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BRAIN ULTRASOUND EXAMINATION IN KITTENS AND HUMAN INFANTS – A PRELIMINARY REPORT

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ABSTRACT

This work demonstrated the usefulness of ultrasound in exploring the feline brain and its applications in neurology. In particular, we highlighted a reliable, rapid, and inexpensive technique, widely used in human medicine, involving the bregmatic fontanelle. In our experimental study, we evaluated the feasibility of transfontanellar ultrasound (TFU) and its use in humans and cats. The comparison of its practicality in human infants and kittens, as well as the particularities of each species, was revealed to report TFU practices in human medicine so they could be extrapolated to the feline species. Among the selected individuals (five kittens, three premature infants) free of abnormal neurological signs. TFU made it possible to rule out the presence of ventriculitis in one of the premature infants, as well as to discover, by chance, ventricular dilatation and cysts in another, in relation to a type 1 subependymal haemorrhage in the neonatal period. The third infant and the kittens had normal TFU findings. In conclusion, TFU is proving to be a reproducible, safe imaging technique that is readily available in resource-limited areas such as veterinary medicine.

Keywords: Transfontanellar ultrasound, fontanelle, brain, kittens, infants, pathology.

INTRODUCTION

Ultrasound of the nervous system was one of the earliest applications in the medical field (Beisteiner *et al.,* 2023). The interaction of ultrasound with bony structures can act as a barrier to the visualization of brain tissue; however, the skull provides certain acoustic windows that allow for such exploration. One of these is the fontanelle, a natural opening present for all newborns.

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In human pediatrics, transfontanellar ultrasound (TFU) is a widely used and current method for diagnosing neonatal brain pathologies and is often comparable to CT scanning (Lorigados and Pinto, 2013). It is a non-invasive, practical, accessible, and inexpensive means of exploring the brain (Ali *et al.,* 2024).

In dogs and cats, the use of ultrasound in the clinical and experimental diagnosis of cerebral lesions is derived from human medicine. Hydrocephalus, in particular, is the primary indication for the use of TFU in animals (other examples include cysts, haemorrhages, abscesses, and certain congenital malformations) (Konan *et al.,* 2020; Dudink *et al.,* 2020). However, this method has largely been replaced by CT and MRI, even though their diagnostic specificity is limited in differentiating between neoplastic, vascular, and inflammatory pathologies (Jeong *et al.,* 2024).

This study covered the basic anatomical and ultrasound knowledge required for the analysis and interpretation of brain ultrasound images in human infants and kittens. This will enable to become familiar with transfontanellar ultrasound (TFU), while highlighting its advantages over MRI and CT. We will also discuss TFU practices in human medicine with a view to extrapolating them to kittens.

MATERIALS AND METHODS

Experimental approach

For comparative purposes, cases involving human infants and feline subjects have been included in our study.

TFU of premature infants was performed by two radiologists in the radiology department of a hospital located in Algiers, on three babies aged between 14 days and 3 months. The selected babies were of different sexes: one boy (case 01), one girl (case 02), and one baby (case 03), whose sex had not been determined. The boy was suspected of having ventriculitis and was admitted for confirmatory diagnosis. The girl was admitted for a routine TFU and a hip examination. The third baby was initially admitted for a pelvic ultrasound to search for the gonads to determine the sex, and a TFU was performed due to prematurity.

TFU was performed through the window provided by the bregmatic fontanelle using an 'XDclear' ultrasound scanner (Figure 1); a linear probe was exclusively used, with an initial frequency of 9 MHz. The infants were covered with a blanket and positioned on their backs, with their mother present to reassure them and hold their heads if needed.

As for the feline species, five European-breed kittens aged between 6 and 23 days, of different sexes (three females and two males), were randomly selected and showed no apparent health issues. Their brains were examined at the BIOMERA platform of Blida1 University by the same examiner, using an 'Esaote' ultrasound scanner and both microconvex and linear probes (Figure 1), with frequencies ranging from 7 to 11 MHz, through the bregmatic fontanelle. The temporal window was also used occasionally to compare image quality with and without bone interposition, using frequencies between 5 and 6 MHz. No euthanasia was performed.

The kittens were placed on a blanket and gently restrained by their owners to ensure both their comfort and that of the examiner (Figure 1).

The ultrasound examination of both species was carried out in the same way: a generous amount of gel was applied to the probe, which was then gently placed on the bregmatic fontanelle and/or the temporal window, without prior shaving of the area.

The probe marker corresponds to the bright point on the ultrasound screen and indicates the anterior or rostral aspect of the patient in the sagittal plane. In the coronal or transverse planes, the marker is positioned so that the left side of the patient appears on the right side of the screen. The probe is tilted from front to back, left to right, or top to bottom, depending on the imaging plane used. Ultrasound settings such as gain and frequency are adjusted progressively throughout the examination. No anaesthesia is used, and the procedure lasts an average of 15 minutes in infants and 25 minutes in kittens.

(a): Ultrasound scanners. Right: 'XDclear' ultrasound scanner for infants; left: MyLab Class C Vet 'Esaote' ultrasound scanner for kittens.

(b): Ultrasound probes used at the Blida platform. Right: high-frequency linear probe (similar to the one used for infants); left: microconvex probe with lower frequencies.

(c): Probe position for examination through the bregmatic fontanelle (right) and through the temporal window (left) in kittens.

