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Development of sucking patterns in preterm infants

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7 General discussion

Introduction

This thesis addresses the development of sucking patterns in fullterm and preterm infants from birth until the age of ten weeks post-term. We assessed the sucking patterns in fullterm infants and four groups of preterm infants by means of the Neonatal Oral-Motor Assessment Scale (NOMAS) (1). The four groups of preterm infants that participated in our study were appropriate-for-gestational age (AGA) preterms, small-for-gestational age (SGA) preterms, preterms with bronchopulmonary dysplasia (BPD) and an age-matched group of preterms without BPD.

The aims of the study were:

- To determine which diagnostic tool was the best option for assessing sucking and swallowing problems in preterm infants, and to describe some of its psychometric properties;
- To gain insight into the developmental course of the sucking patterns of fullterm and preterm infants and into the factors that could influence the development of sucking. The implications of the results are discussed in this chapter.

Main results

The study provided insight into the reliability of the NOMAS. In addition, it provided the general insight that very preterm infants and SGA preterm infants are at risk for disturbances in the development of sucking patterns. Not all our expectations regarding the development of sucking patterns in preterms came out. Indeed, new questions arose. Some of our findings were at variance with findings reported in the literature or with current practice regarding when to start oral feeding and how to set up oral feeding schedules. This called for a critical look at the everyday procedures that surround starting and scheduling of oral feeding of preterms in the Netherlands. Our study is an initiative to look at the sucking patterns of different groups of preterms from a different perspective. From the literature search it was apparent that no reliable, non-invasive, inexpensive, and user-friendly diagnostic tool was available that could be used in both breastfeeding and bottle-feeding situations. The NOMAS emerged as the best option: it is non-invasive and user-friendly, and it can be used in both situations. Since no sound research data were available regarding the reliability of the NOMAS, we started off by doing a reliability study. From this study it appeared that the intra-rater reliability was sufficient, but not so the inter-rater reliability. Since the NOMAS did satisfy the other requirements of a research

instrument we chose to use it for our study purposes. In order to increase the inter-rater reliability each recording was assessed by two certified NOMAS speech therapists. In case they disagreed the recording was reassessed by a consensus group consisting of other certified NOMAS speech therapists.

The NOMAS is an observational method consisting of 28 items: 14 relate to jaw movements and the other 14 to tongue movements. The NOMAS is administered during the first two minutes of a feed. The infant is observed in profile in such a way that its jaws, the base of the mouth, lips and cheeks are clearly visible. The instrument distinguishes three sucking patterns: a normal or mature sucking pattern, a disorganised sucking pattern, and a dysfunctional sucking pattern. In the case of bottle-feeding, Marjorie Palmer, who described the NOMAS in 1993 in a study on 40 fullterm and preterm infants ¹, determined that the cut-off point for scoring rhythmical movements in fullterm infants was ten or more jaw movements (as motor expression of sucking-swallowing-breathing movements) in one burst of sucking. Even though Qureshi also mentioned a minimum of ten jaw movements during bottle-feeding at fullterm age that increases to at least twenty jaw movements at four weeks after term ², we did not find similar results. A third of the healthy, fullterm infants we observed had sucking bursts of less than ten jaw movements during several measurements. In addition, some infants of fullterm age produced much longer bursts while others, at the age of ten weeks, produced burst that were considerably shorter than twenty jaw movements. In our opinion, it says nothing about the infant's sucking skills if the bursts briefly alternate with short pauses. Shorter bursts of sucking alternating with merely short pauses should probably be regarded as normal in contrast to the infant that produces short bursts alternating with long pauses during which the infant tries to recover its breath. This phenomenon could be seen as a problem of coordinating sucking and swallowing.

In practice it is assumed that when preterms reach fullterm age their drinking skill is the same as that of fullterm infants. It appeared from our study, however, that only a quarter of the preterms have a normal sucking pattern at fullterm age and that by the age of ten weeks post-term this had increased to three quarters. Apparently, in current practice there is a tendency to not await the delay in development that evidently accompanies preterm birth, but to more or less push the infant into learning to drink. The paediatric nurse should have insight into the individual infant's sucking skill to decide whether it is ready to start feeding orally and how the feeding schedule should be set up. A conflict of interest is often the case: the infant should be given the opportunity to practise its sucking skills without this causing stress or oxygen saturation drops, or both. We are not aware of research data that show, for instance, that the infant will not learn to drink well if learning to drink is postponed till the due date. Our research showed

