Neonatal outcome in the United Arab Emirates: the effect of changes in resources and practices

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الآثار المترتبة على تحسين خدمات رعاية الولدان في الإمارات العربية المتحدة: تأثير التغييرات في الموارد والممارسات

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الخلاصة: تم إدخال بعض التحسينات الانتقائية في موارد وممارسات رعاية الولدان ما بين عامي 1992 و1994 (الفترة الأولى) وعامي 1995 و1998 (الفترة الثانية)، وذلك في أعقاب مراجعة عامة لخدمات رعاية الولدان في الإمارات العربية المتحدة. وقد قام الباحثون بتقييم تأثير هذه التغييرات على معدل وفيات الولدان، ومعدلات الوفيات المرتبطة بالوزن عند الولادة، وأسباب الوفاة. وقد حدث بصورة عامة تراجُعٌ بنسبة 17٪ في معدل وفيات الولدان في ما بين الفترة الأولى والفترة الثانية، كما انخفضت معدَّلات الوفيات في الولدان الذين كان وزنهم عند الولادة أقل من 1000 غرام وأكثر من 2500 غرام وذلك بنسبة 36٪ و35٪ على التوالي، في ما بين الفترة الأولى والفترة الثانية. وحدث أيضاً، تراجُعٌ طفيف في حالات الوفاة بسبب الاختناق، والانتان والمضاعفات الناتجة عن الولادة المبتَسَرة في ما بين الفترة الأولى والفترة الثانية، إلا أن الفروقات لم تكن مما يُعْتَدُّ به إحصائياً. ويرى الباحثون أن مراجعة خدمات رعاية الولدان هي الأداة التي يمكن من خلالها تحديد المجالات التي تحتاج إلى تحسين، كما يجب أن تركز المراجعة المستمرة لخدمات رعاية الولدان على المجالات الأخرى التي ينبغي التعرض لها لتحقيق رعاية أفضل وحدوث مزيد من التراجُعات في معدلات وفيات الولدان.

ABSTRACT Selective improvements in neonatal care resources and practices were instituted between 1992/1994 (period 1) and 1995/1998 (period 2) following a neonatal audit in the United Arab Emirates. We evaluated the effect of these changes on neonatal mortality rate (NNMR), birth-weight-specific mortality rates and causes of mortality. Overall there was a 17% decline in the NNMR from periods 1 to 2. Mortality rates in infants with birth weight < 1000 g and > 2500 g decreased by 36% and 35% respectively from periods 1 to 2. Modest declines in deaths from asphyxia, sepsis and complications of preterm births occurred from periods 1 to 2 but the differences were not statistically significant.

Résultat néonatal aux Émirats arabes unis : effet des modifications de ressources et de pratiques

RÉSUMÉ Des améliorations sélectives dans les ressources et pratiques de soins néonatals ont été mises en place entre 1992/1994 (période 1) et 1995/1998 (période 2) après un audit néonatal dans les Émirats arabes unis. Nous avons évalué l'effet de ces modifications sur le taux de mortalité néonatale, les taux de mortalité par poids de naissance et les causes de mortalité. Globalement, une baisse de 17 % du taux de mortalité néonatale entre les périodes 1 et 2 a été enregistrée. Les taux de mortalité chez les nourrissons ayant un poids de naissance inférieur à 1000 g et supérieur à 2500 g ont baissé respectivement de 36 % et 35 % entre les périodes 1 et 2. Une légère baisse des décès dus à l'asphyxie, à la septicémie et aux complications de la naissance prématurée a été observée entre les périodes 1 et 2 mais les différences n'étaient pas statistiquement significatives.

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Introduction

Neonatal audit can be used to identify major causes of neonatal death and the changes that would improve perinatal and neonatal care and survival [*1,2*]. In a previous neonatal audit we concluded that more resources for neonatal intensive care, prevention or improvement in the management of asphyxia and respiratory distress syndrome (RDS) and genetic counselling could lead to further reductions in the neonatal mortality rate in the Al-Ain Medical District of the United Arab Emirates (UAE) [*3*]. Since then, neonatal care resources, support supplies and patient care practices have progressively improved. The continuous neonatal audit process in the District provided us with the opportunity to quantitatively analyse some selected changes and to assess the possible impact on neonatal outcome.