Figure 1: Ultrasonographic equipments and examination

The ultrasound images obtained in infants were acquired in the coronal plane, where five slices (anterior and posterior) are recorded. In this plane, lateral ventricle (LV) measurements, as well as colour and pulsed Doppler, were performed only for the little girl. A 90° rotation of the probe allows for the acquisition of sagittal and parasagittal slices (left and right). In kittens, three planes were used: the first is the transverse plane, where rostral and caudal sections are obtained. The second is the sagittal plane, accessed by rotating the probe 90°, which enables imaging of the right and left sides of the animal. The final plane, dorsal (via the temporal window), divides the head into dorsal and ventral halves. Using these imaging planes, a comprehensive visualisation of the most important anatomical structures was achieved.

The topography and echogenicity of the structures were described in each plane for both infants and kittens, and the measurements of the ventricles, along with the resistance index calculated for the little girl, were provided.

The aim of this preliminary study was to highlight the advantages of TFU, to report its use in humans, and to compare these data with those obtained from dogs, enabling extrapolation and assessment of the feasibility of this technique in other species with a significantly smaller bregmatic fontanel, such as the cat.

Ethical statement

All the animal studies were conducted with the utmost regard for animal welfare, and all animal rights issues were appropriately observed. No animal suffered during the course of the work. All the experiments were carried out according to the guidelines of the Institutional Animal Care

Committee of the Algerian Higher Education and Scientific Research (Agreement Number 45/DGLPAG/DVA. SDA. 14) and with the consent of the pets' owners.

RESULTS

During our examination, the fontanelles in all included species (kittens, and infants) were palpable as a slight depression along the midline at the top of the skull.

The images obtained in infants at a frequency of 9MHz were of very satisfactory quality; in cats, a frequency of 8MHz through the fontanelle allowed the visualization of several important structures, while lower frequencies, between 5 and 6 MHz, through the temporal window, provided images of the brain through the bone with lower quality.

In Infants

Two planes were performed to provide a global view of the most important structures.

Coronal sections

This section is equivalent to the transverse section in dogs and cats; it divides the head into anterior and posterior parts.

Section 1: *At the level of the olfactory bulb*

The most anterior section passes through the olfactory bulb, which appears as two vertical hyperechoic grooves in hypoechoic brain tissue, on either side of the longitudinal fissure, which itself is represented by a hyperechoic line (Fig. 2).

Section 2: *At the level of the frontal horns*

By gently manipulating the probe a little further back, the anterior horns of the lateral ventricles enter our field of view and appear as two anechogenic structures in each cerebral hemisphere (Fig. 3).

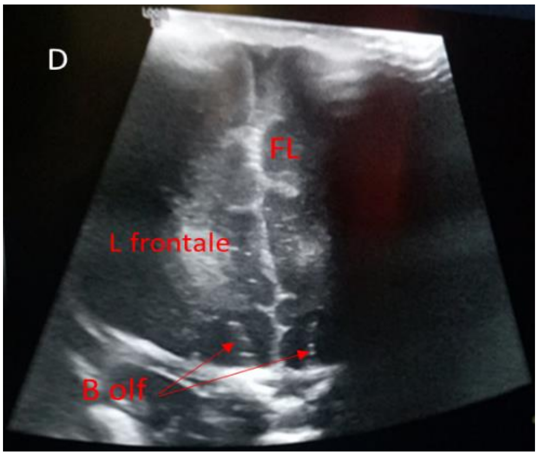

Figure 2: Section through the olfactory bulb in the girl. Similar images were found in the other two infants. FL-longitudinal fissure; L-frontal-lobe; B-olfactory bulb; D-right.

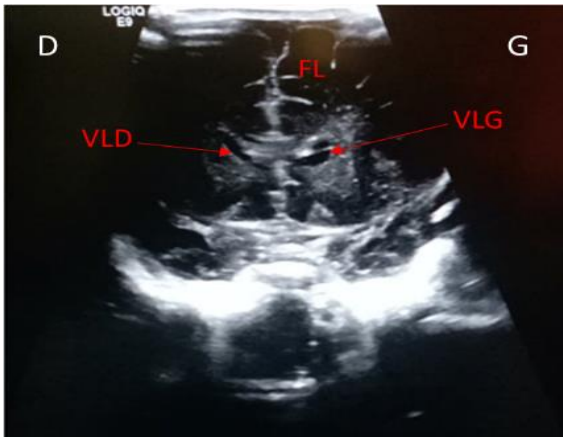

Figure 3: Section through the frontal horns of the girl. Similar images were found in the other two infants. FL – longitudinal fissure; VLG – left lateral ventricle; VLD – right lateral ventricle; R – right; L – left.

Section 3: *At the level of Monro's foramen and the third ventricle*

At this level, the corpus callosum appeared as a hypoechoic structure bordered by two hyperechoic lines.

The fluid-filled lateral ventricles have thin walls in all infants, including the boy, who is the only one showing asymmetry in the size of the lateral ventricles (left LV larger than right LV) (Figure 4d). Their floor was bordered by hyperechoic choroid plexuses.

In the midline, another anechoic structure appeared between the lateral ventricles: the cavum septum pellucidum, present in all infants. Below this structure and the lateral ventricles, the third ventricle appeared as a small anechoic median cleft; it communicated with the lateral ventricles via Monro's foramen (Figure 4).

In the girl, multiple anechoic structures were observed between the lateral ventricles and the third ventricle. These formations represent cysts (Figure 5).

