Comparative study of the tympanic cavity of the cattle and buffalo

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Summary

The objective of the current study was to determine the anatomical features of the tympanic cavity in cattle and buffalo and to be recognize all parts of the tympanic cavity for its clinical purposes. There are general anatomical explanation about the middle ear in anatomy text book, however there are no studies in the literature on the morphology of the tympanic cavity in the buffalo, the region is important clinically as a frequent point of attachment for prostheses. As a recent studies have focused on the reconstruction of defects occurring in these tympanic cavity to aid in the development of new surgical technique. Twelve temporal bones from six heads of adult cattle and buffalo were used, the cavity had been investigated on both sides after dissection them, the features of the cavity were assessed with a measurement done by using digital veirenear calipers and measurement tap and photograph by a stereomicroscope. The result show that the tympanic cavity can be divided into three parts, dorsal (epitympanic recess) middle (proper tympanic cavity) and ventral (tympanic bulla), size communicating freely with each other. Epitympanic recess has handle the head of the malleus ,which embedded in the medial surface of tympanic membrane , the proper tympanic cavity has three ossicles are connected to each other , in buffalo being the most developed and the ossicles of the cattle are relatively small , but the incus is more pronounced. Malleus is intimately fused with the incus, it was therefore not possible to separate the malleus and incus. The proper tympanic cavity has tympanic membrane the membrane can be divided into pars flaccids and pars tensa, in buffalo was more development, large in size and oval in shape, with a darker color and thick, but in cattle was rectangle in shape, with a lighter color and thin comparative with buffalo. The tympanic cavity has two skeletal muscles (stapedius and tensor tympanic muscles), the stapedius muscle is ill developed and the greater part of the tensor tympanic muscle was tendinous in buffalo. The proper tympanic cavity has four opening, the external acoustic meatus, the fenestra ovals, the fenestra rotundum and the Eustachian tube. The first three opening are closed by membrane partitions, the Eustachian tube or the auditory tube is short, and (4-5) cm in length and this can clearly why the tympanic cavity of the animal is easily susptable for infections. The ventral of the tympanic cavity was sieve - like present large number of formation which continues with the air cell of the tympanic bulla, the cell which lie directly ventral to the proper tympanic cavity was communicate with those around the external acoustic meatus and facial canal .

Keywords: tympanic cavity, Cattle, Buffalo.

Introduction

The tympanic cavity is frequently the seat of several diseases when inflammation spread from both the nasal cavity and the nasopharynx. The auditory ossicles are placed in the dorsal aspect of the tympanic cavity, and are responsible for transmitting of vibrations from the tympanic membrane to the middle and inner ear (1 and 2). The different additives ability of the various species is also due to the morphological diversity of the auditory ossicles of their articulation, and of the associated ligament and muscles (3). Analogical descriptions of the ear structures of the animal found in anatomy text books , are scarce , schematic and do not go beyond a rough enumeration of the structures , often with no data on topography (4 and 5).

Trauma of the ossicular chain is a frequently seen complication of temporal bone injury (6) , as a results focused on the reconstration of defects occurring in these ossicles (5), to aid in the development of new surgical techniques , researchers have studied the ossicle chain of several animals (3).

The aims of this study was to demine the anatomical sendures of the tympanic cavity in cattle and buffaloes.

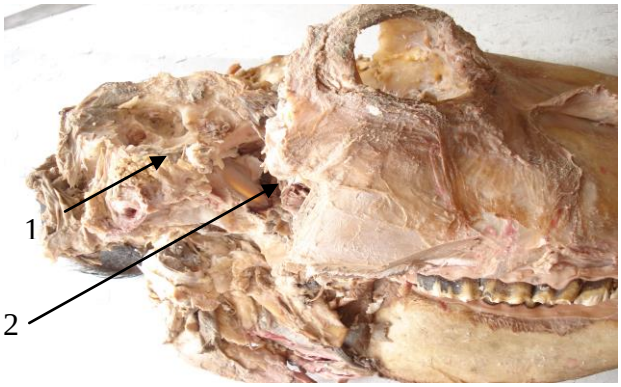
Materials and Methods

Twelve specimens (six for each cattle and buffalo) collected from fresh and preserved heads were used in this study , the skin was removed , a sagittal section of the heads was done and ventral parts of the heads were removed as well as the brain, these cross , oblique and longitudinal section of temporal bones were prepared. The tympanic membrane as well as the contents of the tympanic cavity were studied. Small electric drill was used to separate the stapes from the vestibular window, the tympanic membrane and ossicle in some species were studied in situ within the tympanic cavity, and some were removed and studied with the aid of the illuminated lens and microscopic slid projector .Using the dental machine and Dozar magnifier were useful in this study.

