Magnetic Resonance Imaging of the Normal Brain of Buffaloes (*Bos bubalis*)

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Abstract

There are few studies on the anatomical or diagnostic imaging on the brain of buffaloes (*Bos bubalis*).This initial study demonstrates the first series of magnetic resonance images (MRI) to provide a detailed description of the brain in clinically normal buffaloes (*Bos bubalis*). Normal four heads of adult buffaloes of different ages (4-6 years) and sexes (two females and two males) were used in this study. The buffaloes were slaughtered and the heads were sectioned at the level of atlantoaxial joint. T2-weighted transverse and coronal magnetic resonance image were taken with a 1.5-T Philips NT scanner with slice spacing of 6.0 mm and 6 mm thick. The different structures of the brain including the cerebral hemispheres, hippocampus, thalamus, hypothalamus, cerebellum, pons, myelencephalon and other major features of the brain are illustrated and appeared clearly defined in the MR images. Magnetic resonance imaging (MRI) offers a mean for consistent evaluation of the buffalo brain structures that could be useful for evaluation of many pathological lesions that affect the brain region.

Introduction

Magnetic resonance imaging (MRI) became routine in human medicine during the 1980s.[1,2] MRI has proved to be valuable in the study of anatomy[3] and pathology[4] of the central nervous system in human medicine. Several reports on the use of MRI in small animals have been published.[5,6,7] Few MRI studies on the heads of large domestic animals exist specially in horses[8] and camels.[9]

MRI helps in the description of the different structures of the large brains as in elephants[10], where traditional methods of sectioning, staining, mounting and microscopic examinations are not practical.[11] There are no published descriptions of the basic neuroanatomy of the buffalo by using MRI in the available literatures.

In the present study, the author presents the first labeled sequential description of the buffalo brain. The findings of the present study are based on magnetic resonance imaging (MRI) of a postmortem brain in- situ (within the cranial cavity of the buffalo). This study produced a series of slices in which the detailed brain structures can be observed with little or no distortion caused by physically sectioning of the brain. MRI has been used in large animals to identify many pathological lesions as congenital brain anomalies, evaluation of cranial trauma and detection of brain infections. Therefore MRI is expected to be a valuable method for examining buffalo brains.

Material and Methods

Specimen

Normal four heads of adult buffaloes (*Bos bubalis*) were used in this study. The buffaloes were of different ages (4-6 years) and sexes (two females and two males). The buffaloes were collected from abattoirs after slaughtering and the heads were sectioned at the level of atlantoaxial joint. The heads were obtained immediately after slaughtering, cooled and imaged within 12 hours to minimize post-mortem changes.

Magnetic Resonance Imaging

Contiguous T2-weighted transverse and coronal magnetic resonance images were acquired with a 1.5-T Philips NT scanner. Imaging protocol parameters were: repetition time (TR) = 4757 ms, echo time (TE) = 120 ms, matrix = 245 X 256 pixels, Field of view = 160 mm, 6 mm slice thickness with 6 mm interslice spacing. Each head was imaged with the ventral side down in the human head coil.

Anatomical labeling and nomenclature

All identifiable anatomical structures of the buffalo's brain were labeled in the axial and coronal plane images. The magnetic resonance images were compared with the gross anatomical sections.[9,12,13,14]

Result

General morphology

The normal MR images of the brain of buffaloes were illustrated and studied. A dorsal-to-ventral sequence of originally acquired 6.0-mm-thick transverse magnetic resonance brain sections at 6-mm intervals were illustrated in Figure 1 (A-L). The transverse images were oriented so that the right side of the head is to the viewer's left and the dorsal at the top. The figures include also inset images of buffalo brain showing the approximate orientation of each transverse section. A rostral-to-caudal sequence of originally acquired 6.0-mm-thick coronal magnetic resonance brain sections at 6-mm intervals were illustrated in Figure 2 (A-F).

The T2-weighted MR images provided excellent anatomical views of the anatomy of the brain and associate structures. The cerebrospinal fluid within the subarachnoid spaces and inside the ventricles had high signal intensity and appeared bright white in color. The other brain structures had intermediate signal intensity and appeared dark.

Forebrain anatomy

The cerebral hemispheres were narrow in the rostral part and become wider in their caudal part, as shown in the coronal slices (Figure 2A). The basal ganglia structures such as the caudate nucleus were easily visualized in Figure 1 (D, E, F). The internal capsule that appeared carrying the descending motor fibers was wide and clear (Figure 1 A-I). The hippocampus was small and observed clearly in the ventral position in Figure 2C. The thalamus and hypothalamus were also seen clearly (Figure 1G). The corpus callosum was thin with respect to the size of the cerebral hemispheres.