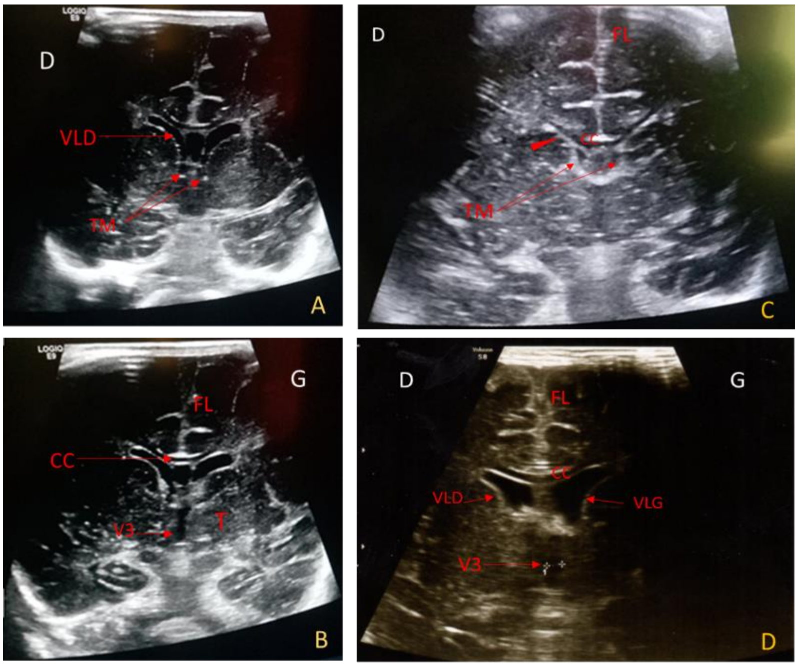

Figure 4: Sections through the foramen of Monro and the 3rd ventricle in the three infants. (A, B): ultrasound images of the girl. A: section at the level of the foramen of Monro; B: section at the level of the 3rd ventricle. (C): section at the level of the foramen of Monro in the infant of undetermined sex (the lateral ventricles are not very visible in this section), the arrowhead indicates the choroid plexuses of the LV. (D): section through the 3rd ventricle in a boy. Note the asymmetry of the lateral ventricles and their thin walls. FL-longitudinal fissure; CC-corpus callosum; VLD-right lateral ventricle; VLG-left lateral ventricle; TM-Monro's foramen; V3-3rd ventricle; T-thalamus; R-right; L-left.

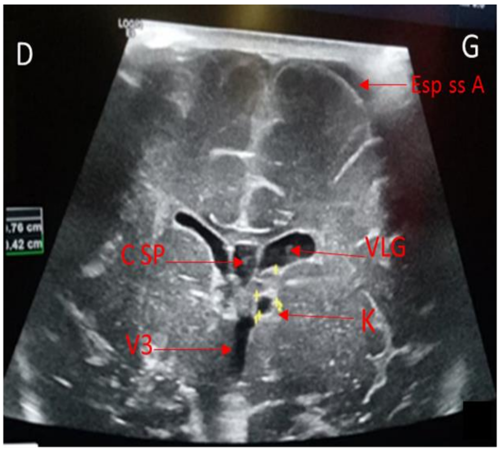

Figure 5: Section through the third ventricle, more superficial than Figure 45b in the girl. Note the anechoic structure between the LV and V3. C SP - cavum of the septum pellucidum (found in all the infants in our study).

Section 4: *At the level of the occipital horns:*

This section passed through the choroid plexuses of the LVs. Orienting the probe backwards allowed to assess the symmetry and appearance of the choroid plexuses, which were seen as a hyperechoic band attached to the walls of each of the anechoic LVs (Figure 6a).

With the exception of the little girl, this hyperechoic band representing the choroid plexuses in the right ventricle appears to be surrounded by cerebrospinal fluid. This abnormal appearance is absent in the other two infants (Figure 6b).

In this section, LV measurements are taken at the level of the temporal horn: the size of the LVs in the little boy and the infant of undetermined sex is normal and less than 8mm; however, the girl showed dilatation of the temporal horns, measuring 12mm on the right and 11mm on the left.

