

Clinical Report

**Three-Dimensional Computed Tomography
Diagnosis of Cranium Bifidum with Meningocele in a Lamb**

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Abstract

Case Description- A three-day-old male Kordi lamb had a soft painless fluctuating mass on the mid-parietal region, with no clinical signs except difficulty in standing; was referred to the clinic.

Clinical Findings- Clinical examination revealed a normal body temperature, a heart rate, a respiratory rate, and inability to stand without any congenital defects. Three-dimensional computed tomography (3DCT) of the skull following radiology and ultrasonography revealed an elliptical defect in the left side of the median parietal line of the skull.

Treatment and Outcome- Unfortunately, before surgery the lamb died. Postmortem findings of meningocele exactly confirmed what was shown with 3DCT technique.

Clinical Relevance- The present clinical case of meningocele is the first report of cranium bifidum at the left parietal bone in a lamb, using this diagnostic imaging technique.

Key words: Three-dimensional computed tomography, cranium bifidum, meningocele, lamb, parietal bone

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Case Description

A 4-year-old male homer pigeon (*Columba livia*) in a flock of 20 pigeons was referred to A three-day-old male Kordi lamb, which had a soft painless fluctuating mass with 8×8 cm dimensions on the mid-parietal region (Fig. 1), was admitted to the veterinary teaching clinic of Ferdowsi University of Mashhad. Clinical examination revealed a normal body temperature (38.5°C), a heart rate (130 beats/min), a respiratory rate (30 breaths/min), and inability to stand without any congenital defects.

Diagnostic imaging evaluations consisted of radiology, ultrasonography and three-dimensional computed tomography (3DCT). Lateral skull radiograph showed decreased bone opacity of the caudal region; this was due to a defect on the cortex of interparietal bone (Fig. 2 A). Ultrasonography was performed to evaluate content of the fluctuating mass, with an 8 MHz linear transducer (Pie Medical, scanner 100LC, Netherland). The defected part was cystic shape filled with anechoic fluid and without shapeless tissues (Fig. 2 B). Though the striking radiographic and ultrasonographic appearances clearly led diagnostic features of cranium bifidum, it was impossible to identify the existence of brain tissue within the sac (cele). Therefore, it was difficult to differentiate between a meningocele and meningoencephalocele, ultrasonographically. That is why for this clinical case we applied 3DCT imaging technique. Image acquisition was obtained using a multi-slice helical CT scanner (Siemens, Sensation 16). CT images were acquired at 4-mm collimation, 120 kV, 176 mA in three dimensions. Images were reconstructed in soft tissue and high resolution bone algorithm. Three-dimensional volume reconstruction of the lamb skull clearly demonstrated an elliptical defect (sagittal and transverse dimensions 1.45×1.67 cm, respectively) in the left side of the median parietal line of the skull. In CT images, Cerebrospinal fluid (CSF), gray matter and white matter differ in density (CSF $\pm 5-10$ HU; white matter $\pm 25-30$ HU; gray matter: $\pm 35-50$ HU).¹ According to CT number of the fluctuating mass and since the CT number for brain is much higher than CSF, the CT images clearly showed no sign of brain tissue in the mass, and meningoencephalocele was therefore ruled out (Figs. 3 A, B, C, D).



Figure 1. Cranium bifidum with meningocele in three-day-old male lamb. The size of the sac was approximately $8 \text{ cm} \times 8 \text{ cm}$.

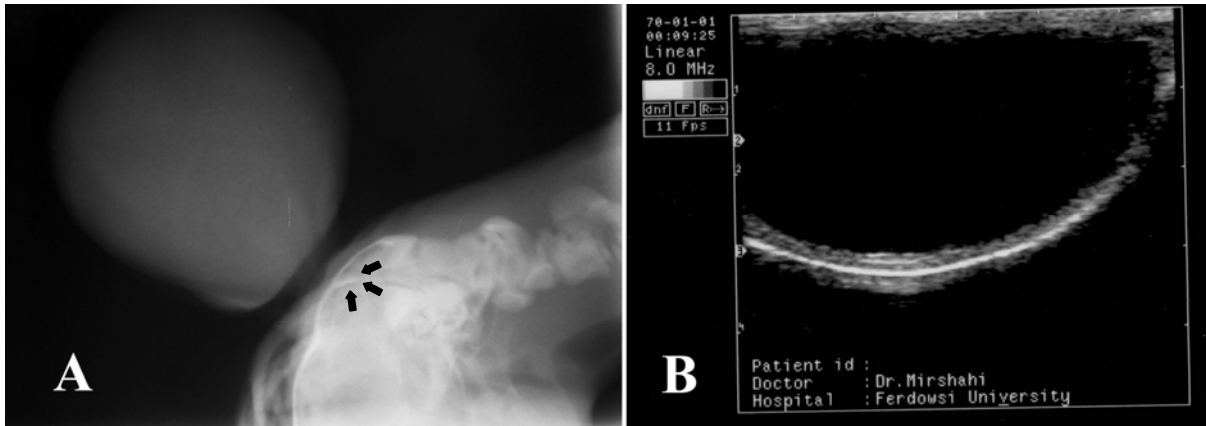


Figure 2. (A) Lateral plain radiograph of caudal part of the skull shows decreased bone opacity represents bone defect (arrows) and (B) sagittal Ultrasonogram of the sac, cystic shape mass filled with anechoic fluid.