Midbrain anatomy

The cerebral peduncle was large and lied on the ventral surface of the midbrain (Figure 1J).

Hindbrain anatomy

The cerebellum appeared large in the buffalo brain (Figure 2 B-E).The pons was also visible and identified (Figure 2F).

Discussion

This pilot study presents the first series of MRI-based anatomically labeled sectioned images of the brain of buffaloes. The present study showed that MR images could allow the visualization of all characteristic features of the buffalo's brain.

The corpus callosum is relatively small structure in the buffalo brain with respect to the size of the cerebral hemispheres. This is in agreement with the earlier findings [15,16] for cetaceans and humans. However this is in contrast in the elephant's brain that has an unusually large corpus callosum.[10]

The results of this study proved that the buffalo's brain has small hippocampus which is found exclusively in the ventral position. This is in contrast to the hippocampus of the elephant brain which is large and extends dorsally.[10]

Understanding of normal brain anatomy of the buffalo using MRI is necessary for the diagnosis of many of the central nervous system diseases.[17]

Conclusion and clinical relevance

Magnetic resonance imaging (MRI) provides a mean for consistent evaluation of the buffalo brain structures that could be useful for evaluation of many pathological conditions that affect the brain region.

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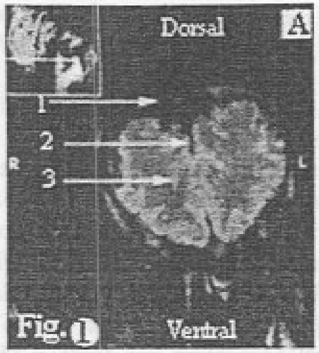
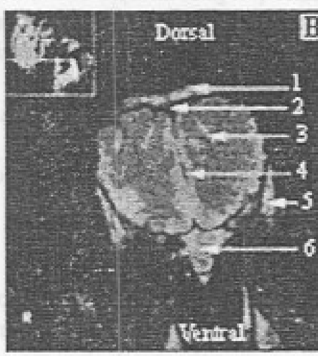
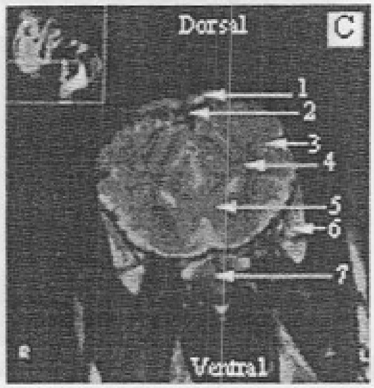


Figure 1 (A-L): Dorsal-to-ventral sequence of anatomically labeled T2-weighted transverse MR images through the whole buffalo brain. The inset is midsagittal MR image and the vertical line represents the exact slice location. R, right; L; left.

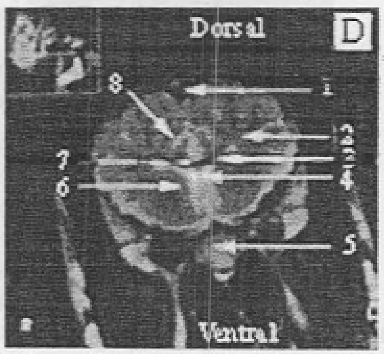
1A. 1, Os parietale (Parietal bone); 2, Fissura longitudinalis cerebri (Cerebral longitudinal fissure); 3, Cerebral hemisphere.



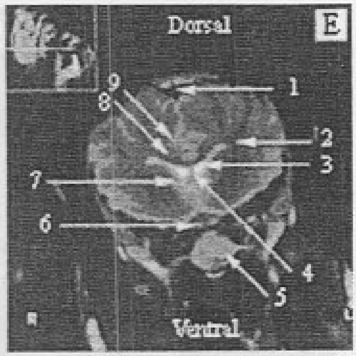
1B. 1, Os parietale (Parietal bone); 2, Sinus sagittalis dorsalis (Dorsal sagittal sinus); 3, Cerebral hemisphere; 4, Fissura longitudinalis cerebri (Cerebral longitudinal fissure); 5, Os temporale (Squamous part of temporal bone); 6, Os basisphenoidale (Body of basisphenoid bone).