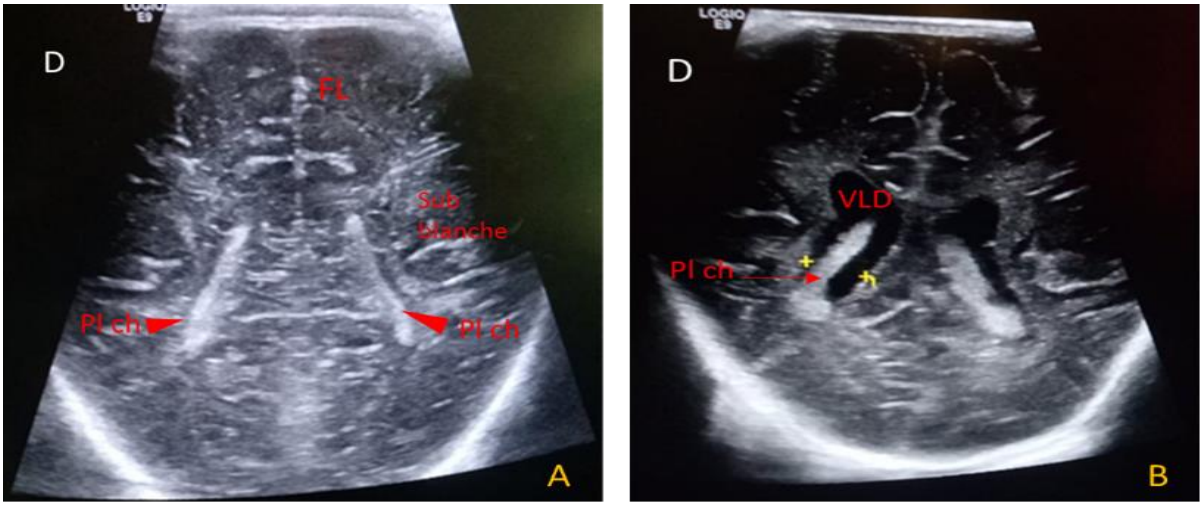

Figure 6: Section through the occipital horns. A: Ultrasound of the infant of undefined sex; a similar image was found in the boy. B: Ultrasound of the girl showing bilateral ventricular dilatation. FL-longitudinal fissure; sub-white-white matter; VLD-right lateral ventricle; Pl ch-VL choroid plexus (arrow and arrowheads); D-right.

Section 5: *Occipital lobes*

This is the most posterior section; it passes through the occipital lobes in search of fluid collections or abnormalities in the cerebral convolutions. At this level, the lateral ventricles are no longer visible (Figure 7).

Figure 7: Section through the occipital lobes in the girl. Similar images are found in the other two infants. FL-longitudinal fissure; sub-white-white matter; D-right.

Sagittal sections

The sections are obtained after rotating the probe by 90°. Similar to the sagittal plane in animals, the median sagittal section divides the head into two equal parts, right and left. The right and left para-sagittal sections are obtained from this by tilting the probe to the right or left.

Median sagittal section

The hypoechoic corpus callosum is bordered by two hyperechoic lines and appears C-shaped; beneath it, the anechoic structure corresponds to the cavum of the septum pellucidum.

Lower down, the caudate nucleus is located anterior to the thalamus. Both structures appear hypoechoic, and their boundaries are not clearly defined. The thalamo-caudate sulcus, which delineates the choroid plexuses, separates these two structures.

Ventrally, in the posterior fossa, the vermis is echogenic and rounded. It is situated posterior to the pons and the fourth ventricle. The cisterna magna, or large cistern, lies between the cerebellum and the dorsal surface of the medulla oblongata (Figure 8).

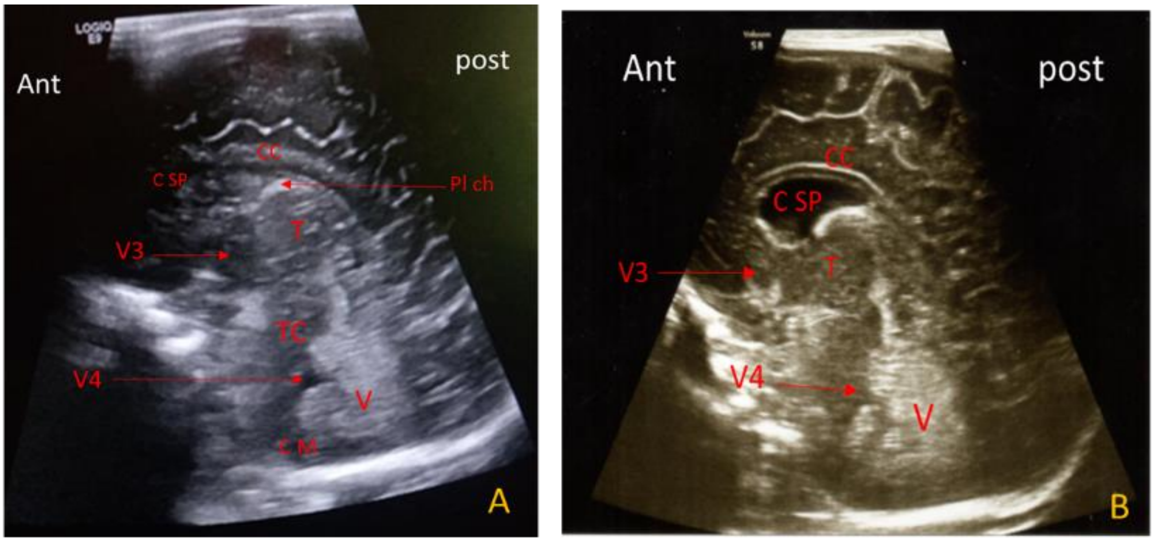

Figure 8: Median sagittal sections in the girl and the boy. A similar image was observed in the other infant. CC – corpus callosum; C SP – cavum of the septum pellucidum; T – thalamus; Pl ch – choroid plexuses; V3 – third ventricle; TC – brainstem; V – vermis; V4 – fourth ventricle; CM – cisterna magna.

In this section, colour and pulsed Doppler were used only in the female infant.
The pericallosal artery is visualised with colour Doppler in Figure 9a. After freezing, the resistance index (RI)—representing the systolic peak over the end-diastolic velocity—is measured at a normal value of 0.6 (Figure 9b).

