REDUCING PAINFUL EXPERIENCES IN NEONATES DURING ROUTINE MINOR PROCEDURES IN SPECIAL CARE NURSERY: A QUALITY IMPROVEMENT PROJECT

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Abstract

Neonates in Special Care Nursery (SCN) are constantly exposed to routine procedures that are painful. Repetitive painful exposures in neonates are known to have long-term deleterious effects that may surpass adulthood. A quality improvement project was designed to reduce the pain experienced by neonates during routine minor procedures in SCN unit of Hospital Tuanku Fauziah (HTF), a tertiary state hospital in Perlis, Malaysia. The Neonatal Infant Pain Scale (NIPS) was used as a pain assessment tool in neonates throughout the study. Several factors contributing to neonatal painful experience during routine procedures were identified, including poor awareness on neonatal pain perception, poor procedural etiquette among paediatric house officers, and lack of non-pharmacological pain relief used during the procedures. Interventional measures included adjunctive use of non-nutritive sucking via orthodontic Avent® pacifier, use of adjustable swaddling blanket via SwaddleMe® size S, and introduction of a clinical training module for the house officers. There were 159 neonates recruited in the pre-intervention period and 163 neonates evaluated in the post-intervention period. Our study revealed a significant decrease in neonatal painful experience during routine procedures, from 49.7% to 17.8% (p<0.001), exceeding the standard set at 20%. This comprehensive strategy of multimodal interventional measures effectively reduced pain perception in neonates during routine minor procedures in SCN, fostering the development of a local procedural guideline to ensure continuous good healthcare services in neonates.

KEYWORDS: Paediatrics, neonates, pain, quality improvement, patient-centred care.

Problem

Neonatal hospital care is divided into Neonatal Intensive Care Units (NICUs) and Special Care Nurseries (SCNs), based on the level of care and medical attention required. Most NICUs worldwide practise procedural guidelines to prevent or minimise pain, particularly during invasive procedures, such as endotracheal intubation, endotracheal suctioning and ocular examination (1). However, little attention is given to the more stable neonates who are subjected to painful routine minor procedures in SCN. Routine minor clinical procedures that cause pain in neonates include venepuncture, intravenous cannulation, heel prick, intramuscular vaccination, orogastric tube insertion and tape removal (2,3).

Hospital Tuanku Fauziah (HTF), Kangar, Perlis, Malaysia is a tertiary state hospital with major clinical specialties catering to a population of 260,000 people. Its SCN unit has a high turn-over frequency with its bed occupancy rate (BOR) reaching up to 140% in the year 2016. Our SCN unit is managed by a paediatrician in-charge, assisted by a dedicated ward sister. The managing clinical team comprises of between 15 to 20 health personnel at any particular time. A majority of the routine minor procedures in SCN including venepuncture and intravenous cannulation are commonly performed by the paediatric house officers, whereas the less common procedures such as orogastric tube insertion are performed by nurses.

A preliminary study conducted from November until December 2016 revealed that 49.7% of neonates in SCN HTF experienced pain during routine minor procedures. This highly prevalent problem became the focus of our study which aimed to reduce painful neonatal experience during routine minor procedures to less than 20% within a year. It is important to note that prior to this, there were no specific pain management guidelines for in-ward neonates in SCN, HTF. Routine monitoring or assessment of pain in neonates during the conduct of routine minor procedures was also not performed.

Background

The pain experienced by neonates during routine clinical procedure is a universal concern. This is evident in a published systematic review on the epidemiology of pain in neonates, which found that pharmacological and non-pharmacological interventions were rarely implemented to reduce pain in neonates prior to procedural conduct (4).

Improving pain management in neonates is not only an ethical expectation from parents, but also prevents future adverse outcomes caused by the repetitive painful stimuli. These include altered pain sensitivity, emotional and behavioral changes, and future learning disabilities (5) that may last into adulthood. Regardless of the duration of exposure in neonates, each repetitive painful exposure has a cumulative effect hence creates substantial developmental consequences including effects on their physiological maturity, brain microstructure and networks, as well as disturbances to their hypothalamic-pituitary-adrenal axis (5).

