



RESEARCH ARTICLE

Investigation of paranasal sinuses based on dissection and multidetector computed tomography images in New Zealand rabbits

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Özet

Özkadif S, Eken E. Yeni Zelanda tavşanlarında sinus paranasales'in diseksiyon bulguları ve multidetektor bilgisayarlı tomografi görüntülerinin araştırılması. **Eurasian J Vet Sci, 2012, 28, 1, 10-14**

Amaç: Yeni Zelanda tavşanlarında sinus paranasales ve concha'ların anatomik özelliklerini diseksiyon ve multidetektor bilgisayarlı tomografi (MDBT) ile ortaya koymaktır.

Gereç ve Yöntem: Araştırmada her iki cinsiyetten toplam 16 yetişkin Yeni Zelanda tavşanı kullanıldı. Sinus paranasales'in yüksek çözünürlüklü MDBT görüntüleri elde edildikten sonra hayvanlar bilinen metodlar ile ötenazi yapıldı ve paranasal sinüsleri diseksiyonla incelendi.

Bulgular: MDBT ve diseksiyon bulguları ışığında Yeni Zelanda tavşanlarının kafatasının her bir yarımında ductus nasolacrimalis vasıtasıyla bağımsız olarak ikiye ayrılan iki bölümlü bir adet sinus maxillaris'in mevcut olduğu tespit edildi. Bu türlerde iyi gelişmiş olan concha'ların concha nasalis dorsalis, concha nasalis media, concha nasalis ventralis ve endoturbinalia'dan oluştuğu görüldü. Sinus frontalis, sinus sphenoidalis ve sinus ethmoidalis'in şekillenmediği saptandı. Diseksiyon ve MDBT görüntülerinden elde edilen verilerin birbirini desteklediği belirlendi.

Öneri: Bilinen metodların yanında görüntüleme yöntemi de kullanan bu çalışmanın sinus paranasales ile ilgili gelecek çalışmalara katkı sağlayabileceği ve anatomi eğitimine modern bir açılım sağlayabileceği düşünülmektedir.

Abstract

Ozkadif S, Eken E. Investigation of paranasal sinuses based on dissection and multidetector computed tomography images in New Zealand rabbits. **Eurasian J Vet Sci, 2012, 28, 1, 10-14**

Aim: The aim of this study is to present anatomic properties of paranasal sinuses and conchae by dissection and multidetector computed tomography (MDCT) images in New Zealand rabbits.

Materials and Methods: In this study a total of 16 adult New Zealand rabbits of both sexes were used. After obtaining high resolution MDCT images of paranasal sinuses, the animals were euthanased by conventional methods and then dissected their paranasal sinuses.

Results: Based on dissection and MDCT images, it was determined that each half of New Zealand rabbit skull had maxillary sinus formed by two compartments that were divided by independently a nasolacrimal duct. We also showed that the well developed conchae were formed by dorsal, middle, ventral nasal conchae as well as endoturbinalia. Interestingly, we recorded no frontal, sphenoidal and ethmoidal sinuses in this species. The data obtained from dissection and MDCT images were in parallel to each other.

Conclusion: It has been suggested that this work using imaging technique in addition to common anatomical techniques may contribute to future studies on paranasal sinuses and may add modern dimension to anatomical education.

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Keywords: Dissection, computed tomography, paranasal sinuses, concha, rabbit

► Introduction

The main properties of paranasal sinuses are to have air holes, complex anatomies and individual variations. Genetic diseases, environmental conditions and experienced infections may affect the developmental process of paranasal sinuses (Tos and Stangerup 1985, Kubal 1998). Knowing anatomic variations are important not only for reducing endoscopic sinus surgery complications but also for correcting surgically variations that might cause chronic sinusitis (Çağıcı et al 2006).