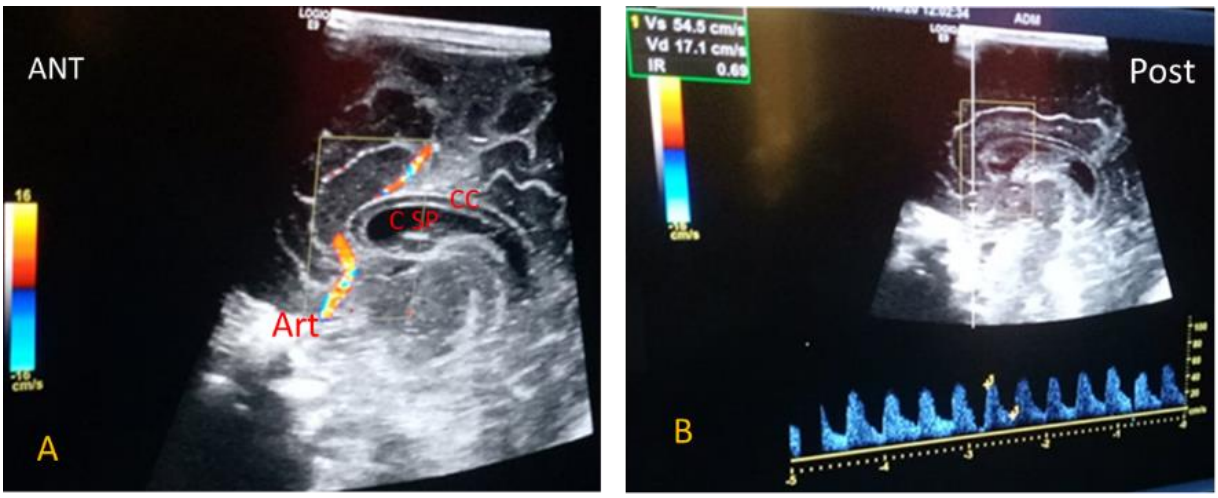

Figure 9: Median sagittal section in the girl. Colour Doppler (A) and pulsed Doppler (B) revealed the pericallosal artery (Art), and the RI was calculated at 0.6.CC – corpus callosum; C SP – cavum of the septum pellucidum.

Right and left parasagittal sections

By tilting the probe laterally to the left or right, the anechoic structure that becomes visible is the lateral ventricle (right or left). Beneath it, two other hypoechoic structures can be faintly distinguished: the caudate nucleus anteriorly and the thalamus posteriorly. Between these structures, the thalamo-caudate sulcus appears hyperechoic (Figure 10).

In the girl, at the level of this sulcus, the multiple cystic formations previously observed in the coronal sections are surrounded by a hyperechoic rim.

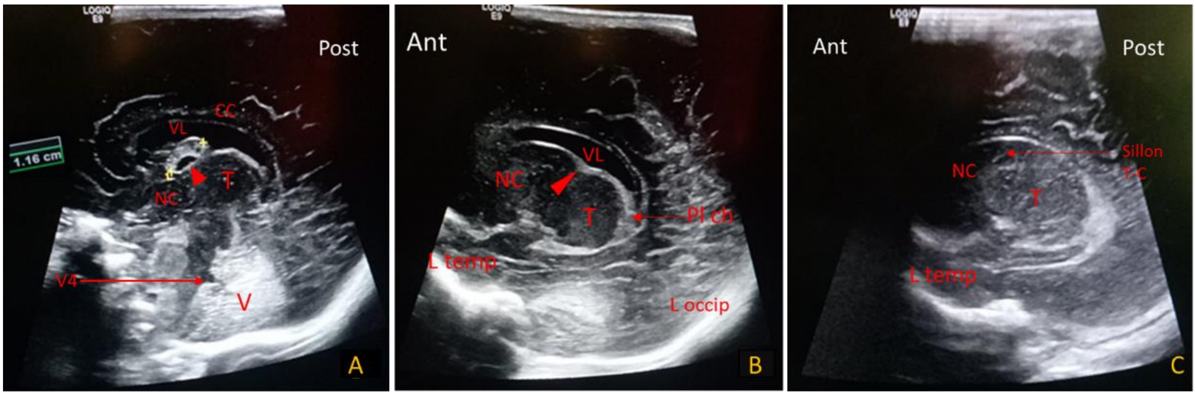

Figure 10: Parasagittal sections in the girl. A: Parasagittal section close to the midline. The cyst is surrounded by a hyperechoic rim (arrowhead).C: Parasagittal section further from the midline than B. CC – corpus callosum; VL – lateral ventricle; T – thalamus; NC – caudate nucleus; V – vermis; V4 – fourth ventricle; L temp/occip – temporal/occipital lobe.

In Kittens

Transverse sections

Only one image is available at present (Figure 11).

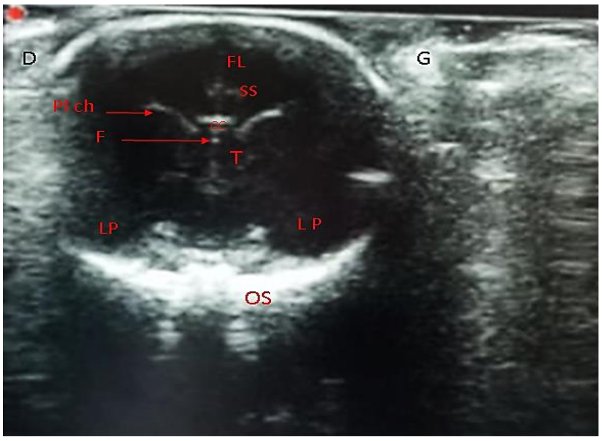

Figure 11: Transverse section in a kitten. FL – longitudinal fissure; SS – splenial sulcus; pl ch – choroid plexus; F – fornix; T – thalamus; LP – piriform lobe.