A number of procedural guidelines for pain relief in neonates during clinical procedures were developed to fit local and regional practices (1,6,7). A cross sectional study in 2008 found a modest increase in measures to prevent neonatal pain in the United Kingdom since a survey in 2000, but there was no pain guideline in nearly 25% of the neonatal units and no guidelines for routine painful procedures in the majority of neonatal hospital care (7). Lack of enforcement also rendered the guideline ineffective, as observed in a study involving eight Australian states and territories which found that only 39% of neonatal units implemented a procedural guideline to control pain in neonates during routine procedures (8).

Previous studies identified various factors proven to cause pain in neonates. At the same time, various effective methods of pain relief have been introduced and were clinically proven to provide comfort during procedural conduct, however, they are often underused (9,10). These include non-pharmacological relief and pharmacological interventions.

Lack of physical comfort during painful clinical procedures has been proven to cause pain in neonates during these events (11). Effective use of non-pharmacological methods including non-nutritive sucking, proper swaddling technique and facilitated tuck (11,12), and direct breastfeeding during procedural conduct (13) have been demonstrated to relieve pain in neonates.

Environmental noise has also been associated with negative developmental outcomes and stress in hospitalised infants (14). Hence a conducive environment (15) such as adequate lighting, good room ventilation and minimal ambient noise (16) has been shown to reduce pain perception in neonates during procedures.

Furthermore, lack of formal clinical training for paediatric interns who are the front-liners in the clinical field may contribute to clinical incompetency and lack of confidence in performing clinical procedures (17,18). This leads to a low procedure success rate, resulting in repetitive procedures.

It is also important to note that pharmacological pain relief in neonates has a definitive role during invasive procedures. A good example is oral sucrose 24% which is listed as a 'Grade A' recommendation for pain-relief in neonates during blood-taking by the Association of Paediatric Anaesthetist of Great Britain and Ireland (APA) (19). However, oral sucrose 24% is not listed in the Malaysia Book of Drug Formulary, hence is unavailable for use during routine procedures in most public hospitals.

Measurement

The general objective of this study was to reduce the percentage of neonatal painful experience during routine minor procedures in SCN to less than 20% within a year. The specific objectives included the identification of the contributing factors to painful experience during minor procedures in neonates, the implementation of improvement strategies, and subsequent evaluation of strategies' effectiveness. This study was conducted from November 2016 until November 2017.

Pain was the main parameter of our study assessment. We used the Neonatal Infant Pain Scale (NIPS) score, a multi-dimensional tool validated for use in neonates (20). NIPS is a composite measure that includes both physiological and behavioural cues, whereby a score of more than three (from a total score of 10) signifies pain (20). Thus, a reduction in the number of cases of NIPS score of more than three, constitutes an improvement.

Based on local consensus, a standard of less than 20% of neonates with painful experience during routine minor procedure in SCN HTF was set.

$$\textit{Percentage of neonates experiencing pain during minor procedures} = \frac{Number\ of\ neonates\ with\ NIPS > 3}{Number\ of\ neonates\ subjected\ to\ routine\ minor\ procedures} x\ 100\%$$

NIPS scoring was done during the routine minor procedures in SCN neonates, charted by independent house officers not primarily involved in the conduct of the procedure. Training programme on the use of NIPS and inter-rater consistencies among the house officers involved were assessed prior to the start of the study. The routine minor procedures included in the study were venepuncture, intravenous cannulation, orogastric tube insertion and tape removal.

Neonates from the Special Care Nursery (SCN) ward who were stable (i.e. neonates not needing supplementary oxygen therapy and not being treated for clinical sepsis), had gestational age of more than 37 completed weeks, had birth weight of 2,500 grams or more, were more than 24 hours of life and less than seven-day old and had good Apgar scores (defined as Apgar score of more than 7 at 1 minute and/or more than 8 at 5 minutes) were included in this study.

Neonates with possible altered pain sensitivity were excluded from this study, including (i) neonates who were given analgesia or sedation within five days of study entry, (ii) neonates with neurological symptoms (i.e. restlessness, seizure), (iii) syndromic babies, (iv) neonates with three or more prick marks at study entry, and (v) neonates with failed second procedural

attempt of venepuncture, intravenous cannulation or orogastric tube insertion.