Specific interventions following our previous study included the 1992 submission of a position statement by the heads of the neonatal units in the 2 teaching hospitals in the Al-Ain Medical District to the Director of the Medical Administration. The position statement addressed resources, support supplies and organizational changes required to further improve neonatal services and neonatal survival [*3*].

In 1994, a committee established by the hospital administration to review potential service improvements in critical care areas in the district submitted recommendations for optimal neonatal and perinatal care resources based on international standards [*4,5*]. These recommendations were implemented gradually and included increases in staffing and physical space, more current equipment and improvements in support supplies, especially the availability of exogenous surfactant for the treatment of respiratory distress syndrome (RDS). Continuing medical education and training activities, including regular symposia on advances in neonatal care and neonatal resuscitations were also initiated. Two of the authors of this paper, A. Dawodu and E. Várady, also participated in the initiation of national annual scientific presentations sponsored by the neonatal section of the Paediatric Society, Emirates Medical Association. These annual presentations focused on aspects of newborn care related to the major causes of morbidity and mortality in the District and in the UAE [*3*].

The objectives of our observational study were to determine the effect of the selected changes in the availability of neonatal care resources and in care practice on the neonatal mortality rate (NNMR), birthweight-specific mortality rates and causes of neonatal death.

Methods

We conducted an observational study among all live births during 1992–1998 at the 2 teaching hospitals of the Faculty of Medicine and Health Sciences, United Arab Emirates University, in the Al-Ain Medical District of UAE. These 2 perinatal institutions provide normal perinatal care and neonatal intensive care services for over 80% of the approximately 8000 births annually in the district. The neonatal care practices at these 2 institutions have been described in detail elsewhere [*3*].

We evaluated neonatal medical and nursing staff numbers, bed capacities, the use of antenatal corticosteroids in preterm births < 34 weeks gestation and postnatal exogenous surfactant for rescue treatment of established RDS from 1992 to 1998. We also estimated the number of items of up-to-date equipment and supplies, such as neonatal ventilatory and electronic monitoring equipment, acquired during the study period.

The specific outcome measures for our study were neonatal mortality rates (deaths during the first 28 days of life per 1000 live births), birth-weight-specific mortality rates and causes of neonatal death. We classified causes of neonatal death according to clinical, laboratory data and imaging studies based on accepted criteria as in our previous study [*3*]. Relevant demographic and other data were collected from the obstetric and neonatal logbooks and by regular review of neonatal charts as part of this ongoing neonatal audit.

Since 1994, the number of units of neonatal intensive care equipment and nursing and medical staff have increased and perinatal and neonatal care practices, especially in the prevention and management of RDS, have significantly changed. We therefore compared the neonatal mortality rates and the pattern of causes of deaths during 1992–1994 (period 1) with 1995–1998 (period 2) to assess the effect, if any, of these selected changes in resources and care practices on neonatal outcome. The chi-squared test was used to compare between the 2 periods; $P < 0.05$ was significant.

Results

Table 1 shows changes in the neonatal population characteristics, selected resources and care practices between periods 1 and 2. There were 18 190 live births during period 1 and 22 218 live births during period 2.

The incidence of preterm births (< 34 weeks gestation) increased from 24 per 10 000 live births in period 1 to 29 per 10 000 live births in period 2 ($P < 0.001$). Furthermore, the incidence rate of very-low-birth-weight infants (< 1500 g) increased from 9.2/1000 live births in period 1 to 13.0/1000 live births in period 2. The number of nursing staff during period 2 increased by 45%. The combined number of

Table **1 Changes in patient population, resources and practices from period 1 to period 2**

