

Contribution and Relevance of Transfontanellar Ultrasound in Newborns in Ouagadougou: Multicentre Study on 1000 Cases

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Abstract

Objectives: To demonstrate the contribution and relevance of ETFs through the study of 1000 examination reports carried out in the medical imaging departments of the OUAGADOUGOU CHU. **Material and method:** Analytical descriptive study with retrospective collection, extended from 1st January 2020 to 1st January 2022. **Results:** Of the 1000 transfontanellar ultrasound reports, the mean age of patients was 7.61 +/- 7.5 days, with extremes of zero and 28 days. Sex was specified in 989 cases. Males accounted for 54.49% and females for 45.51%. 555 transfontanellar ultrasound were performed in 2020. 441 in 2021 and 4 in 2022. 61.9% of transfontanellar ultrasound were performed at the Bogodogo University Hospital, 205 at Charles de Gaulle and 176 at Tengandogo. Indications for transfontanellar ultrasound were dominated by neonatal distress (65.8%), followed by convulsions (10.2%) and prematurity (9.1%). Transfontanellar ultrasound was normal in 570 cases (57%) and abnormal in 430 cases (43%). Abnormalities were dominated by haemorrhage and ischaemic lesions in 66.28% (285) and 21.63% (93) of cases respectively. In the group of normal transfontanellar ultrasound, neonatal distress represented 59.65% of indications and prematurity 10.7% of indications. As for abnormal transfontanellar ultrasound, neonatal suffering accounted for 73.95% of indications and convulsions for 12.56%. The average age of patients with an abnormal transfontanellar ultrasound was 8.74 days

+/- 7.89 days. The indication for investigations was relevant in 42.2% of cases and irrelevant in 57.8%; of the transfontanellar ultrasound with relevant indications, 0.71 were normal and 99.29 abnormal; of the transfontanellar ultrasound with irrelevant indications, the transfontanellar ultrasound was normal in 98.1% and abnormal in 1.9%. **Conclusion:** Transfontanellar ultrasound is an important part of ultrasound in current practice. Haemorrhage, anoxic-ischaemic lesions and hydrocephalus are the most frequent pathologies found by this technique in newborns. Whether or not the examinations were normal depended on the appropriateness of the prescription.

Keywords

Transfontanellar Ultrasound, Neonatal Distress, Relevance

1. Introduction

Transfontanellar ultrasound (TFU) is an accessible, non-irradiating, non-invasive medical imaging technique. It allows the morphological and vascular analysis of intracranial content and is particularly performed in the term newborn and premature due to the absence of fusion of the anterior fontanelle, allowing to offer an acoustic window for this exploration [1].

This examination is indicated in the tables of brain anoxic pathologies, as well as brain hemorrhages to which premature babies are particularly exposed. The most common brain lesions in premature infants are hydrocephalus, ventricular hemorrhages and periventricular leukomalacia [2]. In addition to these lesions, the TFU allows the visualization and monitoring of brain lesions such as abscesses, cerebral empyemes, and certain brain malformations [3].

In Burkina Faso, the TFU is commonly performed in medical imaging services with neonatology services with a majority of demand represented by anoxic-ischemic brain injuries and infections [4]. A previous single-centre study carried out in 2009-2010 at the CHUP-CDG by Ouattara Yé [4] showed that the number of TFU (normal in 64.85% of cases) performed per year was rising steadily, from 64 TFU in 2007 to 114 TFU in 2008 and 182 TFU in 2009. The objective of our multicentre work in the CHU of the city of OUAGADOUGOU was to study the justification of these examinations and their relevance in view of the multiplication of requests with many normal results.

2. Material and Method

It was a retrospective cross-sectional study, extended from January 1, 2020 to December 31, 2021. The sampling was carried out comprehensively, including all TFU reports made during the study period in the medical imaging services of the Ouagadougou City Hospital.

Included were reports of newborns in whom an tus was carried out during the period.

The variables considered in our study concerned the age and sex of the patient; the indication of the examination; the described lesions, the conclusion: normal or abnormal.