During the two-month verification study phase (Phase I: November to December 2016), data on the prevalence of pain in neonates during minor procedures and its contributing factors were collected. These included information regarding the provision of non-pharmacological pain relief during procedural conduct, ability of paediatric interns to demonstrate proper swaddling technique using the conventional swaddling blanket, interns' procedural etiquette, their theoretical performance in objective assessment of good pain management, and their knowledge on procedural conduct in neonates during routine minor procedures. These parameters were re-evaluated during Phase II from April to May 2017 to appraise the effectiveness of the interventional strategies.

The analyses were performed using IBM Statistical Package for Social Sciences (SPSS) version 20.0 for Windows. Descriptive statistics were used for selected variables. The results were presented as frequencies and percentage for categorical data while Pearson chi-square test of independence was used to study significant differences between pre-intervention and post-intervention in each study category.

Initial Assessment of the Problem

The process of care related to the conduct of routine minor procedures in SCN neonates was outlined in Figure 1, and the critical steps that may aid in reducing the percentage of neonatal painful experience during routine minor procedures were marked with double asterisks (**).

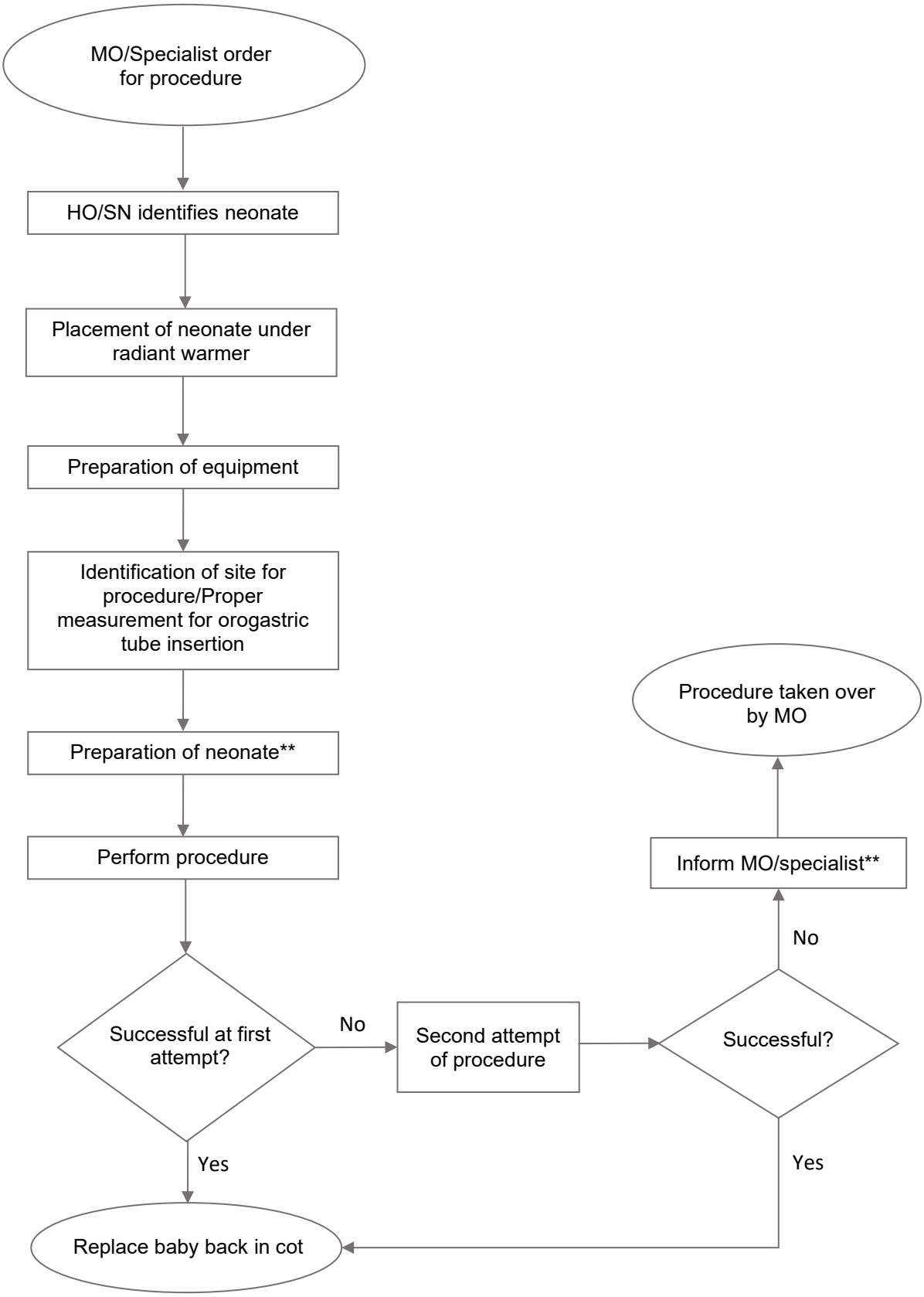
In the verification study, we assessed 159 neonates during routine minor procedures. We found that venepuncture was the most commonly performed routine minor procedures (n=102, 64.2%) in SCN, followed by intravenous cannulation (n=25, 15.7%), tape removal (n=29, 18.2%) and orogastric tube insertion (n=3, 1.9%). We found that up to 49.7% (n=79) of the neonates experienced pain during the conduct of routine minor procedures, predominantly contributed by venepuncture (n=56, 70.9%) followed by intravenous cannulation (n=15, 19.0%). Further analysis found that approximately 60% (n=91) of neonates in SCN, HTF were not given any form of pain relief during the conduct of routine minor procedures. At a more fundamental level, there was no standardised local or national guideline used for pain management in neonates during routine minor procedures in SCN, HTF. Prior to this quality improvement project, there was no formal training on this matter for paediatric interns prior to their rotation in neonatal wards.