that almost all preterms needed more time to develop a normal sucking pattern. In accordance with Simpson et al. we state that it is unwise to want to achieve a sucking pattern in preterm infants that is similar to the sucking skill we are used to seeing in fullterm infants(3). If we allow preterm infants time to mature most of them will develop a normal sucking pattern of their own accord. All other things being equal, we emphasise that an abnormal sucking pattern does not mean that the infant cannot suck effectively. Almost all preterm infants are fed orally entirely even though they still show some abnormalities in their sucking patterns. Fifteen infants (22%), divided over the four groups, were still tube-fed at term age. Two infants, one preterm with BPD and one preterm infant without BPD, were still tube-fed at ten weeks' post-term. The sucking patterns of these two infants were abnormal in the sense that they were unable to sustain sucking or they had problems coordinating breathing with sucking and swallowing, or both. Before reaching fullterm age, preterm infants with BPD experienced much difficulty coordinating breathing with sucking and swallowing. Gewolb 4-6 and Mizuno 7 demonstrated also that until they reach fullterm age, preterm infants with BPD experience more difficulties in learning to coordinate breathing with sucking and swallowing than do infants without BPD. We found, however, that after reaching fullterm age, the development of these infants was comparable to that of fullterms without BPD who had comparable gestational ages. An important point in this connection is the fact that the infants in our study had a relatively mild form of BPD. The largest part of the BPD group developed a normal sucking pattern within a period of merely four weeks (from 44 to 48 weeks' PMA).

Nevertheless, the development of sucking and swallowing in BPD infants is experienced differently in the daily practice of the paediatric nurse and speech therapist: when it comes to learning to drink, preterms with BPD require extra attention longer than do other preterms, even after they have reached fullterm age. In the case of preterms with BPD, sucking appeared to develop in fits and starts and rather unpredictably, as described by Gewolb 5;6. Additionally, BPD is a chronic condition with a variable clinical picture.

It should be noted that not only infants with BPD experienced difficulties in coordinating sucking patterns, but also preterm infants without BPD. Like infants with BPD, very preterm infants without BPD are also at risk for impaired lung development. Birth prior to 30 weeks gestation, with early exposure of the immature lung to air flow, higher oxygen tensions and changes in lung perfusion and blood volume, alters pulmonary development and lung function. This may have impact on the development of sucking patterns. It might explain the delay of both groups in their ability to attain and sustain a normal sucking pattern 8;9. Still, the large differences between the fastest and the slowest infants could not be explained on the basis of gestational age.

Another notable finding of our study was that generally speaking the SGA preterm infants performed the worst: not one of the infants in this group had developed a normal sucking pattern by the time it had reached term age. More often they had difficulty coordinating breathing with sucking and swallowing, in some cases combined with a dysfunctional sucking pattern. According to Palmer, dysfunctional sucking points to a neurologic dysfunction in the motor control of sucking and swallowing movements ^{1;10}. Only half of the SGA preterms had a normal sucking pattern at ten weeks' post-term. This indicated that in SGA preterm care, learning to drink should be carefully supervised. In the case of this group of infants the point is not that they should be fed orally completely and as fast as possible. Precisely by pursuing the policy where by, on the one hand, the infant receives the necessary nourishment by tube-feeding for it to thrive, while on the other hand, it can practise drinking. In this way the infant is afforded time and given the opportunity to develop a normal sucking pattern. By monitoring the development of sucking of these infants carefully it will soon become clear whether it has a dysfunctional sucking pattern that requires intervention.

Recommendations for practice

Primarily, teaching an infant to drink properly is striving for functionality: how can we help the infant to take in sufficient nourishment orally as normally as possible in order for it to grow. The main purpose is not to strive for an entirely normal sucking pattern. It is, rather, a matter of observing closely whether the infant can sustain its sucking, that it does not show any stress signals such as nasal flaring, extraneous movements, and head turning ^{1;11} that there is no drop in saturation, and that it can coordinate breathing with sucking and swallowing. A slightly abnormal sucking pattern is no reason to stop oral feeding, even though it does indicate that everything is not as it should be regarding the rhythm of sucking and swallowing. A definitely abnormal sucking pattern, however, does require extra attention from the paediatric nurse.

There is an increasing tendency in the USA to use oral stimulation programmes to stimulate the development of sucking ¹²⁻¹⁴. Data are emerging, however, that indicate that later eating problems can be traced back to pushing the infant into sucking while it cannot yet handle the coordination between sucking, swallowing and breathing. This leads to serious oxygen saturation drops during drinking and eating problems later on ^{15;16}.