The relevance of the indication of TFU was analyzed according to the Société Francophone d'Imagerie Pédiatrique et Périnatale (SFIPP) which lists the indications of TFU s according to prematurity, suspected malformative pathologies, anoxo-suffering perinatal ischemic and increased cranial circumference with obstetric trauma as a second intention.

The variables were collected using an individual data collection sheet from the archiving system for medical imaging department reports at Ouagadougou University Hospital.

The data collected were entered and processed on a microcomputer using the EPI Info software in its French version 7.2.2.6.

Quantitative data were expressed as average and standard deviations.

The comparative analysis between the results of the relevant and irrelevant indications according to the SFIPP was carried out with the Khi 2 test. The significance threshold was $p < 0.05$.

A collection authorization has been submitted and obtained from the various departments of the city's university hospitals. The anonymity of the records and the confidentiality of the information were respected.

3. Results

We collected a total of 1000 tus reports during the study period.

The average age of patients who underwent an tus was 7.61 +/- 7.5 days with extremes of zero and 28 days. The modal class was [0 - 7] days of life, representing 60.8% of the sample (n = 608).

Figure 1 illustrates the distribution of patients by age group.

Sex was reported in 989 cases. Males accounted for 54.49% (n = 529) and females 45.51% (n = 460). The sex ratio was 1.15.

TFU indications were dominated by neonatal suffering in 65.8% (n = 658), followed by convulsions in 10.2% (n = 102) and prematurity in 9.1% (n = 91).

Table 1 gives a breakdown of patients according to the indications of the TUS.

In 430 cases or 43%, she objected to an anomaly. These abnormalities were dominated by haemorrhage and ischemia lesions in 66.28% of cases (n = 285) and 21.63% of cases (n = 93) respectively. **Table 2** provides a breakdown of patient abnormalities based on TUS results.

Ependymal hemorrhages accounted for 88% (n = 251) of the hemorrhages and were grade 1 and grade 2 in 91.63% (n = 230) and 8.36% (n = 21) of the cases, respectively.

Intraventricular hemorrhages were bilateral in 90.91% of cases (n = 30) and unilateral in three cases or 9.09%. **Table 3** shows the breakdown by type of haemorrhage.

Leukomalacia lesions were cystic in 12 cases or 70.59% and non-cystic in five cases or 29.41% of cases.

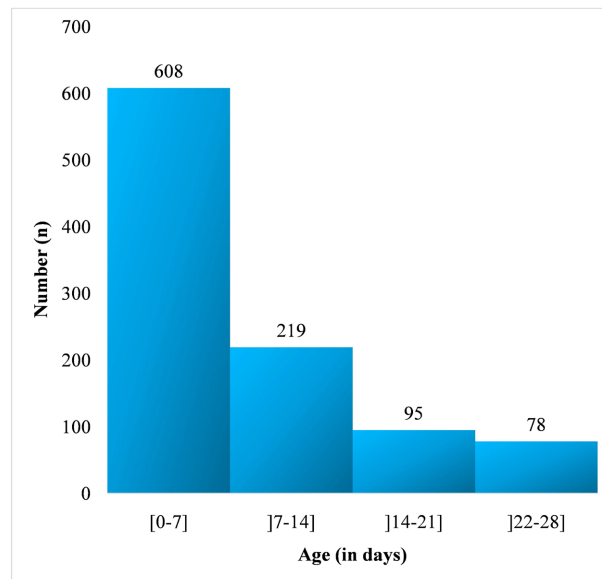


Figure 1. Breakdown of patients by age group (n = 1000).

Table 1. Patient distribution by TFU.

Indications	numbers (n)	Percentage (%)
Neonatal suffering	658	65.8
Convulsions	102	10.2
Prematurity	91	9.1
Malformation	44	4.4
Infectious syndrome	37	3.7
Assessment of an encephalopathy	36	3.6
Tone disorder	34	3.4
Meningeal syndrome	14	1.4
Disorder of conscience	13	1.3
Jaundice	12	1.2
Hemorrhagic syndrome	10	1.0
Hypotrophy	10	1.0
Sero-blood lump	9	0.9
Psychomotor retardation	7	0.7

Table 2. Breakdown of anomaly distributions according to TFU results (n = 430).