Care parameter	Period 1 (1992–1994) No.	Period 2 (1995–1998) No.
Live births	18190	22218
Births ≤ 34 weeks gestation	430	638*
Bed capacity (intensive and intermediate)	35	35
Nursing staff (average)	38	55
Full-time consultant medical staff	3	4
Neonatal medical officers (average)	2	5
Births ≤ 34 weeks exposed to antenatal steroid	43 (10%)	278 (44%)**
Infants ≤ 34 weeks gestation with RDS	180 (42%)	265 (42%)
Infants with RDS treated with surfactant	32 (18%)	184 (69%)**

RDS = respiratory distress syndrome.
P < 0.001; **P < 0.0001.

medical staff providing neonatal care in the 2 institutions almost doubled from 5 in period 1 to 9 in period 2. Furthermore, antenatal corticosteroid use in preterm births and the number of infants with RDS that received exogenous surfactant therapy increased 4-fold during period 2. Surprisingly, there was no change in the prevalence of RDS between the 2 periods.

There were 40 408 live births and 280 neonatal deaths with an overall neonatal mortality rate of 6.9 per 1000 live births during the entire study period. The neonatal mortality rate declined modestly by 11% from 7.9/1000 live births in 1992 to 7.0/1000 live births in 1998. The overall neonatal mortality rate was reduced by 17% from period 2 (6.3 per 1000 live births) to period 1 (7.6 per 1000 live births), although this difference was not significant. When we eliminated variation in the very-low-birth-weight rate (a predictor of neonatal mortality) by dividing the NNMR by the very-low-birth-weight rate, the mortality risk ratio was reduced by 39% from 0.83 in period 1 to 0.48 in period 2 [*6*]. Furthermore, the birth-weight-specific mortality rates for infants with birth weight < 1000 g, 1000–1499 g, 1500–2499 g and > 2500 g declined by 36% (P = 0.01), 31%, 15% and 35% (P = 0.04) respectively from period 1 to period 2 (Table 2).

During the 2 periods lethal malformation was the leading cause of death and comprised 44% of neonatal deaths. Preterm birth complications, which included pulmonary immaturity, RDS and intraventricular or periventricular haemorrhage, accounted for 76% of deaths in infants with birth weight < 1500 g (Table 3). Preterm birth complications and lethal malformations accounted for 77% of all neonatal deaths. Modest reductions in deaths from preterm birth complications, bacterial sepsis/necrotising enterocolitis (NEC) and asphyxia occurred in period 2, although these differences were not statistically significant (Table 4).

Discussion

Neonatal care resources improved during the study years and were more available in 1995–1998 than in 1992–1994. These changes were possibly consequent to the implementation of service improvement recommendations in response to the previous neonatal audit [*3*]. In addition to improved resources, there were wider

Table 2 **Neonatal mortality by birth weight category**

Birth weight (g)	Period 1 1992–1994			Period 2 1995–1998			*P*-value
	Live births	Neonatal deaths	Mortality[a]	Live births	Neonatal deaths	Mortality[a]	
500–999	59	32	542	116	40	345	0.01
1000–1499	108	19	176	172	21	122	0.21
1500–2499	1087	36	33	1354	38	28	0.55
≥ 2500	16 936	52	3.1	20 576	42	2.0	0.04
All	18 190	139	7.6	22 218	141	6.3	0.11

[a]***Mortality = neonatal deaths/1000 live births in that birth weight category.***

Table 3 **Causes of death by birth weight category, 1992–1998**

Causes of death	Birth weight (g)				
	500–999 No. (%)	1000–1449 No. (%)	1500–2499 No. (%)	≥ 2500 No. (%)	All No. (%)
Preterm birth complications	60 (83.3)	25 (62.5)	7 (9.5)	0	92 (32.9)
Lethal malformations	1 (1.4)	7 (17.5)	48 (64.9)	68 (72.4)	124 (44.3)
Asphyxia	0	0	8 (10.8)	16 (17.0)	24 (8.6)
Sepsis/necrotising enterocolitis	11 (15.3)	8 (20.0)	7 (9.5)	8 (8.5)	34 (12.1)
Other or unknown	0	0	4 (5.4)	2 (2.1)	6 (2.1)

applications of current, evidence-based perinatal care therapies, such as the use of antenatal corticosteroids and an expanded use of exogenous surfactant for the treatment of RDS. These changes in care practices and resources were associated with an 18% reduction in the overall neonatal mortality rate and a 36% reduction in neonatal mortality among infants with birth weight < 1000 g.