Dorsal sections

The next figure showed the dorsal section in kittens (Figure 12).

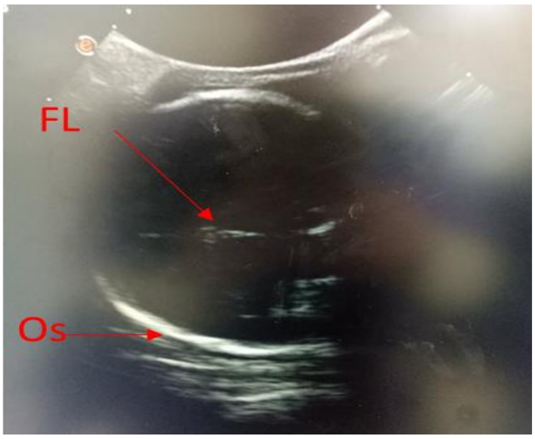

Figure 12: Dorsal section in a kitten. Only the hyperechoic longitudinal fissure (FL) is clearly visible.

The information concerning the individuals selected for our study and the ultrasound findings is presented in Table (1) below.

DISCUSSION

The natural opening provided by the fontanelles allowed for the visualization of major brain structures in both infants and kittens, despite the relatively small size of the bregmatic fontanelle in the latter.

In humans, the structures observed across various imaging planes included the cerebral lobes, olfactory bulbs, sulci and gyri, longitudinal fissure, corpus callosum, lateral ventricles, cavum of the septum pellucidum, third ventricle, foramina of Monro, thalamus, caudate nucleus, fourth ventricle, vermis, cisterna magna, cysts, and the dorsal sagittal sinus (the latter, although not shown in the figures, is located beneath the bregmatic fontanelle).

Table 1: Summary of the study population and transfontanellar ultrasound (TFU) findings.

Species	Sex	Age	Fontanelle Size	Reason for Consultation & Pathologies	TFU Findings		
					TFU Evaluation	**LV Measure**	**Resistance Index**
Human	F	2 months 20 days	1 cm	-Prematurity -Pelvic examination - No neurological signs -Normal head size	Abnormal TFU: -Bilateral dilatation of the lateral ventricles (LV) -Multiple cystic formations in the thalamo-caudate sulcus -TFU suggestive of subependymal haemorrhage -Second follow-up TFU after one month	Right LV: 12 mm Left LV: 11 mm	RI: 0.6
	M	3 months	0.7 cm	-Prematurity - Ventriculitis	Normal TFU: - Asymmetry of LV -Normal thickness of VL walls	LV< 8 mm	/
	I	14 days	1.6 cm	-Prematurity -Gonadal investigation -Congenital adrenal hyperplasia	Normal TFU	LV< 8 mm	/
Feline (cat)	F	6 days	2 mm	/	Normal TFU	Not visible	/
	F		1 mm				
	F	23 days	Barely perceptible				
	M		–				
	M		–				

F = female; M = male; I = undetermined sex

In kittens, the structures identified were the choroid plexuses of the lateral ventricles, fornix, corpus callosum, splenial sulcus, caudate nucleus, piriform lobe, and midbrain. The lateral ventricles themselves were not directly visible; however, their location was inferred based on the echogenicity of the choroid plexuses. Other structures, such as the third and fourth ventricles, were more clearly visualized in humans than in kittens, as these ventricles typically remain undetectable in healthy cats unless hydrocephalus is present (Wolfson *et al.,* 1989; Hudson *et al.,* 1991).

The transverse plane provided significant information on the main structures and existing lesions, allowing for their measurement (e.g., lateral ventricles, cysts). The sagittal plane was used to obtain an overall view of the brain, confirm the presence of the corpus callosum, and perform color and pulsed Doppler imaging. The dorsal plane is not routinely used in infants due to its limited diagnostic value. However, it was applied in kittens for comparison with the TFU; only the longitudinal fissure was clearly visualized, due to bone interposition. Nevertheless, any deviation of this fissure could indicate a mass effect.

The topographical identification of the structures observed in cats was guided by findings from the literature and the experience of radiologists practicing in human medicine. However, the absence of euthanasia and post-mortem brain ultrasound to confirm the precise localization of the visualized structures should be acknowledged as a limitation.

The image quality obtained in infants was excellent compared to that in kittens, where it was moderately satisfactory but of lower resolution. This difference is likely attributable to the size of the fontanelle and the ultrasound settings, which were optimized by experienced radiologists familiar with this technique in human patients. This also accounts for the quicker examination time in infants compared to kittens, where adjustment to the scanner settings required more time.

The cases included in this study, across all species, exhibited no obvious neurological signs. However, TFU is routinely performed in premature infants as part of standard care in human pediatrics.

In the three infants examined, the presence of the cavum of the septum pellucidum was indicative of prematurity. The septum pellucidum, which separates the lateral ventricles, comprises two leaflets. When these have not fully fused, a cavity may persist between them, commonly observed in premature infants and occasionally in those born at term. Typically, the cavum of the septum pellucidum begins to close around the sixth month of gestation and completes closure between three and six months after birth (De Bruyn, 2007; Poretti and Huisman, 2016).

