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USE OF LABAN/BARTENIEFF MOVEMENT STUDIES TO PROFILE NEONATAL MOVEMENTS: AN EXPLORATORY STUDY

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ABSTRACT

Purpose. Monitoring body movements in neonates can have important clinical implications, as these are early predictors of neurodevelopmental disability. The most valid analysis method applied for this purpose is general movement assessment (GMA). Performing GMA requires special training, which is often inaccessible to healthcare providers in low- and middle-income countries. Hence, this prospective exploratory study was proposed to profile movement in typical neonates to distinguish it from abnormal movements using Laban/Bartenieff Movement Studies (LBMS) framework, which has been widely used to analyse movement in a variety of situations.

Methods. Overall, 8 typical neonates were videotaped and 10 cycles of movements were sampled, which resulted in 80 units. Data saturation occurred at 5 children.

Results. The results obtained are consistent when described using LBMS language.

Conclusions. LBMS may be a feasible and viable method to interpret and document movement patterns in neonates as an alternative to other, more resource-intensive methods.

Key words: infants, neonates, newborns, movement

Introduction

Endogenously generated movements are considered to be the most complex movement pattern of the foetus, neonate, and young infant, which emerges during early foetal period and continues for 4 months of the infant phase [1]. These are characterized by variability in speed, amplitude, force, and intensity of the movement pattern [2, 3]. Monitoring these movements has been reported to be a sensitive predictor for neurodevelopmental delay.

Prechtl and colleagues, with their observations of infants, explored a special type of spontaneous movements, so-called writhing and fidgety movements, which are elicited without obvious external stimuli. This initial writhing period may be seen at pre-term to 8 weeks post-term, persisting with slow, powerful, and elliptical movements of varying speed and amplitude performed closed to the body of neonates [4]. Their complexity is enhanced by superimposed rotations on the flexion and extension of the limbs, where the overall form is fluent and elegant. The movements were coded into a form called general movement assessment (GMA).

GMA is considered to be the gold standard for early detection of neurodevelopmental delay. However, potential drawbacks such as lack of trained professionals and proprietorship etc. are challenges to its routine use in low- and middle-income countries. Hence, there is an incipient demand for a comprehensive method of movement analysis in newborns for early diagnosis of neurodevelopmental disability.

Laban/Bartenieff Movement Studies (LBMS) constitute a method and language used to describe, visualize, interpret, and document human movement. It is generally utilised by dancers, musicians, athletes, and by health professionals such as physical therapy and occupational therapy practitioners [5].

LBMS is a system that describes how, what, where, and when the movements takes place, with a focus on entire body segments and their movements, using

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Table 1. Parts of Laban/Bartenieff movement analysis framework

Movement concept					
Body part	Space	Effort	Support	Shape	Relationship
Structural and physical characteristics of body during movement, i.e. what body parts are involved and how a body part moves as a whole or individual	Motion in connection with the environment, i.e. where the movements occur in relation to self and environment	Subtle characteristics of movement with respect to inner intention, i.e. how the movement is performed with respect to space	Area where the body is supported	The way the body changes its shape during movement	Relationship between the movements

Table 2. Subcategories of Laban/Bartenieff movement analysis

Subcategory	Movement elements
Body	1. Type (includes flexion or extension; flexion is sub-classified into contraction, fold, curvilinear, and separation; extension is sub-classified into elongation, unfold, uncurving, and joining) 2. Frequency (includes steady or sporadic) 3. Chronology (includes simultaneous, successive sequential, successive overlapping, and sequential overlapping) 4. Side (includes face, front, or back side)
Space	1. Path (includes locomotor or gesture) 2. Pattern (includes clockwise/counter-clockwise, somersault, cartwheel, and unspecified) 3. Direction (includes forward/backward, upward/downward, and right/left) 4. Level (includes high, mid, and level)
Effort	1. Weight (includes light or strong movement) 2. Flow (includes bound or free movement) 3. Time (includes sudden or sustained movement) 4. Space (includes direct or indirect)
Support	1. Body part (where the body is supported) 2. Level (includes low, mid, and high)

the concept of Body, Effort, Space, and Shape theory of LBMS [6]. The main components of the LBMS framework are illustrated in Table 1 and the subcategories are presented in Table 2.

The system described by LBMS is comprehensive and has the potential to be used as a non-invasive and non-intrusive qualitative movement analysis with minimal resources to obtain the character and quality of movement. Prior to applying it as a tool to detect abnormality, it is necessary to profile the movements in typical neonates. This explorative study aimed to incorporate the framework of LBMS to profile movement in neonates who were expected to develop normally. The hypothesis put forward in the study was as follows: neonate movement analysis using the language of LBMS will be a sensitive and adequate tool to describe neonatal movement systematically and reliably.