Other researchers have also reported significant reductions in neonatal mortality rates with improved neonatal care resources, even with small budgets [*7–10*]. Our study clearly indicates that regular neonatal audit can identify changes in care practices and resources necessary to improve the quality of perinatal and neonatal care and neonatal survival.

After adjusting for variations in the very-low-birth-weight rates, the reduction in birth-weight-specific neonatal mortality rates and mortality risk ratios during period 2 was most likely due to improved resources and changes in care practices. These changes included the expanded use of evidence-based therapies, especially antenatal corticosteroids and postnatal surfactant therapy [*6*]. Our conclusion is supported by many previous reviews in which overall neonatal survival rates significantly improved when the incidence of

Table 4 **Changes in causes of death between 1992–1994 and 1995–1998**

Causes	Period 1 1992–1994		Period 2 1995–1998		*P*-value
	No.	Per 10 000 live births	No.	Per 10 000 live births	
Preterm birth complications	45	24	47	21	0.6
Lethal malformations	58	31	66	30	0.8
Asphyxia	13	6.9	11	4.9	0.8
Sepsis/necrotizing enterocolitis	21	11.2	13	5.8	0.06
Other	2	1.1	4	1.8	0.7

RDS was reduced with antenatal corticosteroids use and postnatal surfactant therapies [*11,12*].

Other changes in patient characteristics and improved professional performance could possibly account for some differences in mortality rates between the 2 periods [*13*]. We were not aware of any other significant changes in the obstetrics or neonatal population that could account for the improved survival. Various educational and training activities in the two periods might have contributed to continuing improvement in professional performance and patient care, but we did not have data to assess their effect on care practices.

It is reasonable to conclude that the reduction in neonatal mortality during period 2 of our study was due to improvement in perinatal and neonatal care. It is however, rather disappointing that only 44% of preterm births < 34 weeks gestation were exposed to antenatal corticosteroids during period 2 despite the proven benefits and the expert support for their use [*11,12,14*]. A higher rate of appropriate antenatal steroid use could be achieved with the continuing review of practices and could significantly reduce the incidence of and mortality from RDS.

Lethal malformation was the leading cause of neonatal death, especially for normal weight infants. Complications of preterm births, sepsis and NEC predominated as causes of death for very-low-birth-weight infants as in a previous study [*3*]. This pattern of causes of death indicates that prevention of premature births and lethal malformations should also be part of a package to reduce the neonatal mortality rate in the district. The pattern of causes of neonatal deaths was similar to patterns in many developed countries with the exception of the high lethal malformation rate [*2,7*]. It differed from less developed countries where septicaemia, neonatal tetanus, asphyxia and birth trauma are still the major causes of neonatal death [*15,16*]. Strategies to improve neonatal survival depend on local patterns and major contributing factors to neonatal mortality in each environment and we emphasize the importance of neonatal audit to determine local needs.

The modest declines in the contribution of bacterial sepsis and NEC, problems of preterm births and asphyxia to neonatal deaths during period 2 suggest progressive improvement in the quality of perinatal and neonatal care. However, to achieve survival rates comparable to international figures among non-malformed very-low-birth-weight infants would require further change and improvement in practice behaviour and resources in perinatal and neonatal care in the District [*2,7,9*]. This would be applicable to the other parts of the country as well.

In conclusion, improvements in neonatal care resources and changes in practices were associated with reductions in neonatal mortality for very-low-birth-weight and normal weight infants. Continued monitoring will identify areas of neonatal and perinatal care that still need to be addressed to further reduce neonatal mortality. Regular neonatal audit should be a priority in other developing countries to pinpoint local determinants of neonatal mortality that would serve as the basis for improving neonatal care and outcome.

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