A detailed analysis to delineate the contributing factors to neonatal painful experience during routine minor procedures showed that up to 80% (n=16) of paediatric interns in SCN rotation were unable to demonstrate correct swaddling technique using a conventional hospital swaddling blanket. Furthermore, during the basic theoretical assessment of good pain relief in neonates, 90% (n=18) of the paediatric interns failed to get the minimum required score. About 80% of the interns also did not use any form of non-pharmacological modalities to reduce pain during the procedures.

In a separate assessment among 80 neonates requiring venepuncture or intravenous cannulation, we found that 35% (n=28) of neonates were subjected to multiple pricks of three times and above without medical officer or specialist in-charge being informed.

Strategy

Our intervention strategies were planned to address the issue of pain in neonates during routine clinical procedures including the preparation of neonates prior to procedural conduct which includes identifying the correct neonate for procedure, placing the neonate under pre-heated radiant warmer, preparation of the equipment, and identifying the site for procedural conduct. This also included (i) enforcement of non-pharmacological pain relief usage during the conduct of routine



HO: House Officer *MO: Medical Officer* *SN: Staff Nurse*
*** Critical Steps*

Figure 1: Flow-chart of process of care for the performance of routine minor procedures in SCN

minor procedures and (ii) training and privileging programme for the paediatric interns, which aimed to increase competency by providing formal hands-on workshop for the house officers prior to their SCN/NICU rotation.

Non-pharmacological pain relief during the conduct of routine minor procedures included adopting the use of non-nutritive sucking via an orthodontic Avent® pacifier and using a standardised swaddling technique via the SwaddleMe® blanket Size S. The insertion of orogastric tube precluded the use of pacifier. The use of pacifier was strictly during the routine procedures in SCN only, in accordance with our policy and status as a baby-friendly hospital since 1997.

The training and privileging programme for paediatric interns were constructed as a half-day hands-on workshop, made mandatory for all paediatric interns prior to their neonatal ward rotation. The workshop included a lecture session delivered by a dedicated paediatrician, aiming to create awareness on pain perception in neonates and the deleterious effects of long-term neonatal pain exposure. The lecture concluded with a theoretical examination consisting of 15 true or false questions evaluating the basic knowledge, clinical skills and knowledge on non-pharmacological pain relief in neonates (Appendix 1). A passing mark of at least 80% from the theoretical examination would enable the paediatric interns to proceed to the practical session. A repeat session was planned should the paediatric interns fail to attain the minimum required scores.

The practical, hands-on session was conducted by paediatric registrars and/or paediatricians in a 1:5 ratio to the paediatric interns. During this hands-on session, a formal training was conducted on basic clinical skills in performing venepuncture, intravenous cannulation, orogastric tube insertion and tape removal. The rationale of the swaddling blanket and non-nutritive sucking use was highlighted and proper technique was demonstrated during the practical session.

The interventional strategies were carried out over a two-month period and paediatric interns were required to undergo the privileging programme at least once during their rotation in Department of Paediatrics, HTF.