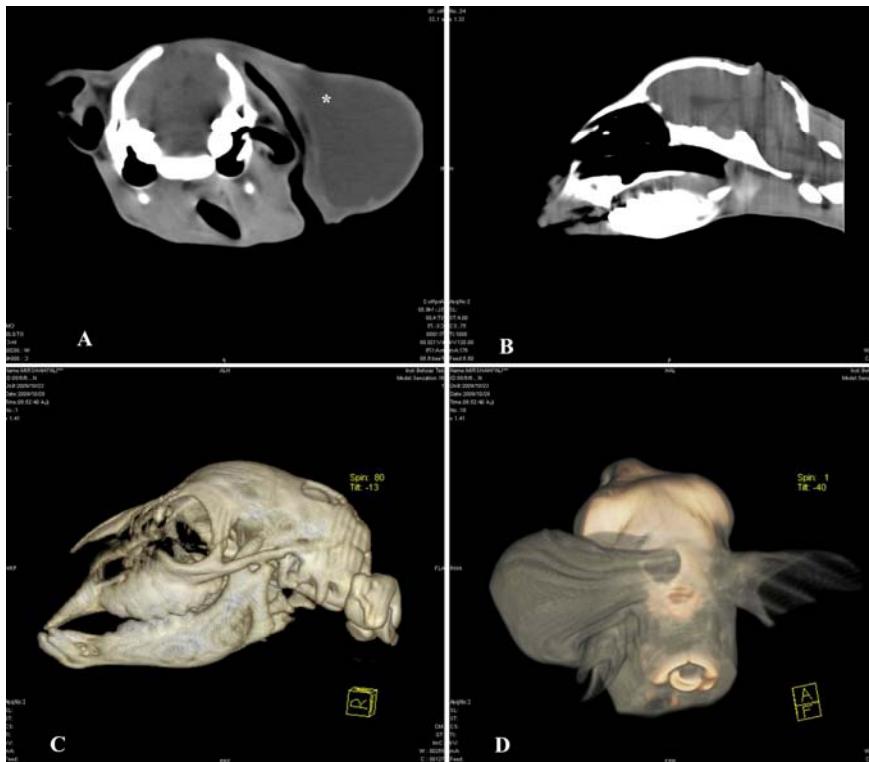


Figure 3. 3DCT images. (A), (B) Transverse and sagittal sections through the skull show parietal bone defect, respectively. CT number of fluctuating mass (asterisk), in the range 0-15 Hounsfield unit (HU) and close to the HU for CSF, was different from the CT number of brain (25-50 HU) (C) Three-dimensional volume reconstruction of lamb skull. Parietal bone defect is seen in the left side of the median parietal line of the skull. (D) Three-dimensional shaded-surface-display image of lamb skull and soft tissue. A large swelling mass and bone defect are seen in the left parietal bone of the skull.

Treatment and Outcome

Before surgery, the lamb died. At postmortem examination, an elliptical defect in the left side of the median parietal line of the skull was observed without brain protrusion. Therefore, cranium bifidum with meningocele was confirmed. The other postmortem findings were analogous to the 3DCT scan findings (Figs. 4 A, B).