Material and methods

The study involved 8 neonates (4 boys and 4 girls) from a tertiary referral hospital who had normal Apgar score of 7 or more at 5 minutes and no maternal history indicative of neurodevelopmental risks. Each baby was video-recorded with 2 Logitech HD C920 webcams, attached to 2 separate tripods and connected to a one-window laptop (2.0 GHz processor; 4 GB RAM; 150 GB hard drive space, and USB ports) by 2 extension cords of 5-meter length. The resolution of 1080 × 1920 pixels (the highest possible) was selected to achieve the desired precision [7]. The video recording was performed when the children were in a state of active wakefulness (but not crying), in supine position, wearing comfortable clothing, with arms and legs bare, at comfortable room temperature, and at least half an hour after feeding [4, 8]. The study was continued until data saturation [9]. Data saturation was obtained when no new movements were identified in 5 neonates (i.e. no additional movement were collected). Overall, 10 cycles of movement per body part were sampled in each of the 8 children, which led to 80 subunits (10 cycles × 8 children = 80 units) of samples. Data were analysed by using narrative description based on LBMS.

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the institutional research committee of JSS College of Physiotherapy.

Informed consent

Informed consent has been obtained from the parents of each neonate included in this study.

Results

The qualitative analysis of 8 neonates was conducted by observing various aspects of movement concepts based on the LBMS framework [10]. Each movement was divided into phases by using LBMS, viz the Body, Effort, and Space components. Finally, the movements analysed in various body parts were formed as a sentence to interpret the results. Thus, the movement analysis of the 8 neonates was framed as follows: '*The approach unit started from initiation of head and limb movement with the support on torso at mid-level. Head moved into fold (i.e. rotation and derotation) steadily towards face side, where as for the extremities (both upper and lower extremities) movement, the type was contraction and elongation. Path of spatial change was gestural (i.e. no change of base of support since the baby in supine position) and the pattern circumscribed clockwise and counter-clockwise for head and unspecified (i.e. no particular direction of change in movement) for the extremities. The direction of movement was right and left for head and forward-upward for extremities, with the exception of lower leg, where it was backward and forward. Throughout the movement patterns of the body parts, the frequency was considered sporadic, with the chronology of sequential overlapping for the extremities. Effort was strong and sudden throughout the movement.*' These results are summarized in Table 3 and illustrated in Figures 1–3.

Discussion

We have developed and clinically tested a movement analysis of neonates using the LBMS framework, which can be applied to monitor neonate movement in clinical settings. When the movement analysed was compared with the terminology of GMA [11–14], similarities were apparent. These included the writhing movement in Prechtl's GMA, which is similar to the Space and Effort components of LBMS, i.e. the Space component (level mid to high, high to mid, and vice versa) correlates with the amplitude component of the writhing movement in Prechtl's GMA [15–17] and the Effort component (strong and sudden movement) correlates with the speed component of writhing in Prechtl's GMA [18, 19].

Using the LBMS framework gives organization to movement analysis and is superior to an informal analysis. When the initial framework was repeated

Table 3. Description of various components of neonate movements

Body	Space	Effort	Support
Type: i) Head and face – rotation and derotation ii) Rest all – contraction and elongation Frequency: Sporadic Chronology: Sequential overlapping except head and face	Path: Gesture Pattern: i) Head and face – clockwise and counter-clockwise ii) Rest all – unspecified Direction: i) Head and face – right and left ii) Rest all – forward and upward except lower leg, which was backward and forward Level: i) Head and face – mid ii) Upper and lower extremity – mid to high and high to mid	Strong and sudden	Mid in torso

Figure 1. The approach unit where the head moved into fold, i.e. rotation and derotation towards the left side

Figure 2. The approach unit where the movement type in upper extremity was contraction and elongation (right side)

Figure 3. The approach unit where the movement type in lower extremity was contraction and elongation (right side)

on random sections of the recorded videos, there was complete agreement of the results. This underlines the fact that the framework is clear and easy to use.

The strengths of this study are as follows:

1. As video recording was performed, the movements could be observed repeatedly to avoid flaws or errors in the analysis.

2. The method of movement analysis does not have proprietorship and can be learned under the tutorship of trained LBMS professionals. Hence, it might be a feasible tool and can be applied by all healthcare professionals who work with movement analysis of neonates.

In turn, the limitations and future recommendations are provided below:

1. This is a preliminary study and the results must be confirmed in a larger group of neonates. Inter-rater agreement must be established and validation in a longitudinal study is required.

2. The Shape component of LBMS was not considered for this study. Future research should incorporate this component to include preliminary understanding of Shape since a large part of neonatal movements includes Shape and inner referential movements.

3. This study should be further validated by professionals trained in the LBMS framework for appropriate use of the LBMS language.

Conclusions

This was an exploratory study and hence firm conclusions cannot be drawn. But from the above results it is clear that the movement analysis using the LBMS framework may be a viable method to detect and describe movement in neonates. Since GMA is considered as the gold standard for early identification of neurodevelopmental delay, the method described here must be validated against GMA. As the primary focus of this study was to explore the possibility of LBMS application in profiling neonatal movement and in early identification of neurodevelopmental disability, the terminology used has been restricted to common language without technical LBMS terminology.

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Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest
The authors state no conflict of interest.

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