

Original Article

Term Admissions to Neonatal Intensive Care Unit: a Maltese observational study

Rebecca Borg, Martha Ann Dimech, Sarah Xuereb, Yves Muscat Baron

Abstract

Objective: This study aimed to identify the number of term infants admitted to the Maltese Neonatal and Paediatric Intensive Care Unit (NPICU) between January and June 2016, as well as factors contributing to their admission.

Methods: All term infants (37+ weeks gestation) born between January-June 2016, transferred from Central Delivery Suite or Obstetric Wards to NPICU were identified. Patient registers, electronic case summaries, and the National Obstetric Information System (NOIS) database were used, with approval from the Data Protection Office, to collect data for a retrospective case control study.

Results: Of the term infants born in these 6 months, 5.2% (101) were admitted to NPICU resulting in 42.6% of all admissions. The mean gestational age was 39 weeks (95% CI 38.8, 39.3) and mean birth weight was 3.3kg (95% CI 3.2, 3.4). More than half had been born by elective and emergency Caesarean section (26% and 27% respectively). Commonest reason for admission was respiratory distress (37%). Others included non-bilious vomiting (20%), congenital abnormalities (13%), hyperbilirubinaemia (8%), and infection (4%). Statistically significant factors associated with admission were operative delivery, threatened miscarriage and maternal infection during pregnancy, maternal insulin dependent diabetes mellitus, and low Apgar scores.

Conclusion: The significant contributing factors should be targeted and further evaluation over a longer time-frame with an interdisciplinary team carried out in an effort to reduce rate of admissions and improve quality of care.

Keywords

Infant, Newborn, Term Birth, Intensive Care, Neonatal, Malta, Case-Control Studies

Introduction

The Neonatal and Paediatric Intensive Care Unit at Mater Dei Hospital (NPICU) in Malta, provides highly specialised care to ill term or preterm newborns as well as children up to three years of age. It provides complex nutritional and respiratory support, cardiorespiratory monitoring, as well as more focused nursing care. Whilst admissions to neonatal intensive care are generally thought of in the context of prematurity or congenital abnormalities, international literature suggests that admission of term neonates (born at 37 weeks of gestation or more) to these units, though unexpected, is not a rare occurrence.¹⁻⁵ This level of care is costly and leads to separation of the infants from their mother and family in the important early moments of life. Such admissions

Rebecca Borg MD(Melit)*

Department of Child and Adolescent Health,
Mater Dei Hospital,
Msida, Malta
rebecca.c.borg@gov.mt

Martha Ann Dimech MD(Melit)

Accident and Emergency Department,
Royal Berkshire NHS Foundation Trust,
Reading, UK

Sarah Xuereb MD(Melit)

Malta Foundation School,
Mater Dei Hospital,
Msida, Malta

Yves Muscat Baron FRCOG (Lond) FRCP (Irel) PhD (UK)

Department of Obstetrics and Gynaecology,
Mater Dei Hospital,
Msida, Malta

*Corresponding Author

can therefore be considered as adverse perinatal outcomes and require additional investigation.⁶

The objective of our study was to determine the number of term infants admitted to NPICU within a specific time-frame, as well as identify factors contributing to their admission. This could guide strategies which aim to reduce admissions of term infants and their length of stay in NPICU. The end result would be an improved family experience, by decreasing the period of separation between the newborns and their family unit, and an overall reduction in the burden on our healthcare system.

Methods

All term neonates (born at 37 weeks of gestation or more) born between January 2016 and June 2016, who were transferred from either the Central Delivery Suite or the obstetric wards to the NPICU, were identified. Patient registers, electronic case summaries, and the National Obstetric Information System (NOIS) database were used in order to collect data for a retrospective case control study. This included maternal demographic data, comorbidities, social and obstetric history, mode of delivery and neonatal factors such as birth weight, gestational age and reason for admission. Term infants born between January 2016 and June 2016 that were not admitted to NPICU were taken as controls. Fisher's exact test, Chi-square test, and unpaired *t* test (with a *p*-value of <0.05 taken to represent significance) were used to determine statistically significant associations between the collected factors and admission to NPICU. Approval was obtained from the Data Protection Office.

Results

A total of 2110 births were recorded during the selected 6-month period. Of these, 1935 were term infants. 101 (5.2%) of these term births were admitted to NPICU, resulting in 42.6% of all admissions (*n*=237) and 55.2% of neonatal admissions (*n*=183).