Results

Our post-intervention study successfully recruited 163 neonates over a two-month duration. Venepuncture was the most commonly performed routine minor procedure (n=110, 67.5%), followed by intravenous cannulation (n=20, 12.3%), tape removal (n=32, 19.6%) and orogastric tube insertion (n=1, 0.6%).

The intervention programme revealed a significant reduction of neonatal painful experience during routine minor procedures from 49.7% to 17.8%, χ^2 (df=1, n=159) = 35.918, p<0.001, a surplus from the standard set of 20%, as observed in Table 1.

Following our interventional strategies, 100% of our paediatric interns (n=20) were able to perform correct swaddling technique using the SwaddleMe® Size S and 85% (n=17) of them passed the theoretical examination in their first attempt following the clinical training programme. The remaining interns required a repeat session and passed during the second evaluation.

A detailed analysis on the different types of procedures revealed a statistically significant reduction in neonatal painful experience during routine venepuncture, χ^2 (df=1, n=102) = 23.041, p<0.001, but not in the intravenous cannulation and the tape removal groups, as shown in Table 2. Due to the limited sample size, insertion of orogastric tube was not included in the detailed analysis.

Lessons and Limitations

Our study provided robust local data that solely using a non-pharmacological method is effective in reducing pain in neonates during routine minor procedures, in agreement to other experimental studies (16,21). Our study, however showed that venepuncture was the only procedure that was significantly affected through the interventional strategies. The statistically insignificant changes observed in the

Table 1. Differences in overall pain reduction pre- and post-intervention.

	No Pain	Pain	*p*-value
Pre-intervention	80 (50.3%)	79 (49.7%)	0.001*
Post-intervention	134 (82.2%)	29 (17.8%)	

Pearson chi-square test of independence.
**Statistically significant.*

Table 2. Differences in pain reduction based on different types of procedures.

		No Pain	Pain	*p*-value
Venepuncture	Pre-intervention	46 (45.1%)	56 (54.9%)	<0.001[a]*
	Post-intervention	88 (80.0%)	22 (20.0%)	
Intravenous cannulation	Pre-intervention	10 (40.0%)	15 (60%)	0.526[b]
	Post-intervention	18 (85.7%)	3 (14.3%)	
Tape removal	Pre-intervention	22 (75.9%)	7 (24.1%)	0.001[b]
	Post-intervention	28 (87.5%)	4 (12.5%)	

[a]*Pearson chi-square test of independence.*
[b]*Fisher exact test.*
**Statistically significant*

intravenous cannulation and the tape removal groups may have been contributed by the small sample size.

Additionally, in view of the high turn-over rate of paediatric interns and their sporadic intake schedule, the training and privileging programme for the paediatric interns need to be organised more frequently. However, there was only one paediatrician and three paediatric registrars who were primarily involved with the training session, making understaffing an initial issue for us. Therefore, we re-shuffled the clinical rotation and distributed the workload evenly among all paediatricians, registrars and senior medical officers in the department who were involved in conducting the training session for the house officers.

Apart from that, as only a minimal financial expenditure was needed to cover the cost of 24 swaddling blankets and 24 orthodontic pacifiers with an overall sum of MYR 1,000, the items were personally funded by the team of study associates. The investment was considered necessary and justifiable in view of long-term use of the materials and their significant role in providing our patients with excellent care services.

Conclusion and the Next Steps

Significant improvement in the reduction of painful experiences in neonates during routine minor procedures in SCN was achieved following this quality improvement project. The success of our interventional programme prompted the development of a local procedural guideline to be implemented during routine minor procedures in neonatal SCN. The guideline incorporates the interventional strategies adopted in this study, including proper swaddling technique and non-nutritive sucking as the non-pharmacological methods of pain relief in neonates during routine minor procedures (Appendix 2).

Our intervention programme can be adopted by other healthcare facilities to improve the quality of care in the management of neonates. The training module for the paediatric interns may be expanded to involve the staff nurses and should be regularly organised to ensure continuous good practice and sustenance of knowledge and enforcement.