Résultts	n	Percentage
Hemorrhages	285	66.28
Ischemia	93	21.63
Hydrocephalus	41	9.53
Leuko malacie lesions	17	3.95
Brain atrophy	4	0.93
Brain malformations	3	0.70
Cerebral edema	2	0.47

Table 3. Breakdown by type of bleeding.

Type of bleeding	(n)	Percentage
Spendymal	251	88
Intraventricular	33	11.56
Hematoma	1	0.35
Total	285	100

TFU was normal in 57% of cases (n = 570). The average age of patients with normal TUS was 6.77 days 7.7 with extremes of zero and 28 days.

Neonatal suffering accounted for 59.65% (n = 340) of the indications of normal TFUs followed by prematurity in 61 cases or 10.70%. **Table 4** gives a breakdown of normal TFUs according to indications.

For abnormal TFUs, the average age of patients with abnormal TFUs was 8.74 days 7.98 with extremes of zero and 28 days.

Neonatal suffering accounted for 73.95% (n = 318) of the indications of abnormal TFUs followed by seizures 54 cases or 12.56%. **Table 5** gives a breakdown of abnormal TFUs according to their indications (n = 430).

According to the French Society of Pediatric and Perinatal Imaging (SFIPP) the indication of the explorations was relevant in 422 cases or 42.2%.

Among relevant indication TFUs, 99.29% (n = 419) were abnormal.

Among the TFU of irrelevant indications, the TFU was normal in 98.1% of cases (n = 567).

The presence of a relevant indication was significantly correlated with the presence of brain abnormalities at the TFU (p < 10-6).

Table 6 shows the correlation between the relevance of the examination and the normality of the examination.

Figure 2 and **Figure 3** represent coronal sections of TFU showing anoxic-ischaemic lesions and ependymal hemorrhage grade III respectively.

4. Discussion

Our study is limited by the problem of archiving, which excluded one university hospital from our study. Also, the retrospective nature of the study may have led to the loss of certain information and selection bias.

In the present study, the average age of patients was 7.61 +/- 7.5 days with extremes of zero and 28 days. These results corroborate those of the literature with Somé *et al.* [5] which reported an average age of 4.5 days and Nagalo *et al.* [6] in Burkina Faso, an average of 2.0 +/- 4.6 days upon admission.

In the present study, male subjects accounted for 54.49% and female subjects 45.51%.

The sex ratio was 1.15 close to those found by Berrada *et al.* [7] in Marrakech, Morocco, which reported 65.6% male newborn and 34.4% female newborn.

Indications of TFUs were represented by neonatal suffering in 65.8%, convulsions in 10.2% of cases and prematurity in 9.1% of cases. Malformations, the

Table 4. Breakdown of normal TFUs according to indications (n = 570).

Indications	n	Frequency
Neonatal suffering	340	59.65
Prematurity	61	10.70
Convulsions	48	8.42
Assessment of an encephalopathy	24	4.21
Malformation	22	3.86
Infectious syndrome	20	3.51
Tone disorder	17	2.98
Sero-blood lump	8	1.40
Disorder of conscience	7	1.23
Hemorrhagic syndrome	7	1.23
Jaundice	7	1.23
Hypotrophy	6	1.05
Meningeal syndrome	5	0.88
Psychomotor retardation	4	0.70

Table 5. Breakdown of abnormal TFUs according to their indications.

Indications	Effect if (n)	Percentage (%)
Neonatal suffering	318	73.95
Convulsions	54	12.56
Prematurity	30	6.98
Malformation	22	5.12
Infectious syndrome	17	3.95
Assessment of an encephalopathy	12	2.79
Tone disorder	17	3.95
Meningeal syndrome	9	2.09
Disorder of conscience	6	1.40
Jaundice	5	1.16
Hemorrhagic syndrome	4	0.93
Hypotrophy	3	0.70
Sero-blood lump	1	0.23
Psychomotor retardation	3	0.70

Table 6. Relevance of review and normality of review.

Relevant indication	Anomaly in the TFU		OR	IC	P
	YES	NO			
Oui	419	3	52.17	29.06 - 93.68	<10 ⁻⁶
Non	11	567			



Figure 2. TFU coronal slice through the lateral ventricles performed in the medical imaging department of the CHU-CDG in a newborn at J16 of life, male indicated for neonatal suffering, showing hyperechogenicity of the cerebral parenchyma in favor of anoxo-ischemic lesions. The ventricular system is normal in size.