Of the 101 term admissions, 60 (59.4%) were male and 41 (40.6%) were female. 20 (19.8%) were non-Maltese. The mean gestational age was 39 weeks (95% CI 38.815, 39.284) and mean birth weight was 3.3kg (95% CI 3.196, 3.403). Mean length of stay was 8.8 days (95% CI 7.603, 10.060).

Mean maternal age was 29.5 years (95% CI 28.488, 30.502). 8 mothers (7.9%) were Rhesus

negative. 60 (59.4%) were primiparous, 35 (34.7%) were multiparous, and 6 (5.9%) had an unknown parity.

Labour onset was spontaneous in 44 mothers (43.6%), induced in 21 (20.8%), via Caesarean section in 30 (29.7%), and unrecorded in 6 mothers (5.9%). More than half of these term neonates had been born by elective and emergency Caesarean section (*n*=26, 25.7% and *n*=27, 26.7% respectively). The rest were born via normal vaginal delivery (*n*=41, 41.6%) and by ventouse-assisted vaginal delivery (*n*=7, 6.9%). 92 neonates (91.1%) were born in the cephalic presentation, 6 (5.9%) in the breech presentation, and in 3 (3.0%) presentation was unknown. 28 neonates (27.7%) were transferred from the Central Delivery Suite, while 19 (18.8%) were transferred from the obstetric wards. Source of transfer was unrecorded for the other 54 neonates (53.5%).

The various reasons for admission are shown as a percentage of the total term admissions in Figure 1. The 'Other' category comprised reasons such as neonatal abstinence syndrome, bradycardia, hypotonia, and hypoglycaemia.

Statistically significant factors associated with admission of term infants to NPICU are shown in Table 1. Table 2 shows the factors for which no significant association with admission to NPICU was found.

Figure 1: Reason for Admission to NPICU

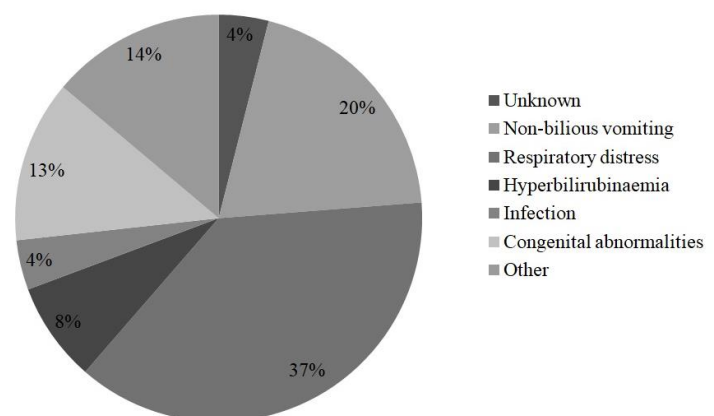


Table 1: Statistically significant factors associated with NPICU admission

| Contributing factor | p-value | Odds Ratio | 95% CI |
|-------------------------|---------|------------|---------------|
| Operative delivery | <0.001 | 2.865 | 1.904, 4.313 |
| Threatened abortion | 0.014 | 2.621 | 1.266, 5.424 |
| Maternal infection | 0.042 | 1.943 | 1.034, 3.652 |
| Maternal IDDM* | 0.035 | 9.242 | 1.672, 51.091 |
| Low Apgar at 1 minute* | <0.001 | 7.100 | 4.137, 12.187 |
| Low Apgar at 5 minutes* | <0.001 | 15.429 | 5.620, 42.359 |

*IDDM = insulin dependent diabetes mellitus; Low Apgar = score 0-6

Table 2: Non-statistically significant factors potentially contributing to admission

