebral hole, on the intervertebral disc, and the rest of the fibers merged with the ones from the dorsal longitudinal ligament.

2. The rib-transversal articulation was done between the articulatory surface of the tubercle of the rib and the transverse process of the homonym vertebra. This articulation of the muskrat presented more anatomical peculiarities,

developed due to the special way of functioning (Coțofan et al., 1998; Spătaru, Coțofan, 1997).

The transverse process of the thoracic vertebrae had a different conformation, depending on the number of the vertebra, correlated to rib implication degree in the breathing process (*Figure 5*). In the first three thoracic vertebrae and the last two ones, the transverse process was completely formed (the blade detached from the body merged with the one detached from the dorsal arch). Starting from the fourth vertebra until the eleventh one, the transverse process was incomplete; between the two independent bony blades, a deep transverse incision was formed.

On the first two thoracic vertebrae, between the ribs and the longitudinal axis of the vertebrae an angle of 90 degrees was formed. The rib-vertebral articulated surface was above the rib-vertebral articulation, but in the same transversal plane. The articulated surface appeared as a continuation of articulated surface for the rib's head. The articulated capsule was narrow and the capsular ligament had short fibers (*Figures 1, 2*).

A B

Fig. 1. Thorax joints, dorsal aspect (A) and ventral aspect (B)

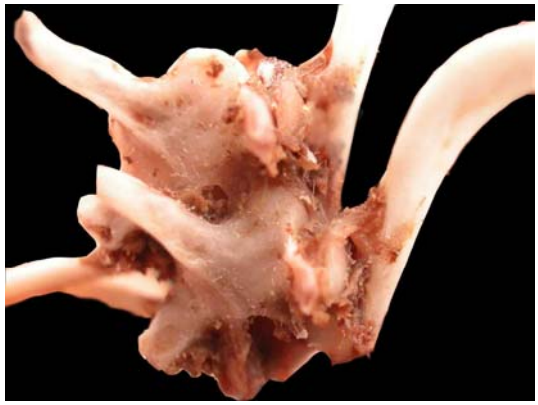

Fig. 2. Costo-vertebral and costo-transversaria joints in muskrat, dorso-lateral aspect

In muskrat, we have noticed that the length of the neck of the rib was approximately constant until the last asternal rib, where the angle between the head of the rib and the longitudinal axis was diminished due to the caudal orientation of the ribs, starting with the forth one (*Figures 1, 3, 4*).

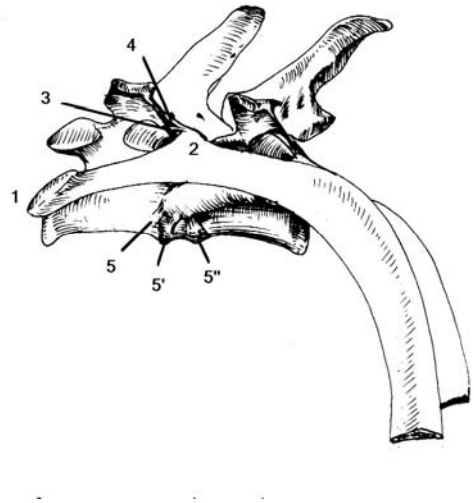

Fig. 3. The rib joints with vertebral column
1 - caput costae,
2 - tubercle of the rib
3 - lig. costotransversarium intraarticulare,
4 - capsula articularis,
5 - lig. capitis costae radiatum:
5 - pars cranialis,
5' - pars intermedia,
5''- pars caudalis

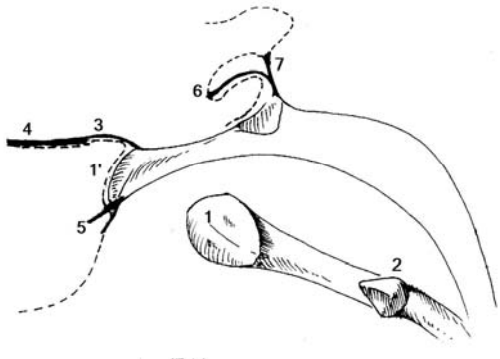

Fig. 4. The rib joints with vertebral column, detail
1 - caput costae,
2 - facies articularis capitis costae,
3 - lig. capitis costae,
4 - lig. longitudinale dorsale,
5 - lig. capitis costae radiatum,
6 - costotransversarium intraarticulare,
7 - capsula articularis

The rib-transverse articulation on the next vertebrae presented the capsular ligament inserted on the neck of the rib and the rib tubercle, in the continuation of the rib-vertebral capsular ligament.

