Application of Bedside Emergency Ultrasound in Neonatal Craniocerebral Diseases

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Abstract: Bedside emergency ultrasound examination is a common method in neonatal examination, and with the increasing resolution of ultrasound diagnostic instruments, ultrasound diagnosis also began to appear in the emergency. It has been widely used in craniocerebral diseases, achieving good results. From the perspective of emergency, bedside emergency ultrasound examination of craniocerebral diseases can be repeated because of its simple operation, and it is a non-invasive bedside examination, so it becomes the first choice for newborns. Especially for the detection and follow-up of high-risk neonatal brain injury in ICU ward, it is of great significance.

1. Introduction

The brain of newborn is also composed of scalp, skull, meninges, brain, cerebellum, brain stem and other tissues like adults. The skull of newborn also includes parietal bone and skull base bone. Parietal bone is composed of frontal bone, parietal bone and occipital bone. The parietal bone of newborn is connected by membrane to form cranial fontanel, including anterior fontanel, posterior fontanel, sphenoid fontanel and mastoid fontanel. The anterior fontanel is closed at 12-18 months after birth, and the posterior fontanel is closed at about 2 months. Because the anterior fontanel is large, it is often the main window of ultrasound examination. So, from the perspective of newborns, using bedside emergency ultrasound can more clearly see the changes of craniocerebral diseases, grasp the symptoms of neonatal craniocerebral diseases.

2. Overview of Neonatal Craniocerebral Diseases

Neonatal craniocerebral disease is a general term for neonatal hypoxic ischemic encephalopathy (HIE), intracranial hemorrhage (ICH) and hydrocephalus. These diseases are common among newborns, especially among premature infants, and are also common in low-birth-weight infants and multiple fetuses. The incidence rate of these neonates is 60%. The incidence rate of newborns with abnormal childbirth can reach 80%. Therefore, in clinical, craniocerebral diseases are important in neonatal diseases, which need prompt detection and better treatment. If not treated in time, there will be a variety of complications, such as neurological sequelae and child mental decline. And for severe newborns, there is a life-threatening risk, so early diagnosis and timely treatment are the key to reduce neonatal disability rate, mortality, and it is of great significance to improve the quality of life. As a non-invasive, cheap, fast, non-radiation, repeatable, non-interference by external factors such as neonatal crying, bedside emergency brain ultrasound has the characteristics and advantages of high efficiency. This kind of high-quality examination technology has been widely used in the diagnosis of emergency critical infant craniocerebral diseases [1].

3. Ultrasonic Examination of Brain of Newborns

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3.1 Instruments and Probes

The initial examination can choose the real-time black-and-white ultrasound diagnostic instrument, which can basically meet the requirements of achieving high resolution and clear image quality report, so the requirements for the instrument itself are not high for the neonatal examination. Machine with image storage function is necessary. This can ensure that in the development of the disease, doctors can choose real-time color Doppler ultrasound diagnostic instrument for further effective diagnosis, judge the situation of brain bone diseases through effective and timely observation of intracranial blood flow. Generally speaking, there are several types of probes to choose from: fan scan, phased array and small convex array probes. This is mainly based on the fact that the smaller the probe diameter is, the larger the fan scan angle is, and the more information is obtained. Therefore, from this point of view, it is more appropriate to meet the probe frequency of 6-8MHz. From the perspective of newborns or premature infants, the higher the frequency of the probe, the more favorable it is for the diagnosis. Because the anterior fontanel of older infants gradually shrinks, the acoustic window also becomes smaller. Therefore, while selecting the probe, only the one with low frequency can be selected, or it can be properly adjusted to meet its more penetrating effect. For some infants, the probe with 3-4MHz can be selected for scanning [2].

3.2 Examination Method of Neonatal Craniocerebral Diseases

Generally, there are two methods of examination. The first is the anterior fontanel ultrasound. This method is mainly through the anterior fontanel, which is the most commonly used method of the acoustic window of craniocerebral ultrasound, namely, the coronal cutting through the anterior fontanel, or the continuous scanning of sagittal plane, so as to obtain the effect of different cut planes. It is of great significance to make a comprehensive judgment of the brain sonogram in different directions. Another method is to examine the temporal fontanelle. This method is a relatively less used in the acoustic window. It is mainly used for the observation of lateral subdural effusion. In contrast, it is mainly to understand the size of the inner diameter of the lateral ventricle and the proportion of the diameter of the cerebral hemisphere, so as to judge the development situation and know the middle cerebral artery hemodynamics through the detection.

