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# The Modified Sarnat Score in the Assessment of Neonatal Encephalopathy: A Quality Improvement Initiative

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**Introduction**

The Sarnat score is a clinical tool used to assess the severity of neonatal encephalopathy. First described in 1976, it uses 6 clinical parameters to classify encephalopathy as mild, moderate, or severe[1]. There are four neurological items, one autonomic nervous system item, and one item related to the presence or absence of seizures. The strength of this score is that it provides a clear picture of the infant's neurological status. It has been widely accepted both nationally and internationally. It plays an important part in the evaluation of new treatment modalities for neonatal encephalopathy. The drawback is that it requires additional work and training. It cannot be applied retrospectively as the specific data items need to be recorded contemporaneously.

Although in existence for 43 years, the Sarnat score is documented sub-optimally or not at all in many cases of neonatal encephalopathy. In a recent national review of neonatal encephalopathy cases, the Sarnat score had been assigned in only half of the cases[2]. The reasons for the low application of the scoring tool are numerous. Without prior training the Sarnat score is difficult to perform. In addition, its importance may not be fully appreciated. 'Neurophobia', the fear of clinical neurology by physicians, is widely acknowledged in the literature[3]. There is undoubtedly a sense of 'neurophobia' among many Paediatric trainees. It is recognised that the neurological assessment of infants is challenging, particularly for inexperienced clinicians. Doctors may have low confidence in their ability to manage babies with neurological illnesses.

The reliability of the neurological examination of newborns was seriously questioned by the British Paediatric Association (BPA), later known as the Royal College of Paediatrics and Child Health (RCPCH). In its 1991 document on brain death in children it stated that between 37 weeks gestation and 2 months of age, it is rarely possible to confidently diagnose death as a result of cessation of brain stem reflexes[4]. The RCPCH reviewed the issue in 2015. The working party found that there was now sufficient new evidence to extend the criteria for diagnosis to the age group of birth to 2 months[5]. The findings have provided a new validation of the reliability of newborn neurological examination.

The importance of accurate, reproducible neonatal neurological assessment has increased since the introduction of therapeutic hypothermia in 2009. The Sarnat score is an effective, objective tool in the evaluation of the infant's level of abnormal neurological behaviour. It allows one to track the infant's encephalopathic status at the outset and both during and after the 72 hours cooling period. The score can be correlated with the brain MRI findings and the neurological outcome. It is informative on trends in the application of therapeutic hypothermia. In particular the score will identify therapeutic creep (i.e. the use of cooling in milder degrees of encephalopathy).

The original paper on the Sarnat score was based on 21 newborns over 36 weeks gestation suffering from perinatal asphyxia. Stage 1 has a duration of less than 24 hours and consists of hyperalertness with a normal Moro, normal stretch reflexes, normal sympathetic effects and a normal EEG. Stage 2 infants are obtunded, hypotonic, with strong distal flexion, and multifocal seizures. Persistence of stage 2 for more than 7 days or failure of the EEG to revert to normal was associated with later neurological impairment or death.
Stage 3 infants are stuporous, flaccid, with suppressed brain stem reflexes, depressed autonomic functions, and an isopotential EEG with periodic discharges. However, the modified Sarnat score commonly in use today does not include EEG data.

**The Modified Sarnat Score Test**

**Table 1. The Modified Sarnat Staging for Neonatal Encephalopathy**

| **Severity** | **Stage 1 (mild)** | **Stage 2 (Moderate)** | **Stage 3 (Severe)** |
|---|---|---|---|
| **Level of consciousness** | Hyperalert | Lethargic / Obtunded | Stupor or coma |
| **Activity** | Normal | Decreased | Absent |
| **Neuromuscular Control:** | | | |
| **Muscle tone** | Normal | Mild hypotonia/hypertonia | Flaccid/rigid |
| **Posture** | Mild distal flexion | Strong distal flexion | Intermittent decerebration |
| **Tendon reflexes** | Overactive | Overactive | Decreased or Absent |
| **Complex reflexes:** | | | |
| **Suck** | Weak | Weak/absent | Absent |
| **Moro** | Strong, low threshold | Weak, incomplete,high threshold | Absent |
| **Tonic neck** | Slight | Strong | Weak or absent |
| **Autonomic Nervous System:** | | | |
| **Pupils** | Dilated pupil | Constricted pupil | Variable: often unequal, poor light reflex, fixed, dilated |
| **Heart rate** | Tachycardia | Bradycardia | Variable |
| **Respiratory rate** | Regular | Periodic breathing | Apnoea |
| **Seizure** | None | Common; focal or multifocal | Uncommon (excluding decerebration) |

* Asymmetric tonic neck reflex: Elicited by rotating the head to one side. In a complete response, the ipsilateral arm and leg will extend and the contralateral arm and leg will flex, producing the “fencing” posture.

The equipment items needed for this test include a copy of the score, cotton wool, a pen torch and a patella hammer.