During the clinical examination of infants, the size and appearance of the fontanel are assessed to detect any delay in closure. On average, the bregmatic fontanel closes at around 13 months of age and measures approximately 2.1 cm. A delayed closure may be associated with certain pathologies such as hypothyroidism, increased intracranial pressure, or achondroplasia. Conversely, some conditions may lead to premature closure of the fontanelles, such as craniosynostosis or abnormal brain development (e.g. microcephaly). On palpation, a bulging fontanel may suggest increased intracranial pressure (e.g. hydrocephalus), infections (e.g. meningitis), or tumours. In contrast, a sunken fontanel is often indicative of dehydration (Kiesler and Ricer, 2003).

In the female infant (case 2), TFU revealed multiple cysts within the thalamo-caudate sulcus, along with ventriculomegaly. This presentation was attributed to a type 1 subependymal haemorrhage in the neonatal period, which was undergoing resorption and showing signs of improvement. Periventricular haemorrhage is the most common type of cerebral parenchymal haemorrhage, and its incidence is directly correlated with the degree of prematurity. Initially, fresh blood appears hyperechoic; however, over the course of several weeks, the haemorrhagic areas undergo liquefaction and adopt a cystic appearance (De Bruyn, 2007).

De Bruyn (2007) described a grading system for periventricular hemorrhage which is employed in in cerebral ultrasound. This system includes four levels: Grade 1 refers to isolated subependymal hemorrhage, while Grade 2 involves hemorrhage extending into the ventricle without any dilatation. Grade 3 refers to hemorrhage into the ventricle with associated dilatation, and Grade 4 represents intraventricular hemorrhage with parenchymal extension.

Post-haemorrhagic ventricular dilatation requires regular follow-up (Meijlerand Steggerda, 2019). Lateral ventricles measuring less than 8 mm are considered normal, whereas measurements exceeding 10 mm indicate dilatation.

Although Doppler examination is not routinely performed, it was utilized in this case to assess intracranial pressure associated with ventricular dilatation. Colour Doppler enabled the visualization of the pericallosal artery, a branch of the anterior cerebral artery. The calculated resistance index (RI) was 0.6, with the normal range being between 0.65 and 0.85. This suggested the absence of increased resistance within the circle of Willis (Poretti and Huisman, 2016; Meijlerand Steggerda, 2019).

In the boy (case 1), transfontanellar ultrasound (TFU) was used to rule out the presence of ventriculitis. This condition would typically present as thickened and hyperechoic walls of the lateral ventricles, with or without associated hydrocephalus (Meijlerand Steggerda, 2019).

The asymmetry observed in the size of the ventricles is considered a normal variant. Such asymmetry is very common in both premature and full-term infants, with an incidence ranging from 20% to 40%. Most frequently, the left lateral ventricle is wider than the right (Poretti and Huisman, 2016).

The final infant (case 3), presented with a normal TFU.

In veterinary medicine, the effect of prematurity on the central nervous system has never been studied, and the relationship between hypoxia and/or intraventricular haemorrhage and hydrocephalus has yet to be demonstrated, due to the lack of meticulous monitoring of gestation in dogs and cats.

In cats, the breed may potentially influence the age at which the fontanelles close, but they remain sufficiently wide for transfontanellar ultrasound (TFU) up to 4–5 days of age. In the study by Jäderlund *et al.* (2003), the lateral ventricles (LVs) could be visualized and measured up to 5 months of age.

In our study, no measurements of the LVs were taken in cats, as these structures were not visible. This is likely due to the ultrasound settings, as well as the absence of ventricular dilatation. Nevertheless, previous reports provided guidance on how to approach this. Given the differences in anatomical landmarks, the most reliable and reproducible measurements are obtained by assessing the central portion of the LV in the parasagittal plane (at an angle of 5–10° to the midline), at the junction of the sella turcica and the cranial fossa (Jäderlund *et al.,* 2003; Penninckand D'Anjou, 2015).

The anatomy of the human and feline brains as visualized by TFU appears to be quite different. Nevertheless, the most important structures are readily identifiable due to similarities in their echogenicity.

The infant skull contains six fontanelles that serve as acoustic windows: the anterior (bregmatic) fontanelle, the largest, the posterior fontanelle, the two mastoid fontanelles, and the two sphenoid fontanelles (Kiesler and Ricer, 2003; Meijlerand Steggerda, 2019).

Humans and kittens share a common characteristic in the form of certain maturation-related changes that are observable on transfontanellar ultrasound (TFU). In humans, gyration begins with the formation of the Sylvian fissure around the 14th week of gestation and is completed by term. However, in very premature infants, the underdevelopment of cerebral convolutions gives the brain a less encephalic appearance, with the Sylvian fissure sometimes being the only recognizable sulcus

In cats, gyration is completed approximately two weeks after birth, which explains the relatively smooth appearance of the brain prior to this age.

The thalamo-caudate sulcus is an important anatomical landmark in humans. In cats, this structure is not visible on ultrasound images, nor is the interthalamic adhesion (Jäderlund *et al.,* 2003).