But in the newborn craniocerebral diseases, it is worth noting that the ultrasound examination for those more critical infants should be paid special attention. Because of the poor and serious condition of these children, it is necessary to conduct ultrasonic examination by the bed or in the incubator. It is difficult for the new hand. Therefore, it is usually required to be carried out under the guidance of experienced doctors. The method of the regulation is as follows. First, touch the front fontanel of the infant by hand to find the position. Second, deal with the too dense hair to avoid affecting the ultrasonic penetration. Third, apply the coupling agent to make the probe contact with the scalp well, so as to get a clear image. In addition, if the local skin is damaged or the scalp needle is located near the front fontanel, 75% alcohol disinfection should be carried out to the probe before further examination to avoid the risk of cross infection [3].

4. Sonographic Findings of Normal Brain of Neonates

From the normal brain sonogram of newborns, it is mainly the feedback of the brain tissue, which is generally characterized by relatively uniform density, and diffuse low echo. These conditions are mainly seen in the cerebral cortex, thalamus, caudate nucleus, cerebral peduncle, etc., while the small brain has different performance state, generally characterized by strong uniform echo. There are sulcus or fissure on the surface of the brain, and abundant pia mater covering the blood vessels. At the same time, it can be seen from the comparison between cerebrospinal fluid that there are large differences in sound resistance at different positions, which can effectively form obvious strong echo band. Therefore, on the sonogram, it can present a clear structural outline consistent with the anatomy of the brain.

5. Application Scope and Main Contents of Observation of Neonatal Craniocerebral

Ultrasound

5.1 Application Scope of Neonatal Craniocerebral Ultrasound

From the application scope, it is mainly based on the routine screening of premature infants, neonatal asphyxia, neonatal hypoxic encephalopathy, intracranial hemorrhage, intracranial infection, intracranial occupying lesions, hydrocephalus, etc. All of these are common forms of craniocerebral diseases.

5.2 Main Contents of Observation of Neonatal Craniocerebral Ultrasound

The main contents of the observation of neonatal craniocerebral ultrasound include whether the intracranial structure meets the requirements of clarity, whether there is displacement in the middle line structure of brain, whether there is abnormal echo in the brain tissue, such as the enhancement of echo, the decrease of echo and the occurrence of mixed echo, especially whether the distribution is even. Space occupying lesions and whether there are changes in the ventricle should be also considered.

6. Analysis of Cases of Ultrasonic Diagnosis of the Bedside Emergency Neonatal Craniocerebral Diseases

Take the neonatal hypoxic-ischemic encephalopathy as an example: HIE is asphyxia and hypoxia of newborns during the perinatal period. It can cause physical damage to the brain tissue due to hypoxia and ischemia. A series of clinical symptoms and manifestations caused by brain injury will appear. When hypoxia is incomplete, it can be seen from ultrasonic diagnosis that the sagittal area of the cerebral cortex and its lower brain white matter are most vulnerable; when hypoxia is acute completeness, the nucleus of thalamus and brain cadres is the main affected part.

6.1 Basis of Clinical Diagnosis

The clinical diagnosis basis mainly includes the following types. First, there is a definite situation that can lead to fetal intrauterine hypoxia or abnormal obstetric history. This is a more likely situation. Second, there is a history of asphyxia at birth, which is more likely, especially there is severe asphyxia. Third, there are problems of disturbance of consciousness such as excessive excitement within 12 hours after birth. Different degrees of changes of muscle tension of limbs and the occurrence of abnormal reflex are also included. Fourth, the severe cases may produce the brain stem symptoms. Fifth, the situation of intracranial hemorrhage in newborn, or the presence of intrauterine infectious encephalitis and congenital malformation of the central nervous system should be investigated. The above situation can be judged as the possibility of neonatal craniocerebral disease [4].

6.2 Pathophysiological Changes

The main pathological and physiological change of neonatal brain diseases is brain edema, which is a very typical symptom. It can be caused by the pre-causes of selective neuronal necrosis and basal ganglia injury. There are focal or multifocal ischemic cerebral infarction, periventricular leukomalacia and other phenomena. Therefore, intracranial hemorrhage and cerebellar injury are the main characteristics of its physiological changes.

7. Conclusion

Ultrasound examination of neonatal craniocerebral disease is a widely used method in emergency department. Because of its advantages of convenience, speed, repeatability and bedside, it can especially meet the requirements of high-resolution examination of neonatal brain central lesions, and can be used as the preferred means of routine screening for early neonatal brain lesions, so it has high clinical application value.

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