In daily practice it is the paediatric nurse, under supervision of the paediatrician, who teaches the preterm infant to drink. In the Netherlands, if

problems are encountered or sucking develops differently than expected, a speech therapist is often involved. Involving a speech therapist differs from hospital to hospital as does the needs assessment ¹⁷. Due to the exploratory nature of this study we can only offer provisional recommendations for the way in which the paediatric nurse, in collaboration with the speech therapist, can teach a preterm infant to drink from a bottle or suckle at the breast to its best ability.

An essential topic of discussion in present policy is when to start an infant on oral feeding and how to set up the oral feeding schedules. Our findings could contribute to this discussion in terms of general tendencies and adjusting the recommendations for daily practice. The question is whether present policy, i.e. the infant's age determines when it is started on oral feeding, is indeed the correct policy. A positive development in this respect is the view of Suzanne Thoyre and her 'Early Feeding Skills Assessment' ¹⁸. She recommends not taking age per se as the indicator when to start feeding an infant orally, but to check each infant individually to determine whether it is ready for oral feeding. Internationally, the Netherlands is in the lead when it comes to teaching preterms to suckle at the breast. The Breastfeeding Protocol of the University Medical Center Groningen (UMCG) ¹⁹ allows infants to smell and lick the nipple from a very early age, in fact as part of pouching. When the infant starts rooting the nurse will check to see if it is able to keep the nipple in its mouth. In this way the infant is given the opportunity to suck if it wants to and is capable of doing so, or not, if the conditions are not right. This is an essentially different approach from pushing an ever-dripping bottle into an infant's mouth from a set age, even if the infant is not rooting or not in the right behavioural state. Studies demonstrated that by starting early or by stimulating its mouth an infant can usually feed orally completely one to two weeks earlier ¹²⁻¹⁴. This raises two questions. Firstly, would this be an advantage in the Netherlands where, contrary to practice in the USA, discharge from hospital is linked to whether or not the infant is capable of all-oral feeding? Secondly, how does the infant drink? Is it drinking calmly, relaxed, and well-coordinated without dips in oxygen saturation? Such data are not mentioned in the studies. Moreover, no data are available on the influence of this method on the development of eating behavior of these stimulated infants later on. In our opinion, the aim of setting-up oral feeding schedules should not be to strive for a completely normal sucking pattern, but rather to achieve that the infant can sustain sucking, that it shows no signs of stress, and that it can coordinate breathing with sucking and swallowing. Therefore, a slightly abnormal sucking pattern (yellow in the Figures) is no reason to be extra careful when offering this infant oral nourishment. A definitely abnormal sucking pattern (all other colours in the Figures) does require extra attention from the paediatric nurse. This extra attention could be summarized as

follows: be alert during the entire feeding session and stop oral feeding as soon as the infant shows signs of stress.

Many infants are transferred from the NICU to peripheral hospitals before they are ready to learn to drink. It is necessary, therefore, to develop nationwide guidelines for paediatric nurses so as to streamline when to start oral feeding and how to set-up oral feeding schedules for preterms in the Netherlands, thus preventing it from being handled differently throughout the country.

The tendency indicated by our study, that a SGA preterm needs more time to develop a normal sucking pattern than an AGA preterm does, strengthens the recommendation to allow the SGA preterm more time and opportunity to learn to drink, while tube-feeding guarantees the necessary growth. Moreover, the paediatric nurse should be aware of the fact that a dysfunctional sucking pattern occurred more often in this group, so that a speech therapist could be consulted on time. The speech therapist examines the infant's abnormal sucking, determines the possible causes and draws up an intervention plan together with the paediatric nurse.