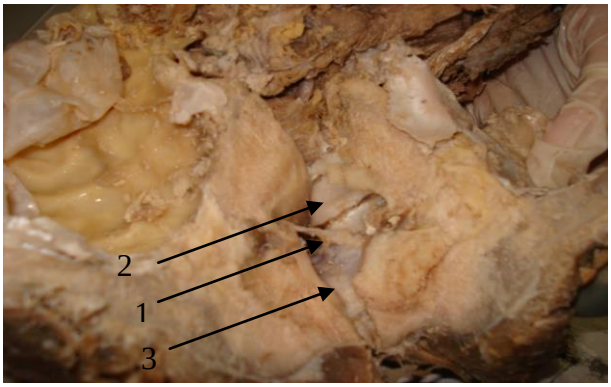
All of the specimens were dissected through the external acoustic meatus and tympanic bulla then examined under a binuclear stereomicroscope (stemiSV6, Zeiss, Germany), using magnifications of up to×50, after dissection them, the feature of the auditory tube, measurement was done using digital veirenear calipers and measurement tap, and photographed by stereomicroscope (1), the nomenclature used was adopted by Nomina Anatomica Veterinarian (2005).

Results and Discussion

The tympanic cavity (Cavum tympani) in buffalo is large irregular while it is small in cattle, in both animals the cavity is lined by mucous membrane which cover its contents, the upper part from tympanic cavity is compressed from side to side and slanted outward, and the lateral wall of the cavity incorporates the tympanic membrane. The medial wall is formed by the petrous part of the temporal bone (fig.1). The cavity can be divided into three divisions dorsal, middle and ventral division (fig. 2).



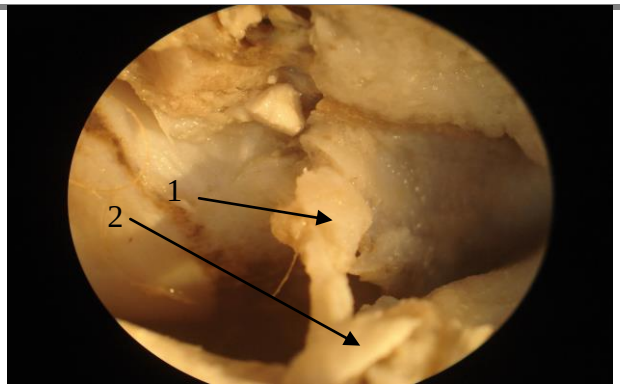
Figure, 1: Show the 1- petrous part of the occipital bone 2- the tympanic cavity in buffalo, power of Samsung camera 7.2 Mac pixels zoom 5.8 – 17.4 mm.



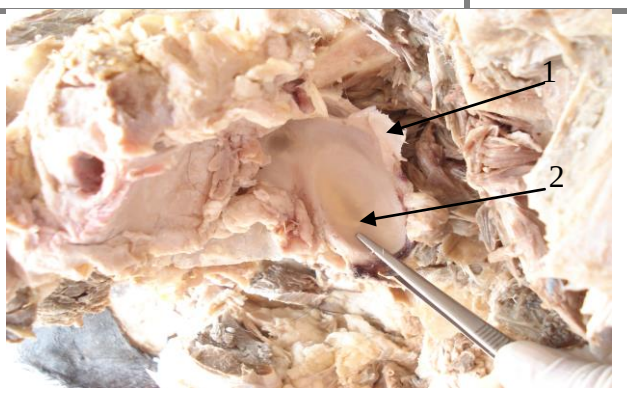
Figure, 2: Show the1- dorsal 2- middle 3-ventral parts of tympanic cavity in cattle, power of Samsung camera 7.2 Mac pixels zoom 5.8 – 17.4 mm.