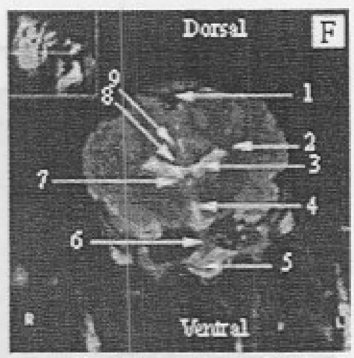
1C. 1, Os parietale (Parietal bone); 2, Sinus sagittalis dorsalis (Dorsal sagittal sinus); 3, Cerebral hemisphere; 4, Capsula interna (Internal capsule); 5, Nucleus caudatus (Caudate nucleus); 6, Os temporale (Squamous part of temporal bone); 7, Os basisphenoidale (Body of basisphenoid bone).



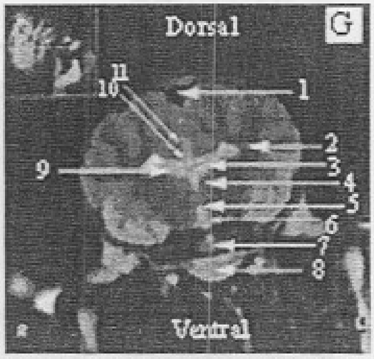
1D. 1, Sinus sagittalis dorsalis (Dorsal sagittal sinus); 2, Capsula interna (Internal capsule); 3, Ventriculus lateralis (Lateral ventricle); 4, Septum pellucidum; 5, Os basisphenoidale (Body of basisphenoid bone); 6, Nucleus caudatus (Caudate nucleus); 7, Corpus callosum; 8, Gyrus cinguli (Cingulate gyrus).



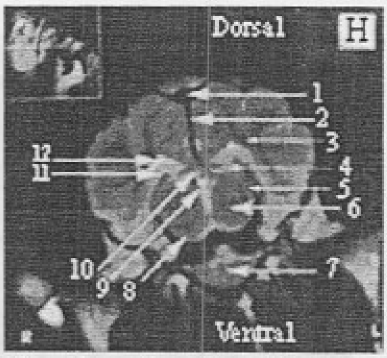
1E. 1, Sinus sagittalis dorsalis (Dorsal sagittal sinus); 2, Capsula interna (Internal capsule); 3, Ventriculus lateralis (Lateral ventricle); 4, Septum pellucidum; 5, Os basisphenoidale (Body of basisphenoid bone); 6, Nervus opticus (Optic nerve); 7, Nucleus caudatus (Caudate nucleus); 8, Corpus callosum; 9, Gyrus cinguli (Cingulate gyrus).



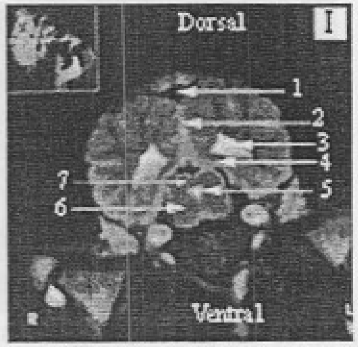
1F. 1, Sinus sagittalis dorsalis (Dorsal sagittal sinus); 2, Capsula interna (Internal capsule); 3, Ventriculus lateralis (Lateral ventricle); 4, Ventriculus tertius (Third ventricle); 5, Os basisphenoidale (Body of basisphenoid bone); 6, Glandula pituitaria (Pituitary gland); 7, Nucleus caudatus (Caudate nucleus); 8, Corpus callosum; 9, Gyrus cinguli (Cingulate gyrus).



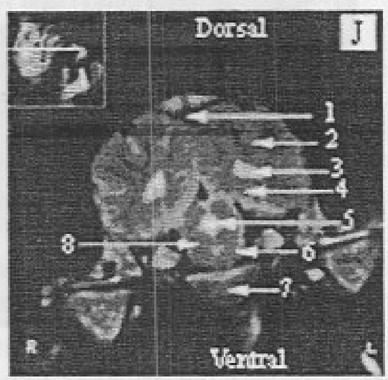
1G. 1, Sinus sagittalis dorsalis (Dorsal sagittal sinus); 2, Capsula interna (Internal capsule); 3, Ventriculus lateralis (Lateral ventricle); 4, Thalamus; 5, Ventriculus tertius (Third ventricle); 6, Hypothalamus; 7, Glandula pituitaria (Pituitary gland); 8, Os basisphenoidale (Body of basisphenoid bone); 9, Hippocampus; 10, Corpus callosum; 11, Gyrus cinguli (Cingulate gyrus).