| Contributing factor | p-value | Odds Ratio | 95% CI |
|--|---------|------------|----------------|
| Infant demographics | | | |
| Male | 0.183 | 1.335 | 0.888, 2.007 |
| Non-Maltese | 1.000 | 1.007 | 0.609, 1.666 |
| Gestational age | 0.440 | - | - |
| Birth weight | 0.894 | - | - |
| Maternal demographics | | | |
| Maternal age | 0.274 | - | - |
| Mother's education | 0.404 | - | - |
| Mother's height | 0.831 | - | - |
| Mother's weight at delivery | 0.501 | - | - |
| Mother's weight before pregnancy | 0.204 | - | - |
| Obstetric risk factors | | | |
| Maternal smoking | 0.320 | 1.440 | 0.732, 2.835 |
| Maternal alcohol use | 0.102 | 18.330 | 1.137, 295.400 |
| Maternal drug use | 0.062 | 6.148 | 1.225, 30.864 |
| Maternal cardiovascular disease | 1.000 | 1.059 | 0.061, 18.481 |
| Maternal NIDDM | 1.000 | 6.021 | 0.244, 148.850 |
| Artificial reproductive therapy | 0.118 | 2.208 | 0.924, 5.275 |
| Gestational age at first antenatal visit | 0.728 | - | - |
| Gestational hypertension | 0.339 | 1.478 | 0.666, 3.280 |
| Pre-eclampsia | 0.313 | 3.047 | 0.363, 25.562 |
| Gestational diabetes | 0.254 | 1.624 | 0.636, 4.145 |
| Suspected IUGR | 0.767 | 0.630 | 0.152, 2.618 |
| Twin delivery | 0.489 | 1.373 | 0.417, 4.518 |
| Antepartum haemorrhage | 1.000 | 1.200 | 0.068, 21.178 |
| Placenta praevia | 1.000 | 1.069 | 0.141, 8.116 |
| Placental abruption | 0.102 | 18.330 | 1.137, 295.400 |
| Threatened labour | 1.000 | 0.781 | 0.046, 13.358 |

Discussion

In February 2017 NHS Improvement issued a resource pack and patient safety alert⁶⁻⁷ to support safer care for full-term babies by reducing harm leading to their avoidable admission into neonatal units. This was in reaction to observed increasing rates of admission of term infants to intensive care (a 24% increase between 2011 and 2014), despite a downward trend in term live births (a decline of 3.6% between 2011 and 2014).⁶ Unexpected admission of a term neonate to intensive care can be said to be a sign of preventable harm that may have occurred during the antenatal, intrapartum, or post-natal period. Admission to neonatal intensive care means separation of the infant from the mother which can lead to difficulties with breast feeding and bonding, as well as have a negative effect on maternal mental health.⁸ It also increases the burden on a healthcare system⁶ in terms of bed availability, economic cost, and staff to patient ratios. Keeping mother and baby together is therefore a case of getting it right from the start since it improves health outcomes for both in the short and long term.^{6,9}

Using a 2-sample z-test, the local rate of term admissions to intensive care of 42.6% for the 6 month period studied was found to be lower than the rates for England in 2011, 2012, and 2013 (56.6%, 58.3%, and 59.8% respectively, $p < 0.001$).¹⁰ However, since the Maltese unit is both a neonatal and paediatric intensive care unit, catering for children up to three years of age, this rate of 42.6%, though reflecting the local burden on the unit, cannot be used to compare with rates in the UK which take into account only admissions to a neonatal unit. Indeed the rate of 55.2% which represents the term admissions as a percentage of only neonatal admissions is comparable to the rates in England between 2011 and 2013 ($p = 0.705$, $p = 0.397$, $p = 0.203$ respectively). It is also important to point out that in Malta, when compared to the UK, access to a neonatal unit might relatively be easier, there being only one general hospital and one unit in the same hospital catering for the whole population.

The commonest reason for admission in the studied 6 month period was respiratory distress, accounting for 37.6% of admissions. Respiratory distress was also the commonest reason for admission of term infants in the UK with 25% of admissions having this listed as their main reason

for admission.⁶ A quarter of these respiratory distress admissions in both Malta and the UK had been delivered by elective Caesarean section.⁶ The risk of respiratory morbidity is known to be increased in babies born by Caesarean section before labour, but this risk is decreased if elective Caesarean section is performed after 39 weeks.¹¹ Thus NICE guidance recommends that elective Caesarean section is not performed prior to 39 weeks.¹²

Admission due to non-bilious vomiting was also another important reason for admission locally, at 19.8% of all term admissions. Non-bilious vomiting may indicate a primarily feeding problem, ranging from normal variation to overfeeding, to gastro-oesophageal reflux disease. Further evaluation of such admissions to determine what management was required would be necessary to properly classify the reason for admission.

The 12.9% admitted due to congenital anomalies can be said to be expected admissions to intensive care. There was no data regarding the severity and type of congenital anomaly, and whether this had been diagnosed antenatally and if admission had been planned beforehand.