**The Sarnat Score – a Quality Improvement Initiative**

We carried out a quality improvement initiative in a tertiary neonatal unit with the aim of educating doctors regarding the importance of systematic evaluation and documentation of neonatal encephalopathy using the Modified Sarnat Classification.
An education session for all medical staff working in the neonatal unit was arranged, outlining the Modified Sarnat Classification system. Pre and post education questionnaires were obtained to assess effectiveness of teaching. Index cards were issued to all staff, describing the individual components of the Modified Sarnat Score (see table 1) and

those techniques necessary to elicit the relevant neurologic signs (see table 2). A teaching video, demonstrating neurological assessment of a neonate using the Sarnat Classification, was produced.

| **Table 2. Techniques necessary to elicit the relevant neurologic signs** |
|---|
| ✓ **Key parameters to assess level of consciousness:** response to stimuli, corneal and gag reflex, motor activity<br>✓ **Stimulation technique:** Mild stimuli (tactile touch), Moderate stimuli (heel flick), Noxious stimuli (pinch of thumbnail/earlobe) |
| • **Hyperalert:** respond readily to stimuli, corneal and gag reflexes present, normal motor activity<br>• **Lethargy:** delayed response to stimuli, corneal and gag reflexes present, reduced motor activity<br>• **Obtunded:** delayed, incomplete response to stimuli, corneal and gag reflexes present, markedly reduced motor activity<br>• **Stupor**: only respond to strong noxious stimuli, Absent corneal and gag reflexes , no spontaneous motor activity, other – shallow ataxic breathing, apnoeic<br>• **Coma:** No response to noxious, vigorous stimulation, absent corneal and gag reflexes, no motor activity<br>• **Posture:** Normal posture = flexion and adduction of all limbs |
| ➢ **Key DTRs:** knee, supinator, biceps<br>➢ **Mean horizontal pupillary diameter:** Term neonates: 3.8 mm +/- 0.8mm (SD) |

Seventeen medical staff attended the education session (n=3 Consultants, n= 6 Registrars/Specialist Registrars, n=5 Senior House Officers, n=2 Clinical Nurse Managers/Nurse Specialists, n=1 staff nurse). Staff had a mean experience of 8 years and 7 months working in Paediatrics (range: 1 year 4 months – 30 years). Fifty-eight percent (n=10) had received education on the Sarnat Score previously (80% through self-directed learning, 20% through formal education sessions). Forty-seven percent (n=8) had used the score previously in clinical practice. Twenty-three percent (N=4 (n=3 Consultants, n=1 SpR)) correctly identified the individual components of the Modified Sarnat Score prior to receiving education. Prior to receiving education staff were asked to accurately score 10 clinical scenarios. One staff member (Consultant) scored 100% of the scenarios correctly. One staff member (Consultant) scored ≥ 80% of the scenarios correctly. Six staff members (n=1 Consultant, n=4 Reg/SpR, n=1 Staff nurse) scored ≥ 50-80% of the scenarios correctly. Nine staff members (n=2 Reg/SpR, n=5 SHO, n=2 CNM/CNS) accurately scored less than 50% of the scenarios.

All staff (n=17) found the education session informative and felt more confident using the Modified Sarnat Score following the education session. Fifty-eight percent (n=10) felt that further education on the score was required. Following education, two staff members (n=1 Reg/Spr, n=1 Staff nurse) scored 100% of the scenarios correctly. Ten staff members (n=3 Consultant, n=3 Reg/SpR, n=4 SHO) scored ≥ 80% of the scenarios correctly. Three staff members (n=1 SHO, n=1 CNM/CNS, n=1 staff nurse) scored ≥ 50-80% of the scenarios correctly. Two staff members (n=2 Reg/SpR) accurately scored less than 50% of the scenorios.

**Sarnat Score Training**

All doctors who undertake Sarnat score recording should be provided with appropriate training. The key is to perform the assessment on a number of healthy infants. This is the only way of understanding and appreciating what is normal. It is estimated that one should undertake the score in 6 normal infants. It is not acceptable that the first time a doctor undertakes the Sarnat score is when he/she is confronted when an infant with neonatal encephalopathy.
The consultant trainer should demonstrate step by step how to record the 6 items of the score. Trainees must be supervised to ensure that they are able to carry out the examination correctly. Considerable emphasis should be placed on the infant's level of consciousness. This is of fundamental importance. An alert infant cannot have significant encephalopathy. A non-alert obtunded infant is invariably neurologically compromised. Particular attention needs to be placed on the assessment of tone. Trainees have a difficulty with the examination of tone in

small infants. Achieving competency needs both training and practice. The accurate evaluation of tone is the cornerstone of neonatal neurology. Trainees should routinely observe the posture of all infants that they encounter in order to appreciate what is normal. Experience evaluating the strength and quality of the normal newborn's suck response is essential. The Moro reflex is user friendly and is quickly acquired by trainees. Similarly, the asymmetric tonic neck reflex (ATNR) is easy to evaluate. The flexion of the elbow on the occipital side is more reproducible than the extension of the upper limb on the contralateral side. Trainees need to acquaint themselves with the normal pupil size (3.8mm).

**The Frequency of Sarnat Score Testing**

The Sarnat score should be documented prior to the commencement of therapeutic hypothermia. During the 72 hours of TH the score should be performed every 12 hours. Following the cessation of TH the score should be performed daily until discharge.
The sequence of Sarnat scores should be included in the discharge summary. This will enable the correlation between the brain MRI, the neurodevelopmental outcome and the Sarnat score.

**Summary**

The Sarnat score is an essential component in the assessment and evaluation of the infant with neonatal encephalopathy. This clinical tool provides physicians with a standardised approach to systematic neurological examination and documentation of pertinent neurological findings. The value of the Sarnat Score has increased with the advent of therapeutic hypothermia and the need to evaluate the neurological response to treatment.

**Declaration of Conflict of Interest:**
The authors have no conflicts of interest to declare.

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