The policy changes regarding the implementation of the guideline when managing neonates in SCN during routine procedures are currently undergoing local institutional assessment for long-term feasibility. We aim to promote the use of a standardised modified swaddling blanket to ensure that proper swaddling technique is continuously practised. We are currently collaborating with local tertiary institutions majoring in tailoring and fashion industry to improvise the existing hospital conventional swaddling blanket to create an adjustable blanket that is easier to use, effective and time-saving. Should the collaborative effort produce fruitful results, healthcare policy changes may be proposed to the higher level in using an improvised, adjustable swaddling blanket to ensure proper swaddling technique is practised throughout neonatal centres nationwide.

In the future, we aim to involve other categories of neonates in our project, such as premature babies who are known to be more sensitive towards pain and stress. We also aim to include other routine painful procedures, including heel-prick testing for glucose monitoring and intramuscular vaccinations. Incorporation of pharmacological methods may also be feasible with adequate funding in the future.

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Conflict of Interest

The authors have no conflict of interest to disclose.

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Appendix 1

ASSESSMENT FOR PAEDIATRICS HOUSE OFFICERS

PAEDIATRICS DEPARTMENT

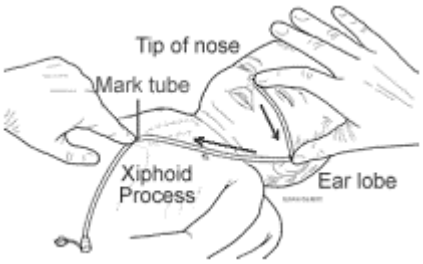
HOSPITAL TUANKU FAUZIAH, KANGAR, PERLIS

Name: _____ Date: _____

Please encircle your answer

PART I: CLINICAL PROCEDURE TECHNIQUES

1. This is the correct way to measure approximate length of Ryle's tube prior insertion T/F



2. 24-G intravenous cannula is purple in colour T/F
3. Drop method is commonly used when withdrawing blood in paediatrics setting T/F
4. Applying alcohol swab must be followed by air-dry for 10 seconds to ensure proper disinfectant T/F
5. The vein must be visualized before a needle is pricked into the skin T/F

PART II: PAIN RELIEF MODALITIES DURING ROUTINE MINOR PROCEDURES

6. Neonates nervous system is underdeveloped that renders them incapable to perceive pain T/F
7. Non-nutritive sucking is an effective, non-pharmacological method of pain relief in neonates T/F
8. Improper swaddling technique adds risk to the development of hip dysplasia T/F
9. Minor procedure can cause pain in neonates T/F
10. Neonatal pain has long-term adverse effects T/F
11. Neonates are more sensitive to pain than older children and adults T/F
12. Pharmacologic/non-pharmacologic interventions are necessary even though many procedures can be completed quickly. T/F
13. Parents are emotionally affected by the pain their infant may be experiencing T/F
14. Parents should be involved with the care and comfort of their infant during painful procedures T/F
15. Non-pharmacological pain management is effective in neonatal pain management. T/F

Appendix 2

STEP-BY-STEP PROTOCOL FOR PAIN MANAGEMENT IN NEONATES DURING ROUTINE MINOR PROCEDURE IN SCN

Pre-heat radiant warmer in servo-controlled baby mode



Place the opened SwaddleMe® blanket under the radiant warmer in T-shape.
Place neonate on the blanket. Identify which limb to be used in procedure.
Attach SpO_2 probe to any free limb (not used in procedure).



Tuck baby legs inside the pouch.
Align baby shoulders with the top of open wrap. Leave out the limb that will be used in the procedure.



Keep the elbow extended, forearm pronated and shoulder adducted.
Wrap the left wing over baby's torso and tuck around baby's opposite arm.
Open fabric patch on the underside of the left wing and secure Velcro to top of leg pouch



Place right wing over left and secure opened Velcro tabs to fabric patch on left wing.
The wings should be snug, not tight, over baby's chest



Allow baby to suck on Avent® orthodontic pacifier for 1-2 minutes
Make sure the baseline HR and SpO2 is achieved before starting the procedure

Upon completion of procedure:

- Gently remove the blanket
- Gently tuck away pacifier

Pacifier is cleaned with specialized liquid cleanser and rinsed dry
Place the dried pacifier in the dedicated bag
Blanket is kept clean, folded and kept in the specialized compartment

- Dirty blanket (i.e. from feces, milk curds) will be put away for proper cleaning
- Blanket will be used up to three consecutive babies and will be put aside for cleaning

Place baby back in designated cot