Head dissection is important to reveal nose and sinus anatomy of human cadaver and for technical application. It's mostly difficult for medical students to find enough head of human cadaver (Gardiner et al 1996). At the same time, it's ethically not possible to perform experiments on human beings for the research of nasal and paranasal sinus diseases. Almost all of studies related with surgical traumas of these regions and regeneration patterns following them have been also performed on animals (Köybaşıoğlu et al 1997). For these reasons, knowing anatomy, biology and behavior of animals is highly important in terms of producing models that might be applied on human beings (Palumbo et al 2004). Basic information should be presented before transferring techniques and models to the clinical medium. Results of studies with animals can be adapted on human models (Grauer et al 2000). For this purpose, rabbits are mostly used as experiment animals in human and veterinary medicines. For example, rabbits can be used in the development of infection similar to paranasal sinus aspergillosis in human beings. In the study of this infection, mice and rats were failed (Chakrabarti et al 1997).

In the literature, although there were few studies related to morphology of rabbit paranasal sinuses dissection findings of rabbit paranasal sinuses, no studies using imaging techniques were found. Therefore this study was performed for the aim of filling the deficiency in this field as comparing dissection and MDCT findings of paranasal sinuses and conchae in New Zealand rabbits.

► Materials and Methods

In this study, a total of 16 New Zealand rabbits of both sexes aged 1-1.5 and weighing between 3 and 3.5 kg were used. Study protocol was approved by Ethical Committee of Veterinary Faculty, Selcuk University. The rabbits were intravenously anaesthetized with the mixture of 5 mg/kg ketamine-HCl (Ketamidol™ RicherPharma AG, Wels, Austria) and 20 mg/kg propofol (Propofol™ Amp., Fresenius Kabi, Austria). Under anesthesia, MDCT images of animals in prone position were obtained. The parameters of MDCT (Somatom Sensation 64;Siemens Medical Solutions, Forchheim, Germany) instrument were adjusted as; physical detector collimation, 32 x 0.6 mm; final section collimation, 64 x 0.6 mm; section thickness, 0.75

mm; gantry rotation period; 330 msec; kVp; 120; mA, 300; resolution, 512 x 512 pixel; resolution range, 0.92 x 0.92. Dosage parameters and scannings were performed by predicating them on standard protocols and literature (Prokop 2003, Kalra et al 2004). Thus, it was tried to obtain radiometric resolution (MONOCHROME 2;16 bit) at the lowest radiation level with optimum image quality. The axial images obtained were stocked in DICOM format and then were evaluated in a personal computer.

After obtaining high resolution MDCT images of paranasal sinuses were obtained, the animals were euthanased by conventional methods for dissection. After the skin of the dorsal portion of the nose was trimmed, the skin and periosteum in middle line were elevated carefully to reveal the nasal bone between naso-frontal suture and naso-incisive suture (Bahadır et al 2008). Osteotomy was performed transversally along the back of nasal and maxillary bones and a cut was formed on upper part of the lateral cartilages. Lateral nasal septum including maxillary sinus ostium was also cut and removed. This cut piece is conjugated with front part of ethmoid (Velwoerd- Velhoef and Verwoerd 2003). Anatomy of lateral nasal septum, conchae and ostium of maxillary sinus were investigated within these incisions. Moreover, the inner side of sinus maxillaris was investigated by getting coronal cross sections (Köybaşıoğlu et al 1997). The emerging maxillary sinus and conchae were photographed and named. Nomina Anatomica Veterinaria (NAV 2005) was used as terminology in study.

► Results

• Dissection of paranasal sinuses

The right and left lateral nasal septums were observed after nasal bone and maxilla are removed. Nasal septums were intimate contact with the rostral part of ethmoid bone. We showed the right and left maxillary sinus ostiums at the bottom of both nasal septums. Dorsal, ventral and middle nasal conchae and endoturbinaria were determined on lateral nasal septum. The dorsal nasal concha was on top of cavum nasi, middle nasal concha was the oro-ventral third of the dorsal nasal concha, the ventral nasal concha was aboro-ventral third of the dorsal nasal concha. Endoturbinaria was located ventral to the middle nasal concha. It was observed that conchae were quite sinuous (Figure 1).