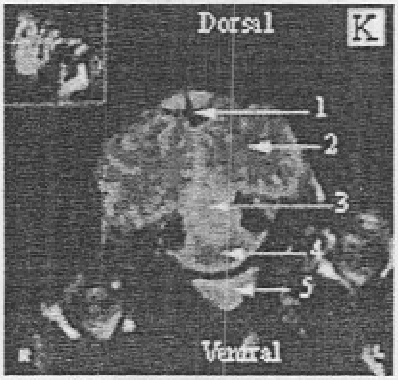
1H. 1, Sinus sagittalis dorsalis (Dorsal sagittal sinus); 2, Fissura longitudinalis cerebri (Cerebral longitudinal fissure); 3, Capsula interna (Internal capsule); 4, Corpus geniculatum laterale (Lateral geniculate body); 5, Corpus geniculatum mediale (Medial geniculate body); 6, Tegmentum mesencephali (Mesencephalic tegmentum); 7, Os basisphenoidale (Body of basisphenoid bone); 8, Crus cerebri; 9, Ventriculus tertius (Third ventricle); 10, Glandula pinealis (Pineal gland); 11, Hippocampus; 12, Ventriculus lateralis (Lateral ventricle).



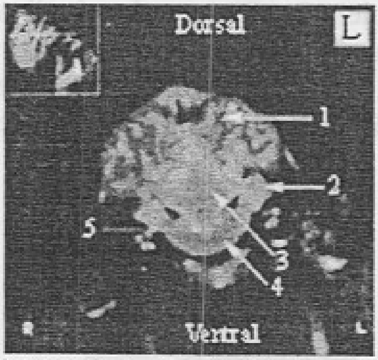
1I. 1, Sinus sagittalis dorsalis (Dorsal sagittal sinus); 2, Fissura longitudinalis cerebri (Cerebral longitudinal fissure); 3, Ventriculus lateralis (Lateral ventricle); 4, Hippocampus; 5, Aqueductus mesencephali (Mesencephalic aqueduct); 6, Tegmentum mesencephali (Mesencephalic tegmentum); 7, Tectum mesencephali-colliculus rostralis.



1J. 1, Sinus sagittalis dorsalis (Dorsal sagittal sinus); 2, Cerebral hemisphere; 3, Ventriculus lateralis (Lateral ventricle); 4, Hippocampus; 5, Aqueductus mesencephali (Mesencephalic aqueduct); 6, Cerebral peduncle; 7, Os occipitale (Occipital bone); 8, Tegmentum mesencephali (Mesencephalic tegmentum).



1K. 1, Sinus sagittalis dorsalis (Dorsal sagittal sinus); 2, Cerebral hemisphere; 3, Cerebellum; 4, Pons; 5, Os occipitale (Occipital bone).



1L. 1, Cerebral hemisphere; 2, Cerebellar hemisphere; 3, Vermis; 4, Medulla oblongata (Myelencephalon); 5, Ventriculus quartus (Fourth ventricle).

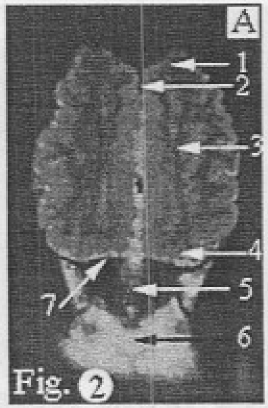
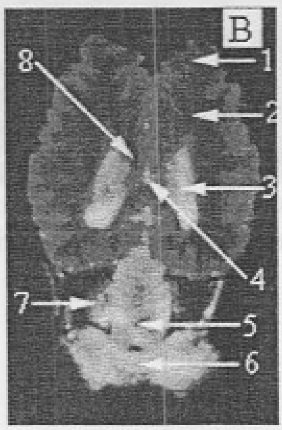
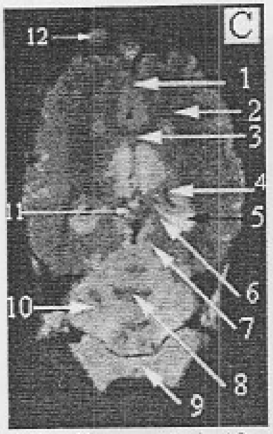


Figure 2 (A-H): Rostral-to-caudal sequence of anatomically labeled T2-weighted coronal MR images through the whole buffalo brain.

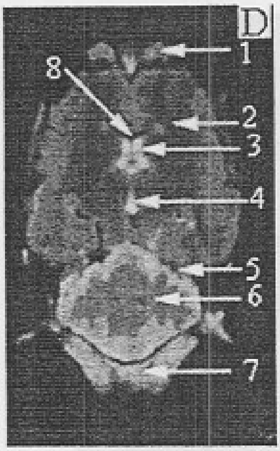
2A. 1, Frontal pole; 2, Fissura longitudinalis cerebri (Cerebral longitudinal fissure); 3, Cerebral hemisphere; 4, Occipital pole; 5, Cerebellar vermis; 6, Os occipitale (Occipital bone); 7, Fissura transversa cerebri (Transverse fissure containing tentorium cerebelli).