Figure 3. TFU coronal slice through the lateral ventricles and the third ventricle performed in the medical imaging department of the CHUP-CDG in a female newborn at J15 of life, indicated for hypotonia and notion of resuscitation at birth, showing bilateral intraventricular hemorrhage with ventricular dilation in favor of ependymal hemorrhage grade III.

balance of encephalopathy represented respectively 4.4% and 3.6% of the indications of the TFU.

Berrada *et al.* [7] in his series noted that neonatal suffering (minimal, moderate and severe), convulsions and prematurity respectively accounted for 64.1% 28.9% and 22.7% of TFU indications while malformations accounted for 9.3%.

In addition, another study conducted by Bennaoui *et al.* [8] in 2017 at Mohammed VI University Hospital in Marrakech, Morocco, reported as indications of ETF, perinatal asphyxia in 55% of cases and convulsions in 35% of cases.

Immediate pre, per or post partum fetal suffering is a major problem because of its frequency, severity and consequences on the psychomotor devel-

opment of the child.

Despite well-conducted resuscitation measures, the Diarra study [9] showed that 15.3% of acute fetal suffering developed neurological complications.

In our study, the TFU was abnormal in 43% with a predominance of hemorrhages and ischemic lesions in respectively 66.28% and 21.63% of cases. Hydrocephalus and leuco malacie lesions were objectified in respectively 9.53 and 3.95% of cases.

The sensitivity and specificity of the TFU justify its use in haemorrhagic pathology of premature infants. It also allows the monitoring and detection of possible complications including post-hemorrhagic ventricular dilatation that occurs a few days to a few weeks after the initial heavy bleeding.

This may warrant early and frequent ultrasound examinations especially during the first week of life in premature infants with ventricular measurements [10].

Indeed, high-grade intra ventricular hemorrhages represent one of the most frequent causes of long-term disability, hence the interest of TFUs [11].

In the Bennaoui *et al.* [8] series, intraventricular hemorrhage and periventricular leukomalacia were the lesions most found in 45% and 8.5% respectively in preterm infants.

Regarding the type of hemorrhage, ependymal hemorrhages accounted for 88% of hemorrhages, followed by intraventricular hemorrhages in 11.56% of cases. Intraventricular hemorrhages are the prerogative of premature newborns while in the term newborn, intracerebral hemorrhages are much less frequent. Rather, they are related to traumatic delivery or abnormal coagulation [12].

Our series reported a 26.63% rate of cerebral ischemia lesions contrasting with the high frequency of TFU indications for neonatal suffering. This last indication represents 59.65% of normal TFUs.

It is therefore necessary to insist on a correct diagnosis of this neonatal suffering both by anamnestic arguments and the careful examination of the newborn in order to limit irrelevant TFU prescriptions.

As with normal TFUs, neonatal suffering and prematurity were at the forefront of abnormal TFU indications with 73.95% and 12.56% respectively.

In our series, we found a statistically significant association between the relevance of indications and the presence of abnormalities with a p -value $< 10^{-6}$.

These results testify on the one hand to the considerable contribution of the TFU in the relevant indications such as prematurity and neonatal suffering properly evaluated. On the other hand, they raise the interest of rationalizing prescriptions in the neonatal period.

A good clinical evaluation of newborns suspected of neonatal suffering and a good knowledge of the recommendations of scientific imaging societies, would streamline prescriptions and be more efficient.

5. Conclusions

Transfontanellar ultrasounds, examinations of common practice in the medical imaging services of the Ouagadougou city hospital in the newborn are dominated

in their indications by neonatal suffering and convulsions. Hemorrhages, ischemia and hydrocephalus were the most frequently found pathologies in our context.

TFU indications were relevant in 42.2% of cases with a significant association between the relevance of the indication and the presence of brain abnormality.

A local guide to the correct prescription of TFUs could be adapted and proposed to all key actors in the management of mother and child to streamline the prescription of this widely prescribed and performed examination due to its accessibility, its non-irradiating and non-invasive character.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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