In the case of very preterms (GA<30 weeks) and especially of those with BPD, one should take into account the fact that due to their lung problems they have more difficulty keeping up their oxygen saturation while drinking. In this respect, breathlessness could lead to refusing to swallow and even to refusing teat or nipple. Such a defence is, therefore, also linked to the development of eating problems later on ^{15;16;20;21}. In the case of these infants in particular, we recommend looking closely at the necessary preconditions for when to start oral feeding and only to allow the infant to learn to drink while physiological parameters (oxygen saturation, heart rate) and neurobehavioral functioning (muscle tone and behavioral state) are carefully monitored. A most promising way of monitoring the infant while monitoring the equipment at the same time is the Early Feeding Skills Assessment (EFS) tool ¹⁸. This method assesses whether the infant is ready for oral feeding (oral feeding readiness), which means the infant shows rooting, it is in an awake state and it is able to hold its body in a flexed position, and shows oral feeding skills (the ability of oral-motor functioning, the ability to coordinate swallowing, and to maintain physiologic stability). In addition, the method checks how rapidly the infant recovers after the first five minutes of feeding (with regards to oxygen saturation, heart rate, state, and muscle tone). On the basis of all these details a decision is made regarding the following feeding time. In case the infant recovers rapidly the paediatric nurse will decide to again observe the infant's next feed with the help of the EFS in order to determine whether the infant is capable of oral feeding. Should the infant not recover from the impact of oral feeding within five minutes, the paediatric nurse will decide to only tube-feed the infant at the following feeding time or times.

One of the responsibilities of the paediatric nurse is to offer the parents support in caring for the preterm infant. The paediatric nurse should teach the parents to observe their infant and to correctly interpret the signs emitted by the infant. At a certain point learning to drink becomes a daily recurring event. Parents often want the infant to drink as many cm³s as possible so that it can go without tube-feeding sooner. The example set by the paediatric nurse, who is not primarily interested in how much the infant has drunk, but rather in the way the infant drank, helps parents to view their infant's drinking behavior in a different light. Much attention, explanation, and empathy is required of the paediatric nurse to teach parents to observe whether the necessary preconditions (rooting and state) are present to start oral feeding and to teach them to continuously watch their infant - and the monitors! - during oral feeding. Being alert and stopping as soon as the infant shows signs of stress is the approach that should be explained to parents and the one they should be taught.

Implications for future research

In this thesis we reported on the need for developing a reliable diagnostic tool to assess sucking patterns in infants. The NOMAS is such a tool. We consider it worth the effort to adjust the NOMAS since it enabled us to assess the entire context of a drinking or suckling infant according to a set protocol and thus we obtained important information. In addition, new techniques offer different, supplementary possibilities. One such development is the use of ultrasound, pioneered by Geddes et al. ²², Miller et al. ²³, and Mizuno ²⁴, to aid and improve the assessment of tongue movements, especially in the case of a dysfunctional sucking pattern. Until such time as these techniques become available, we recommend that the individual observer be tested regularly and given extra training if need be, in order to increase the intra-rater agreement of the NOMAS. In addition, we advise against involving more than one assessor in the longitudinal follow-up of the same infant. In case the NOMAS is used as a means to assess neurodevelopmental outcome for research purposes, we recommend that each recording is assessed by two reliable assessors, and that they reach consensus in case of absence of agreement. We expect the inter-rater agreement to improve if the intra-rater agreement increases and after the instrument has been adjusted.

Another important point to be considered concerns the optimal age at which to start oral feeding. It is unknown whether there is a relationship between the point in time oral feeding is started and the way the sucking pattern develops. From a study by Simpson et al. (3) it appeared that under special conditions an early start would lead to a shorter transit time from full tube feeding to all oral feeding in healthy preterm infants. It remains unclear

how practising their innate sucking skills benefits the infant. An added danger is that of offering the infant oral feeding at a time when it is not yet able to control its physiological parameters. This has a baneful influence on both the developmental course of sucking and on the later development of eating. We need a fundamentally new approach to determine the starting point of oral feeding. No longer should we take the age in weeks' PMA as the starting point. Currently in the Netherlands this is still approximately 34 weeks. On the contrary, we should consider the individual infant, for instance with the help of EFS, to determine whether it is ready to start feeding orally. Policy with regards to setting up the oral feeding schedule should be adjusted to suit the individual skill of the infant.

In this study we investigated the development of sucking patterns. It would be interesting to examine the relation between our data on the development of sucking patterns and the motor, cognitive, oral-motor, and articulatory development at the age of two and five years. Possibly the development of sucking patterns of preterm infants has predictive value, as the outcome of a number of studies leads us to suspect 25-27.

In conclusion, the studies reported on in this thesis strengthen our opinion that also as far as the development of sucking patterns is concerned preterm infants differ from fullterms. Preterms should be given time to develop their sucking skills. SGA preterm infants and very preterm infants, especially those with a BPD, require extra attention with regard to when to start oral feeding and how to set up oral feeding schedules. Close collaboration between the paediatric nurse and the speech therapist is of the utmost importance for this group of infants.

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