The dorsal part (epitympanic recess), was situated above the level of the tympanic membrane, is the smallest in cattle compared to the buffalo, it contains of the handle of the malleus, is embedded in the medial surface of the pars tensa of tympanic membrane, the handle (manubrium) of the malleus can be seen when the membrane is viewed from the external acoustic meatus as a light streak (stria mallearis). The head of the malleus protrudes above the membrane by a few millimeters. The head articulates with the body of the incus and the latter articulates with head of stapes by means of its long crus. The base of the stapes sits in the vestibular window in the medial wall of the tympanic cavity (fig. 3).

The middle part (proper tympanic cavity), was bounded laterally by the tympanic membrane which closes the medial end of the external acoustic meatus, thus forms the septum between the external and middle parts of the ear, the membrane is slopes ventro - medially at an angle of about 20 degrees with the ventral wall of the external acoustic meatus (fig . 4).



Figure, 3: Show the 1- mallues 2- incus in buffalo, power of Samsung camera 7.2 Mac pixels zoom 5.8 – 17.4 mm.

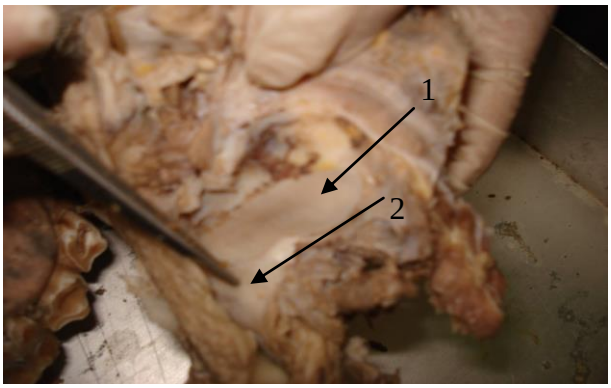


Figure, 4: Show the 1- flaccid 2- tensa two parts of the tympanic membrane in buffalo, power of Samsung camera 7.2 Mac pixels zoom 5.8 – 17.4 mm.

The membrane in both animals can be divided into pars flaccids and pars tensa, the pars flaccids much smaller than pars tensa (fig. 4). In buffalo the tympanic membrane was large in size, oval in shape and more developed, with a darker color and thick, the circumferential thick border (anulur fibro-cartilagineus) (fig. 4) is lodged into the thin bony ring (anulur tympanicus), the central part of the membrane was pulled in ward (promenentia mallearis) by the well – defined handle malleus producing large concavity on the outer surface of the membrane. In cattle the membrane was rectangle in shape, with a lighter color and thin comparative with buffalo (fig. 5), the parsa tensa was much larger rectangular in outline, with a highly raised medial surface which is surrounded by a flat – surfaced periphery.

In both animals outline stretching from the incisures, the pars tensa latter is firmly attached to the handle of the malleus to the lateral process of the malleus , the umbo membrane tympani is very prominent , as is the stria mallearis.

The auditory ossicles, in both animals are attached to the wall of the epitympanic recess by several ligament, and their relationships can be altered by two small muscles (tensor tympani and stapedius). Three auditory ossicel (malleus, incus and stapes) situated partly in epitympanic recess and partly tympanic cavity proper, all the bone lei in the medial plan accepted the handle of malleus (fig. 3 and 6).



Figure, 5: Show 1- flaccid 2- tensa the two parts of the tympanic membrane in cattle, power of Samsung camera 7.2 Mac pixels zoom 5.8 – 17.4 mm.

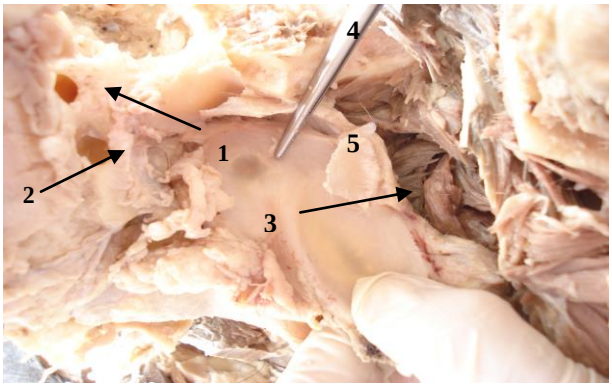
Figure, 6: Show the 1-mallus 2- incus 3- stapes the ossicle bones in buffalo, power of Samsung camera 7.2 Mac pixels zoom 5.8 z– 17.4 mm.