The rib participated with an articulated surface as a glenoid cavity elongated cranial-caudal. The vertebra participated with articulated surfaces developed on the two blades. In this way, the blade detached from the body was totally transformed in an articulated process composed by two surfaces: a lateral one (ventral), which articulated with the rib tubercle, had a plane-condilar shape,

and another plane-condilar surface was medially situated (dorsally) towards the transverse incision. An obvious crest separated the two articulated surfaces (*Figures 4, 5*). Over this crest, *the intraarticulated rib-vertebral ligament,* specific to the muskrat, passed as over a trochlea. This was made up of fibers, which were inserted on a rib in a ligamentary fosset situated on the dorsal face of the neck of the rib (on the first ribs) or slightly dorsal-caudal orientated on the last ribs and the bottom of the transverse incision. This ligament has slide over the medial articulated surface. The articulated capsule was inserted on the ventral face of the dorsal blade of the transverse process (*Figures 2, 3, 4*).

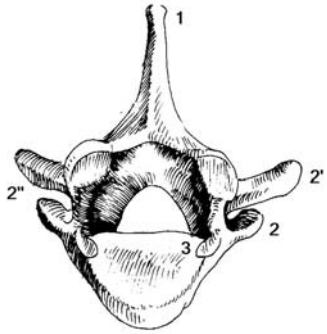

Fig. 5. The tenth thorax vertebrae
1 - processus spinosus,
2 - processus transversus, lamina ventralis,
2' - processus transversus, lamina dorsalis,
2'' - incisura transversa,
3 - fovea costalis cranialis

If between the first three ribs and the longitudinal axis, a 90 degree angle was formed (the ribs were perpendicularly spread on the vertebrae), starting with the forth rib, the angle between the rib and the longitudinal axis has progressively decreased, so the plane of rib-transversal articulation met the rib vertebral articulation at the anterior edge.

The muskrat has seven thoracic ribs, three asternal and three floatant ones. We have noticed that the first inter-rib spaces were wide, the fifth vertebra, and the forth inter-rib space were situated in the middle of the thoracic cavity (situated between the first sternal rib and the tenth rib, the last sternal rib), then the inter-rib spaces diminished because of the reduction of the angle between the rib and the vertebra (*Figure 1*).

Under the action of the respiratory muscles, the rib was moved in transversal plane, being approximately perpendicular on the sagital plane, and formed with the symmetrical one an oval shape, which transversal diameter was bigger than the dorsal-ventral one. The proximal and middle third of the rib's arch was cranial-caudal flattened.

During the aspiration, the intra-articulate rib-transversal ligament slide over the medial articulate surface of the transverse process, through an ample movement in cranial sense.

The cranial-caudal flattening of the proximal extremity of the ribs was an ancestral feature. During swimming, the muskrat performs lateral wavy movements of the vertebral spine, favoured by the wide inter-rib spaces.

3. The rib-transversal joints of the floating ribs are differentiated because the cranial joint of the rib's head is diminished, and the rib joints with the intervertebral discus and the rib foveae of the homonym vertebra. The rib transversal articulatory capsule is stretched from the articular head on all of the transverse process, this progressively becoming a joint of fiber type (Spătaru, Coțofan, 1997).

4. The joints between the articulatory processes are particularly because the articulatory surfaces are plane, stretched through the surface of all the articulatory processes, and medial-lateral oblique orientated; the articular capsule is wide, allowing besides flexion and extension, movements of laterality through the lateral sliding of the articulatory surfaces one over the other (Spătaru, Coțofan, 1997; *** - Nomina Anatomica Veterinaria, 1994).

CONCLUSIONS

The muskrat has not the conjugate ligament, the ligament of the head rib being inserted on the crest that separates the two articulatory surfaces of the head rib and on the circumference of the vertebralis lateralis, the intervertebral disc and ligamentus vertebralis dorsalis.

The processus tranversus of the thorax IV-XI vertebrae is incomplete, being formed of two independent blades (the first one detached from the vertebra body and the other one from the vertebra arch). Between the two boned blades a deep transversal incision is formed

The blade that is detached from the body is rubbed, both laterally and on the medial faces by an articulatory surface.

The costo-transversary ligament, specific to muskrat, is very developed, being made up of some fibres bunch that are inserted between the ligamentary surface of the rib and deep into the transversary incision, crossing over the medial articulatory surface of the blade detached from the body vertebra.

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