It was recorded that maxillary sinus was in the maxilla ventral to conchae. Maxillary sinus ostium was opened to the narrow field at the back of ethmoturbinal concha. In coronal cross sections, it was observed that maxillary sinus was constituted by dorsal and ventral compartments. The nasolacrimal canal was determined to cross between the ventral and dorsal compartments (Figure 2). The ventral compartment of the maxillary sinus was placed at the base of the nasal cavity. It was observed that the maxillar si-

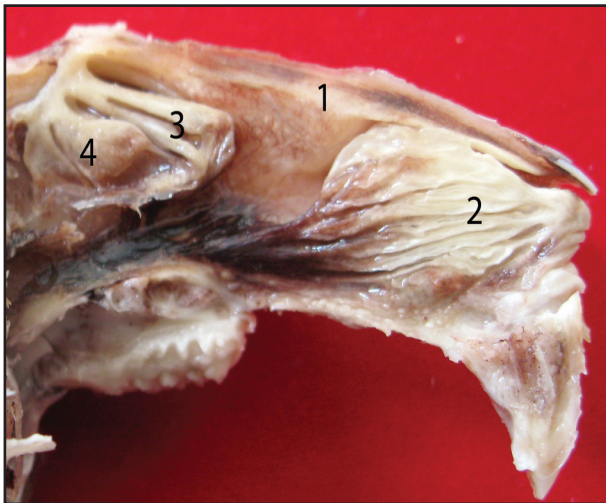


Figure 1. View of 1: Dorsal nasal concha, 2: Ventral nasal concha, 3: Middle nasal concha and 4: Endoturbinalia on lateral nasal septum.

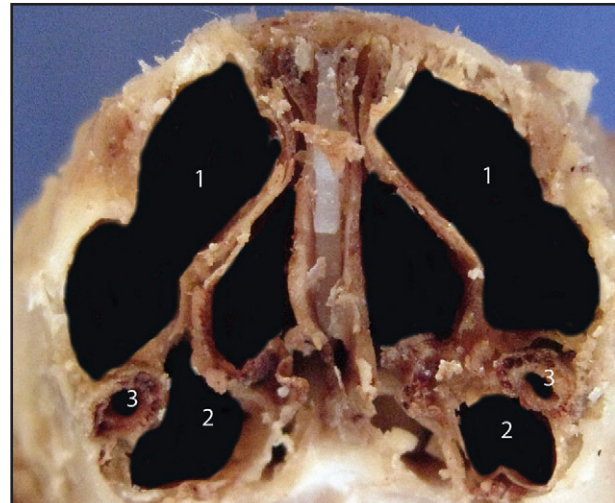


Figure 2. In coronal cross section, 1: dorsal compartment of maxillary sinus, 2: ventral compartment of maxillary sinus, 3: Canalis nasolacrimalis.

nus ostium was opened to the nasal cavity at the base of the dorsal compartment (Figure 3). In coronal and lateral cross sections, frontal, sphenoidal and ethmoidal sinuses were not seen.

- *Analysis of MDCT images taken from paranasal sinuses*

In sagittal sections of paranasal sinuses, it was determined that dorsal nasal concha was dorsal to the nasal cavity. The ventral nasal and middle nasal conchae were located aboro-ventral and oro-ventral to the dorsal nasal concha, respectively. Both conchae were seen to be formed by white colored curls whose spaces were black colored. Endoturbinalia was observed caudal to the middle nasal concha (Figure 4).



Figure 3. Ostium of maxillary sinus.

In coronal sections of paranasal sinuses, there was the ventral nasal concha that was located in the right and left sides of the cranial part of nasal septum had grey colored curlings including black colored spaces (Figure 5).

In coronal sections of paranasal sinuses, the middle nasal concha was seen as grey colored line in the right and left side of medial face of the nasal septum. The endoturbinalia was also grey colored in the both side of caudal face of nasal septum. In all sections, the spaces among the middle nasal concha and endoturbinalia were black colored (Figure 6).

In coronal sections of paranasal sinuses, the dorsal nasal concha and maxillary sinus were seen as black colored, and they were bordered by a grey colored septum. The dorsal and ventral compartment could be discernible (Figure 7).