In cattle the malleus is a delicate bone and is intimately fused with the incus, it was therefore not possible to separate the malleus and incus. the mulleus can be described as having a head, a neck and a manubrium , or handle, the head of the mallus is ill

development it has triangular plate, it almost appears to be overlapp by the body of the incus, the neck is not obvious it continuous as a handle , just above these continuous, muscular process, which give strong a attachment to the tensor tympanic muscles (fig. 7), at the same level at which the muscular process or (lateral process) on the medial aspect of the neck arise long process, the head of malleus very small completely covered by the body of incus (fig. 6 and 8). The latter articulates with the head of stapes by means of the long crus the base (foot plate) of the stapes sits in the vestibular window in the medial wall of the tympanic cavity (fig. 9). In buffalo the malleus is a wall developed bone (fig. 3) the head is spherical, and strongly convex, the neck is a slightly constricted part below the head, the handle is strong curved ventrally and it is cylindrical in form, the vertical part of the handle together with the lateral and rostral process are comletly embedded in the tympanic membrane (fig. 3).

In cattle , the incus is relatively wall development and strong bone , it has body and two crura , the body is irregularly in outline and the long crus is twice as long as the short one , the lenticular process is absent and is partly covered by the tensor tympanic muscle (fig. 8). In buffalo ,the incus is small and teeth-like , the articular surface of the body corresponds to that of the malleus and the long crus is triangular in form and about four times longer than the short one , the lenticular process by which the incus articulate with the head of stapes .

Figure, 7: Show 1- the temporal bone 2- external acoustic meatus 3- tympanic bulla 4- tensor tympani muscles in cattle, power of Samsung camera 7.2 Mac pixels zoom 5.8 – 17.4 mm.



Figure, 8: Show the 1-fenestra cochleae 2- fenestra Vestibule 3- secondary tympanic membrane 4- temporal membrane 5- flaccid parts of tympanic membrane in buffalo, power of Samsung camera7.2 Mac pixels zoom 5.8- 17.4 .mm.

The stapes in both animals can be described that they have head, neck, two crura, base and muscular process, this takes the form of the small circular (fig. 9). The head pronounced and the neck is obvious, the muscular process for the stapedus muscle was relatively ill developed and projects close to the head, the crura are nearly equal in length, the base is relatively large and circular in outline, the stapes encloses a small rounded foramen (fig. 6). It is associated with the cartilaginous covering of the vestibular window.

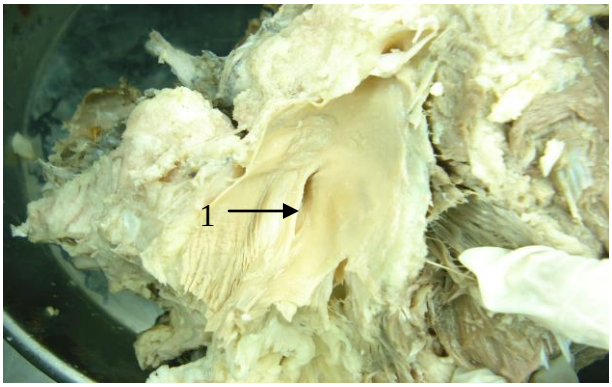
The cochlear window (venestra cochleae), in both animals was circular in outline and closed by the second tympanic membrane (membranea tympani secundaria) which separated the tympanic cavity from the scala tympani of the cochlea (fig. 8).

The vestibular window (fenestra vestibule), in both animals was an oval small foramen which lies more rostral and dorsal than the cochlear one, it is occupied by the base of stapes and it is located medial to the pars flaccida of the tympanic membrane (fig. 8).

The auditory tube (Eustachian tube), in both animals it was short (4-5) cm in length and very narrow lumen that is laterally compressed and usually collapsed, connect between tympanic cavity and nasopharynx, consist from two parts (membranous and

cartilaginous), the tube is confined by an inverted cartilage except along its ventral border, the cartilaginous part is formed by medial and lateral plates (fig. 10), and the pharyngeal opening of the auditory tube extended into the lateral walls of the nasopharynx and are marked by accumulations of lymphoid tissue (tubal tonsils) (fig. 11), the opening of the Eustachian tube in the tympanic cavity was semiluner or slite like opining leading into the narrow canal fig. (10).