The human ventricular system differs somewhat anatomically from that of animals. The lateral ventricles in humans have an occipital horn, whose lateral ventricles are C-shaped. In cats, the lateral ventricles have a central part along with rostral and occipital horns. Another difference lies in the apertures of the fourth ventricle: in humans (primates), it has the foramina of Luschka and Magendie, whereas in dogs and cats, the foramen of Magendie is absent (Hudson *et al.,* 1991; Gonzalez-Soriano *et al., 2001*; Jäderlund *et al.,* 2003; Lorenz and Kornegay, 2004; Penninck and D'Anjou, 2008).

Asymmetry of the lateral ventricles can be a normal variant in humans. In cats, however, no asymmetry was observed in the study by Jaderlund *et al.* (2003). Lateral ventricles separated by the cavum of the septum pellucidum anteriorly and the cavum vergae posteriorly are a common finding in humans (De Bruyn, 2007). In puppies, however, these structures are uncommon (Hudson *et al.,* 1991).

The first limitation of the examination concerns the opening of the fontanelle. Its absence renders this acoustic window inaccessible, and its small size prevents the probe from exploring a large portion of the brain.

Image quality can be affected by thick hair or fur, a small fontanelle, and artefacts. The use of ETF through the bregmatic fontanelle results in blind zones corresponding to the lateral contours (convexity) of the skull, which in itself constitutes an unavoidable limitation of the examination.

As previously mentioned, a thorough knowledge of both anatomy and ultrasound settings is essential for the analysis and interpretation of the images obtained. Furthermore, experience is required to distinguish between normal and pathological appearances, bearing in mind that certain features that may appear abnormal can in fact represent normal variants (e.g., asymmetric lateral ventricles).

TFU is a routine examination in human pediatrics. Many diseases can be diagnosed using this technique: hemorrhages (subarachnoid, intraventricular, intra-parenchymal), ischemic lesions (e.g. periventricular leukomalacia), cystic lesions (e.g. Dandy-Walker malformation), infections, hydrocephalus (Poretti and Huisman, 2016). This makes it the method of choice for the initial cerebral assessment and follow-up in premature babies.

In cats, its use has been abandoned in favor of other diagnostic methods. However, its introduction into veterinary medicine as standard practice could have the same advantages as in human medicine, especially as the majority of veterinary clinics in Algeria have ultrasound scanners. Its ability to visualize the most important structures with satisfactory image quality (even if the fontanel is relatively small), its practicality and affordability make it extremely useful. The presence of a persistent fontanel in certain breeds of dog is an additional advantage that should be exploited.

In the literature, its primary indication in cats is hydrocephalus. Some of the pathologies diagnosed in humans could be explored in animals, suggesting other indications for the use of TFU for mutual benefit.

CONCLUSIONS

Ultrasound offers numerous applications for the diagnosis of conditions or induced lesions, such as hydrocephalus, arachnoid cysts, neoplasia, and more. Its practicality and availability give it a clear advantage in the exploration of the brain. In human pediatrics, TFU is widely used and serves as an alternative to more costly examinations such as MRI or CT scans.

The acoustic window provided by the bregmatic fontanel (open for up to 5 months in cats, and up to 13 months in infants) enabled good visualization of the main structures of the brain tissue of both infants and kittens in a non-invasive manner.

The temporal acoustic window used to examine the kittens' brain, did not provide us with particularly satisfactory images but could potentially yield information regarding mass effects.
Furthermore, ultrasound through the foramen magnum proved to be very useful in infants for visualizing the caudal fossa and for diagnosing conditions such as Chiari-like malformation.

Further studies are required to assess the application of TFU in cats. It is suggested that this technique be brought back into routine use and employed as a first-line examination in kittens with an open fontanel and abnormal neurological clinical signs.

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فحص الموجات فوق الصوتية للدماغ لدى صغار القطط (شبارق) والأطفال الرضع

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أظهرت هذه الدراسة فائدة استخدام الموجات فوق الصوتية في استكشاف دماغ القطط وتطبيقاتها في علم الأعصاب. على وجه الخصوص، تم تسليط الضوء على تقنية موثوقة وسريعة وغير مكلفة، وتستخدم على نطاق واسع في الطب البشري، وتتعلق بالفتحة الجبهية. في دراستنا التجريبية، قمنا بتقييم جدوى استخدام الموجات فوق الصوتية عبر اليافوخ (TFU) وتطبيقاتها على صغار القطط والأطفال الرضع. تم الكشف عن مقارنة العملية في الأطفال الرضع والهرر، بالإضافة إلى خصوصيات كل نوع، بهدف تقديم ممارسات TFU في الطب البشري بحيث يمكن تعميمها على الأنواع القططية. من بين الأفراد المختارين (خمسة هرر وثلاثة أطفال مبتسرين) الذين لا يعانون من علامات عصبية غير طبيعية، سمحت تقنيةTFU باستبعاد وجود التهاب البطينات في أحد الأطفال المبتسرين، بالإضافة إلى اكتشاف، بشكل عرضي، تمدد البطينات وأكياس في طفل آخر، مع وجود نزيف تحت الظهاري من النوع الأول في فترة الوليد. أما الطفل الثالث والهرر فكان لديهم نتائج طبيعية باستخدام TFU. في الختام، أثبتت تقنية TFU أنها وسيلة تصوير قابلة للتطبيق وآمنة ومتوفرة بسهولة في المناطق المحدودة الموارد مثل الطب البيطري.

الكلمات المفتاحية: الموجات فوق الصوتية عبر اليافوخ، اليافوخ، الدماغ، الهرر، الأطفال الرضع، الأمراض