Admissions for hyperbilirubinaemia accounted for 7.9% of term admission to the intensive care unit. Other term neonates with hyperbilirubinaemia would have been admitted to the general paediatric wards if less aggressive management was deemed necessary. This is an example of where a transitional care model can be applied. Admission for the indicated medical care may be necessary and unavoidable. However certain services may be provided outside the neonatal unit in a transitional care model where the mother is resident with her child and plays a role in providing care.⁶ Transitional care, apart from providing an alternative setting for admission, may also lead to earlier discharge from the intensive care unit, acting as a bridge prior to definite discharge home.

4% of admissions were reported to be due to infection. However, other commoner reasons for admission, such as respiratory distress or non-bilious vomiting, could have very well been the first sign of sepsis, and thus this could be an under-estimation. Classifying admissions according to diagnosis on discharge may be more indicative of the true reason why the neonate needed admission to the unit. On the other hand using the recorded reason on admission demonstrates which presenting

symptoms are causing term neonates to be admitted in the first place.

Hypoglycaemia was the third commonest cause for admission in the UK⁶, but in Malta only 2 out of the 101 term admissions had hypoglycaemia recorded as their principal reason for admission. Hypoglycaemia could have been present but not regarded as the main reason for admission, thus leading to its under-estimation.

In the case-control part of our study various possible contributing factors were assessed to determine whether there was a significant association with admission to NPICU. Operative delivery, including emergency and elective Caesarean section and instrumental delivery, was found to be significantly associated with admission to the neonatal unit. This could be interpreted as babies who are born by Caesarean section or by an assisted delivery are more likely to be admitted to intensive care. However whether this is due to the mode of delivery itself or the underlying reason for the need of an operative delivery (such as foetal distress leading to emergency Caesarean section) is not clear.

Threatened miscarriage during pregnancy, presenting mostly as vaginal bleeding during pregnancy, was also found to be significantly associated with admission to NPICU. This has also been demonstrated in studies elsewhere.¹³⁻¹⁴

The category maternal infection during pregnancy in our study included hepatitis C positive mothers, vaginal infections, urinary tract infections, and vulval warts. However in our study, the 2 mothers that were hepatitis C positive were ex-intravenous drug users on methadone and their babies were admitted to NPICU due to neonatal abstinence syndrome rather than due to signs of sepsis.

Type 1 diabetes in mothers was also found to be associated with admission to neonatal intensive care. Infants of diabetic mothers can be macrosomic or small for gestational age, are at an increased risk of neonatal hypoglycaemia, polycythaemia, respiratory distress syndrome, and congenital anomalies. Interestingly however, no significance was found for association between non-insulin dependent diabetes or gestational diabetes and admission to NPICU. Since pregnancy is itself diabetogenic, it may be an additional challenge for glucose control in insulin dependent diabetics as insulin requirements will change.

Low Apgar scores indicate inappropriate adaptation to extra-uterine life, and thus admission to NPICU may be said to be expected in such cases. A low Apgar score may therefore alert the clinician to a possibly at risk neonate.

With regards to the other possible contributing factors assessed, significance may have not been achieved due to the small numbers used in the study. No cases of eclampsia in either the cases or controls were reported and this could be due to both the study's small sample size as well as its short time-frame. Other limitations include incomplete medical record-keeping in the patient registers from which the raw data was collected, and confounding variables which might not have been taken into account. Such limitations lead to the recall bias commonly attributed to retrospective studies as well as the inability to predict whether admission of term infants to NPICU was in fact preceded by exposure to a risk factor. The first step in overcoming these limitations is the introduction of an electronic database in order to ensure standardisation of accurate and timely data compilation.

The above results have been communicated to the relevant stakeholders at various departmental meetings. Increasing staff awareness and providing tools for training and education is essential to bring about quality improvement. Health Education England (Wessex) for example have commissioned a multi-disciplinary interactive eLearning resource and the British Association of Perinatal Medicine (BAPM) has proposed the Newborn Early Warning Trigger and Track (NEWTT) charts as an early warning score system for neonates.¹⁵⁻¹⁶ An effort towards improving all aspects of antenatal, intrapartum, and postnatal care is necessary and this would require an inter-disciplinary approach with good communication between the different healthcare professionals taking care of both mother and baby.