► Discussion

The conformations and locations of the nasal sinuses and conchae in New Zealand rabbit were consistent with the Köybaşıoğlu et al (1997) and Özer (2004). We showed that the maxillary sinus was located just ventral to the nasal bone as recorded by Asai et al (2002). New Zealand rabbit had two compartments that the nasolacrimal canal separated one another, which is inconsistent with human being. The conchae of New Zealand rabbit were more developed and more curling than human being (Köybaşıoğlu et al 1997). In both dissection and MDCT images the frontal, sphenoidal and ethmoidal sinuses were not seen in this work.

As mentioned by Pinkston et al (1995), the anatomy of nose and maxillary sinus belonging to rabbits principally was similar to those of human beings. However, the most important difference was that the upper part and turbinals of maxillary sinus in rabbits were placed in the upwards of lateral nasal wall. Due to this similarity, it was determined in the studies of Chakrabarti et al (1997) and Jyonouchi et al (1998) that rabbit maxillary sinus can be used in the research of paranasal sinus aspergilosis and bacteroids.

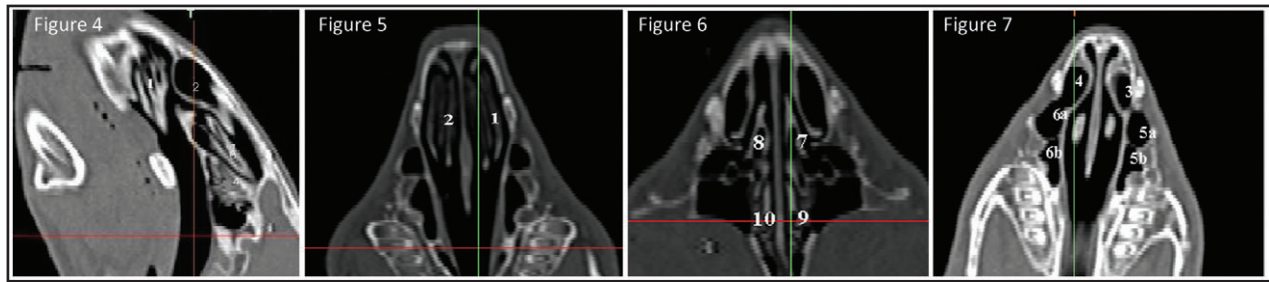


Figure 4. Sagittal MDCT view of paranasal sinuses. 1: Left ventral nasal concha, 2: Left dorsal nasal concha, 3: Left middle nasal concha, 4: Left endoturbinolia.

Figure 5. Coronal MDCT view of paranasal sinuses. 1: Left ventral nasal concha, 2: Right ventral nasal concha.

Figure 6. Coronal MDCT view of paranasal sinuses. 7: Left middle nasal concha, 8: Right middle nasal concha, 9: Left endoturbinolia, 10: Right endoturbinolia.

Figure 7. Coronal MDCT view of paranasal sinuses. 3: Left dorsal nasal concha, 4: Right dorsal nasal concha, 5a: Dorsal compartment of left maxillary sinus, 5b: Ventral compartment of left maxillary sinus, 6a: Dorsal compartment of right maxillary sinus, 6b: Ventral compartment of right maxillary sinus.

As it was specified by Verwoerd-Verhoef and Verwoerd (2003), maxillary sinus was connected with nasal cavity. Maxillary sinus which is below maxillary sinus turbinale was opened to nasal cavity with a single hole which is called the maxillary sinus ostium. In maxillary sinus research of Watanabe et al (1999) and in experimental operations of Pinkston et al (1995) on lateral nasal wall, it was determined that rabbit had many advantages as a good model.

It was shown by Peltola et al (2001), Peltola et al (2003), Peltola et al (2006) that the frontal sinus in rabbits was present just in young rabbits and was disappeared in the course of time. Since the rabbits used in our study were adult, frontal sinus was not encountered. Although Jacob and Chole (2006) reported that the mouse had a pair of sphenoidal sinus, it was not encountered in New Zealand rabbits.

► Conclusions

This study using dissection and MDCT imaging techniques revealed that each half of the New Zealand rabbit skull had one maxillary sinus consisting of two compartments and four conchae named dorsal, middle, ventral nasal conchae and endoturbinolia. We hoped that the results from this study will shed light on further studies on paranasal sinuses, and we can say that making use of computer technology in changing and developing anatomy education and researches is ethically quite important.

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