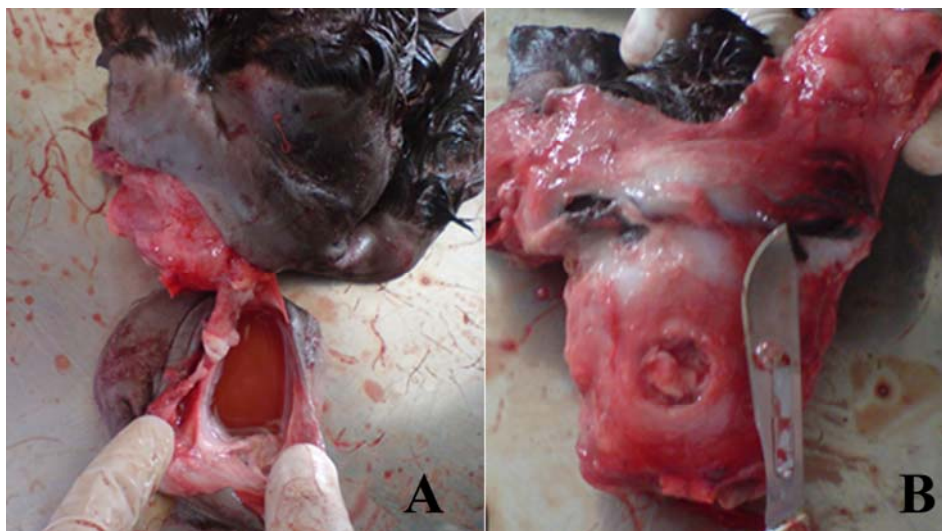


Figure 4. Gross photographs of meningocele and cranium bifidum. (A) Fluid-filled sac of meninges without any brain parenchyma has protruded through the skull defect. The sac contains fluid and has lined by arachnoid and dura, which are continuous with those surrounding the brain. (B) An elliptical defect in the left side of the median parietal line of the skull is seen without brain protrusion has allowed the meninges to herniate into a large external pouch covered by skin.

Discussion

Cranium bifidum is characterized by a dorsal midline cranial defect through which meningeal and brain tissue can protrude. The protruded material, which forms a cele, is covered and protected only by skin and can be lined by meninges (meningocele) or meninges accompanied by a part of the brain (meningoencephalocele).² Both meningocele and meningoencephalocele are very rare congenital anomalies.³ Meningocele has recently been described in cattle, sheep, horses, pigs, dogs and cats,^{4,5} but no report is available in one side of a lamb's skull, and our current reports would be valuable for veterinarians.

In Cranium bifidum, the clinical examination can be helpful in developing the differential diagnosis and the imaging strategy. However, a single imaging study is insufficient and it is necessary to image with more one modality to correctly diagnose a lesion and provide adequate information for the surgeon. Radiography and ultrasonography are often the initial screening diagnostic tests, followed by magnetic resonance imaging (MRI) or 3DCT for a precise diagnosis.⁶

In lamb, cranium bifidum has also been diagnosed by radiography⁴, but differentiation between meningoencephalocele and meningocele by radiography and ultrasonography is not easy. Differential diagnosis between meningocele and meningoencephalocele can only be achieved by 3DCT and MRI techniques.³ 3DCT scans make it possible to differentiate between a meningocele and a meningoencephalocele, and to measure the diameter of the defect before surgery. The CT images are a simple and valuable non-invasive diagnostic

technique in a lamb.³ According to these facts, 3DCT have provided more precise differential diagnosis and greater detail about the anatomic extent of disease.⁷

The herniations are related to suture lines and are almost always median. They vary from 2-10 cm in diameter, and the largest diameter is always much larger than the diameter of the cranial opening. The skin forms the hernial sac, and ectopic bits of disorganized neural tissue may be attached to it; the dura mater does not form in the areas of defect. Encephalocele and meningocele occur usually in the frontal regions but some are occipital and occipital crest.⁷ This lamb had cranium bifidum in the left parietal bone of the skull that is very rare location in parietal bone.

To the knowledge of the authors, the present case is the first report of 3DCT scan diagnosis of cranium bifidum with meningocele in a lamb. We can further apply this imaging technique for livestock.

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تشخیص کرنیوم با یفیدوم به همراه منگوسل در یک راس بره با تکنیک سی تی اسکن سه بعدی

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توصیف بیمار - بره نر سه روزه نژاد کردی با توده آویزان و بدون درد در ناحیه استخوان آهیانه بدون نشانه‌ی بالینی غیر طبیعی دیگر بجز مشکل ایستادن به کلینیک ارجاع داده شد.

یافته‌های بالینی - در معاینات بالینی دمای بدن، ضربان قلب و تنفس در محدوده طبیعی بود. علیرغم فقدان دیگر نقایص مادرزادی حیوان قادر به ایستادن نبود. سی تی اسکن سه بعدی مجموعه متعاقب رادیولوژی و اولتراسونوگرافی توده، نقیصه‌ای بیضی شکل در سمت چپ استخوان آهیانه را نشان داد.

درمان و نتیجه آن - قبل از جراحی، حیوان زنده نماند. یافته‌های کالبدگشایی منگوسل را که در تکنیک تصویربرداری سی تی اسکن سه بعدی مشخص شده بود، تایید کرد.

کاربرد بالینی - این گزارش اولین گزارش کرنیوم با یفیدوم در سمت چپ استخوان آهیانه بره با ارزیابی سی تی اسکن سه بعدی است.

کلید واژگان - سی تی اسکن سه بعدی، کرنیوم با یفیدوم، منگوسل، بره، استخوان آهیانه