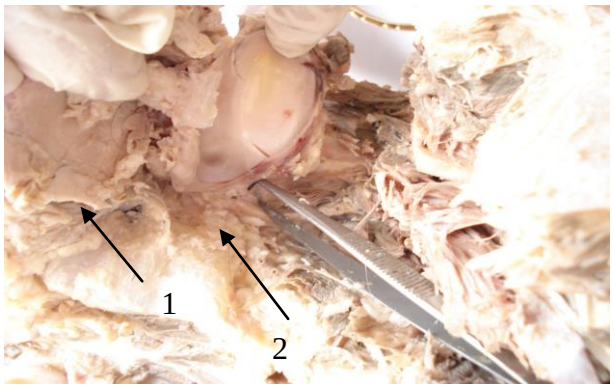
Figure, 9: Show the staps in cattle, power of Samsung camera 7.2 Mac pixels zoom 5.8 – 17.4 mm



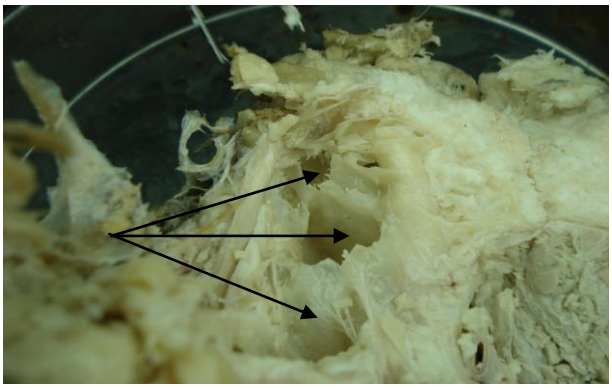
Figure, 10: Show the 1- cartilage of the auditory tube in buffalo , power of Samsung camera 7.2 Mac pixels zoom 5.8 – 17.4 mm.

The auditory muscles, were two in number (tensor tympani and stapedius), tensor tympanic muscle an irregular shape muscle wall developed, it covered by incus and malleus. In cattle, was muscular rather than tendinous, while in buffalo the greater part of the tensor tympanic muscle was tendinous.

The stapedius muscle is ill developed, it's fleshy origin and arising from the facial canal, run rostrally to be fixed to the muscular process of stapes (fig .7). The ventral part (tympanic bulla), was wall developed most ventral portion of the tympanic cavity in both animals, the interior of the bulla shows a series of small and numerous inter communicating cavities or air cells which are smaller and numerous dorsally, and become larger in the ventral part of the bulla (fig.12). It has elliptical opening facing dorsally, the cells which lie directly ventral to the tympanic cavity proper communicate with those around the external acoustic meatus and facial canal.



Figure, 11: Show the 1- auditory tube 2- tubal tonsil in cattle , power of Samsung camera 7.2 Mac pixels zoom 5.8 – 17.4 mm.



Figure, 12: Show the tympanic bulla in buffalo , power of Samsung camera 7.2 Mac pixels zoom 5.8 – 17.4 mm

The present finding showed that the cavity is irregular and laterally space, moreover, the epitympanic recess as revealed by this study contain, the upper parts of malleus and body of the incus which the ox (8 and 9), in this connection (10) in camel reported that, the

proper tympanic cavity contain , the upper parts of malleus and body of the incus. The middle ear is housed in the temporal bone and is essentially the small air filled space known as the tympanic cavity, the tympanic cavity may be divided dorsal, middle and ventral parts (11).

This work has been demonstrated that the tympanic membrane in buffalo is large in size and more developed oval in shape, with a darker color and thick, while in cattle the membrane is rectangle in shape, with a lighter color and thin comparative with buffalo, the tympanic membrane variation of shape, color and thicknesses were not reported by any of the above mentioned on authors in any of the mammalian. The oscillations of the tympanic membrane perceived by the handle of the malleus are magnified and transmitted to the vestibular window by lever action through the chain of the ossicles (12). In camel the tympanic membrane is circular in shape (8).

This work it has been demonstrated that three auditory ossicel (malleus, incus and stapes) situated partly in epitympanic recess and partly tympanic cavity proper, all the bone lei in the medial plan excepted the handle of malleus , the head of malleus very small completely covered by the body of incus and the latter articulates with the head of stapes by means of the long crus the base (foot plate) of the stapes sits in the vestibular window in the medial wall of the tympanic cavity, therefore the trauma of the ossicular chain is a frequently seen complication to the tympanic cavity (12 and 13). The present work revealed that the tympanic bulla of both animals have a large number of the air cells, smaller and large number dorsally, while they become larger in the ventral part of the bulla, this observations are in agreement with the finding of (9) .The auditory tube, in both animals was short (4-5) cm in length and, similar to that was reported by (8) in camel.