In order to be able to put all this into practice a targeted working group, made up of a multidisciplinary team involving obstetricians, midwives, neonatal nurses, neonatologists, and paediatricians, is being suggested. Such a working group could review admissions case by case and thus determine what care was provided, what the diagnosis at discharge was, whether admission was justified in retrospect, and whether an alternative setting of admission could have been possible, amongst other aspects. Such an evaluation over a

longer time frame may guide the setting up of specific local guidelines (such as guidelines on criteria for admission to NPICU) and the implementation of practical strategies to improve neonatal care.

This study has identified a considerable number of term admissions to NPICU during the stipulated time period, highlighting respiratory distress as the most common cause of admission. Several factors have been described which have been found to contribute towards these admissions, including operative delivery, threatened miscarriage, maternal infection, and maternal IDDM. It is advised that a working group is set up which can eventually use this information to suggest practical strategies which will minimise term admissions to NPICU. This will result in keeping mother and baby together, proven to improve health outcomes in the short and long term for both, as well as alleviate some of the burden on our healthcare system.

Acknowledgments

The authors would like to thank Dr Neville Calleja from the Directorate for Health Information and Research (DHIR) Malta for help with the statistical analysis and Dr Miriam Gatt from NOIS for the data provided.

References

1. Granger C, Okpapi A, Peters C, Campbell M. PA.48 Expected and Unexpected Term Admissions to Neonatal Intensive Care (NICU). *Arch Dis Child Fetal Neonatal Ed* 2014;99:A32.
2. Harrison W, Goodman D. Epidemiologic Trends in Neonatal Intensive Care, 2007-2012. *JAMA Pediatr* 2015;169:855-62.
3. Ram Mohan A, Chawda N, Misra I. Term Admissions to the Neonatal Unit; Are They Avoidable? *Arch Dis Child Fetal Neonatal Ed* 2013;98:A17-A18.
4. Thankappen RA, Chetcuti Ganado C. Unexpected term admissions to the neonatal unit: Can the burden be reduced? *Arch Dis Child Fetal Neonatal Ed* 2014;99:A56.
5. Tracy SK, Tracy MB, Sullivan E. Admission of term infants to neonatal intensive care: a population-based study. *Birth* 2007;34:301-7.
6. NHS Improvement. Reducing harm leading to avoidable admission of full-term babies to neonatal units. London: NHS Improvement, 2017.
7. NHS Improvement. Patient Safety Alert: Resources to support safer care for full-term babies. London: NHS Improvement, 2017.
8. Crenshaw JT. Healthy Birth Practice #6: Keep Mother and Baby Together— It's Best for Mother, Baby, and Breastfeeding. *J Perinat Educ* 2014;23:211-7.
9. Crenshaw JT. Care Practice #6: No Separation of Mother and Baby, With Unlimited Opportunities for Breastfeeding. *J Perinat Educ* 2007;16:39-43.
10. Attrell V. Insight into a Network approach to ATAIN: action plan to reduce term admissions. [Presentation] How to Reduce your Neonatal Term Admissions. 17th May 2017.
11. Morrison JJ, Rennie JM, Milton PJ. Neonatal respiratory morbidity and mode of delivery at term: influence of timing of elective caesarean section. *Br J Obstet Gynaecol* 1995;102:101-6.
12. National Institute for Health and Care Excellence. Caesarean section (NICE guidelines CG132). London: National Institute for Health and Care Excellence, 2011.
13. Nagy S, Bush M, Stone J, Lapinski RH, Gardó S. Clinical significance of subchorionic and retroplacental hematomas detected in the first trimester of pregnancy. *Obstet Gynecol* 2003;102:94-100.
14. Petriglia G, Palaia I, Musella A, Marchetti C, Antonilli M, Brunelli R, et al. Threatened abortion and late-pregnancy complications: a case-control study and review of literature. *Minerva Ginecol* 2015;67:491-7.
15. NHS Health Education England. Reducing Avoidable Term Admissions. Available from: <https://hee.nhs.uk/hee-your-area/wessex/our-work/research-innovation/elearning/mobile-learning/reducing-avoidable-term-admissions> [Accessed 8th October 2017].
16. British Association of Perinatal Medicine. Newborn Early Warning Trigger & Track (NEWTT) - a Framework for Practice. Available from: <https://www.bapm.org/resources/newborn-early-warning-trigger-track-newtt-framework-practice> [Accessed 8th October 2017].