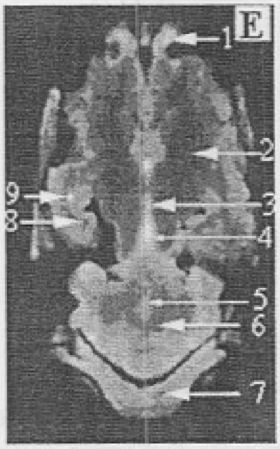
2B. 1, Frontal pole; 2, Capsula interna (Internal capsule); 3, Ventriculus lateralis (Lateral ventricle); 4, Septum pellucidum; 5, Vermis; 6, Os occipitale (Occipital bone); 7, Cerebellar hemisphere; 8, Corpus callosum.



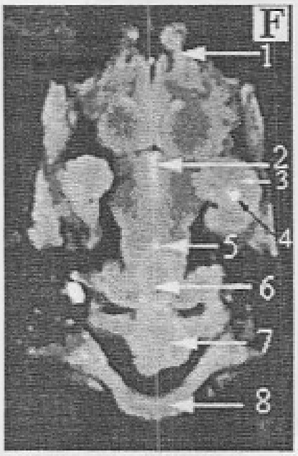
2C. 1, Fissura longitudinalis cerebri (Cerebral longitudinal fissure); 2, Capsula interna (Internal capsule); 3, Corpus callosum; 4, Hippocampus; 5, Ventriculus lateralis (Lateral ventricle); 6, Rostral colliculus; 7, Caudal colliculus; 8, Vermis; 9, Os occipitale (Occipital bone); 10, Cerebellar hemisphere; 10, Cerebellar hemisphere; 11, Glandula pituitaria (pituitary gland); 12, Olfactory bulb.



2D. 1, Olfactory bulb; 2, Capsula interna (Internal capsule); 3, Ventriculus lateralis (Lateral ventricle); 4, Ventriculus tertius (Third ventricle); 5, Fissura transversa cerebri (Transverse fissure); 6, Cerebellum; 7, Os occipitale (Occipital bone); 8, Corpus callosum.



2E. 1, Olfactory bulb; 2, Capsula interna (Internal capsule); 3, Ventriculus tertius (Third ventricle); 4, Aqueductus mesencephali (Mesencephalic aqueduct); 5, Ventriculus quartus (Fourth ventricle); 6, Cerebellum; 7, Os occipitale (Occipital bone); 8, Piriform lobe; 9, Continuation of lateral ventricle.



2F. 1, Olfactory bulb; 2, Ventriculus tertius (Third ventricle); 3, Piriform lobe; 4, Continuation of lateral ventricle; 5, Aqueductus mesencephali (Mesencephalic aqueduct); 6, Cerebellum; 7, Pons; 8, Os occipitale (Occipital bone).

التصوير بالرنين المغناطيس لدماغ الجاموس المصري

أحمد كساب

هناك القليل من الأبحاث التي أجريت على دماغ الجاموس من بين المجترات. تهدف هذه الدراسة إلى معرفة الوصف المفصل لدماغ الجاموس المصري السليم إكلينيكيا، بالتصوير بالرنين المغناطيسي. استخدمت في هذه الدراسة رؤوس أربعة من الجاموس المصري السليم البالغ (ذكران وأنثيان)، تراوحت أعمارها بين ٤ و ٦ سنوات. تم فصل الرأس بعد الذبح مباشرة، عند مستوى المفصل الفهقي المحوري، وتم تصويرها في غضون ١٢ ساعة من الذبح، بالرنين المغناطيسي، حيث تم تصوير مقاطع عرضية وجبهية تتابعية بمسافة بينية بلغت ٦ ملليمترات.

تم التعرف على مختلف تراكيب الدماغ، في صور الرنين المغناطيسي، والتي شملت: نصفي الكرة المخية وبُطينات الدماغ الأربعة والمهاد وتحت المهاد والمخيخ والقنطرة والنخاع المستطيل والفرسية (قرن آمون) والجسم الأعجر والنواة المذيلة والمحفظة الداخلية....

لذلك يعتبر التصوير المغناطيسي طريقة لتقييم التراكيب المختلفة للدماغ والتي تستخدم لتقييم الأمراض التي تصيب دماغ الجاموس.