According to the tensor tympanic muscle present results it was irregular in shape and well developed, it covered the incus and malleus. In cattle, the muscle was muscular rather than tendinous, in buffalo the greater part of the tensor tympanic muscle is tendinous, (9 and 14) observed that this muscle in sheep, goats and ox is well developed and arises from the fossa which lie rostral to the vestibular window, however the stapedius muscle in our results was ill developed, its fleshy origin and arising from the facial canal, run rostrally to be fixed to the muscular process of stapes.

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دراسة مقارنة للتجويف الطبلي في الابقار والجاموس

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الخلاصة

هدفت الدراسة الحالية تحديد شكل وموقع ومكونات التجويف الطبلي في الابقار والجاموس لاهميتها من الناحية السريرية وكذلك لقلة المصادر حول الدراسة المورفولوجية للتجويف الطبلي في الجاموس وهذه النقطة بالذات مهمة لمعرفة التغيرات غير الطبيعية للتجويف ولتكون عونا على تطوير التكنيك الجراحي للتجويف الطبلي. وقد اجري البحث على 12 عينة من الابقار والجاموس (ست عينات للابقار والجاموس) وتمت دراسة شكل وموقع ومكونات التجويف و العظيمات في مكانها الطبيعي داخل الاذن الوسطى على الجانبين وكذلك عند ازالتها من التجويف وتم قياس القناة السمعية عن طريق استخدام الورنية الالكترونية وشريط القياس وصورت مكونات التجويف عن طريق المجهر التشريحي . اوضحت الدراسة ان التجويف الطبلي ينقسم الى ثلاثة اجزاء ظهري واوسط وبطني متصلة مع بعضها الجزء الظهري او (الفرجة فوق الطبلية) تحتضن راس المطرقة المطمور في الغشاء الطبلي على حين يحتوي التجويف الطبلي الاساسي على الغشاء الطبلي الذي ينقسم الى قسمين (جزء رخو والاخر مشدود) في كلا الحيوانين وعند الجاموس يكون كبير ومتطور شكله بيضوي ولونه داكن وسميك اما في الابقار يكون شكله مستطيل ولونه فاتح واقل سمكا بكثير مقارنة بالجاموس . كما ويحتوي التجويف الطبلي الاساسي على ثلاث عظيمات اساسية هي المطرقة والسندان والركاب في كلا الحيوانين تكون متصلة مع بعضها وان هذه العظيمات متطورة في الجاموس و صغيرة نسبيا في الابقار ولكن السندان اكثر وضوحا واقوى صلابة علاوة على وذلك لايوجد في الابقار القرن العدسي وهو الذي يتمفصل مع القرن الطويل للسندان , وقد اظهرت الدراسة ان المطرقة والسندان تندمج بشدة مع بعضها ومن الصعوبة الفصل بينهما في كلا الحيوانين. و يحتوي التجويف الطبلي الاساسي على عضلتين هيكليتين وهما (الموترة الطبلية والركابية) وتكون الاخيرة غير متطورة واكثر اجزاء العضلة الموترة الطبلية وترية عند الجاموس , يمتلك التجويف الطبلي الاساسي اربعة فتحات هي فتحة الميزاب السمعي الخارجي و الفتحة البيضوية والفتحة المستديرة والتي تكون مغطاة بفاصل غشائي وكذلك فتحة الانبوب السمعي اوالقناة البلعومية الطبلية تكون هلالية الشكل و يتراوح طولها (4-5) سم في كلا الحيوانين وان قصر القناة النسبي يودي الى توقع الانتشار السريع لاي تلوث من البلعوم. يكون الجزء البطني لقاع التجويف الطبلي متسع وياخذ شكل المنخل نتيجة وجود عدد كبير من االخلايا المختلفة الاحجام والاشكال و تسمى الفقاعة الطبلية والتي تتصل مباشرة مع الجزء البطني للتجويف الطبلي الاساسي ومع الميزاب السمعي والقناة الوجهية .

الكلمات المفتاحية: التجويف الطبلي، الابقار، الجاموس.