Brief Reports

Hepatic Dysfunction in Childhood Dengue Infection

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Summary

Hepatic functions of 61 children, diagnosed to have dengue infection (DI), aged 2 months to 12 years comprising 37 cases of dengue fever (DF), 16 with dengue hemorrhagic fever (DHF), and eight with dengue shock syndrome (DSS) were prospectively studied during the acute attack. Hepatomegaly (74 per cent), epistaxis (26 per cent), jaundice (25 per cent), and petechial rashes (18 per cent) were the common clinical manifestations of DI. On admission, levels of serum aspartate transaminase (AST), serum alanine transaminase (ALT) and serum alkaline phosphatase (AP) were raised in 80–87 per cent of children with hepatomegaly (group I) and 81 per cent of cases without hepatomegaly (group II). During the second week of hospitalization the proportion of cases with raised levels of AST, ALT, AP and serum bilirubin increased and the mean levels were significantly higher ($p<0.05$) in both the groups. These levels gradually declined over the next 2–3 weeks. All the cases with DSS and DHF had raised AST, ALT and AP levels and the mean levels of these enzymes were significantly higher ($p<0.05$) as compared to DF. Our results suggest a transient derangement of liver functions in childhood DI, more so in DSS and DHF, with or without hepatomegaly.

Introduction

Dengue infection (DI) of classical type has been endemic in India for many years. Epidemics of dengue fever (DF) with or without hemorrhagic manifestation (DHF) and shock (DSS) have been reported from several countries.[1–5] Prolonged shock with metabolic acidosis and severe disseminated intravascular coagulation (DIC) may lead to hypoxia/ischemia resulting in both hepatic and brain dysfunction. DI can also bring about the inhibition of certain liver functions even in the absence of abnormal clinical signs of hepatic insufficiency, while normal liver functions may be restored after termination of the illness. This prospective study has been undertaken to assess hepatic functions of children hospitalized with DF/DHF/DSS who were followed up until their liver functions returned to normal.

Materials and Methods

The study included children hospitalized in the Division of Pediatric Gastroenterology and Nutrition, Kalawati Saran Children's Hospital, New Delhi, during a dengue epidemic between August 1996 and October 1996, in whom a diagnosis of DI was made. The diagnostic criteria of DHF/DSS were based on the Technical Guide for Diagnosis, Treatment and Control of DHF.[6,7] Severity was graded according to the WHO criteria,[6,7] which includes:

grade I (fever accompanied by non-specific constitutional symptoms; the only hemorrhagic manifestation is a positive tourniquet test);
grade II (spontaneous bleeding in addition to manifestations of grade I patients, usually in the form of skin and/or other hemorrhages);
grade III (circulatory failure manifested by rapid and weak pulse, narrowing of pulse pressure – 20 mmHg or less – or hypotension, with presence of cold clammy skin and restlessness); and
grade IV (profound shock and undetectable blood pressure).

Besides detailed history and a thorough clinical examination, the following investigations were undertaken: complete hemogram; platelet count; liver function tests (LFT) which included serum bilirubin, aspartate transaminase (AST; SGOT), alanine transaminase (ALT; SGPT) and alkaline phosphatase (AP); blood culture; kidney function tests (blood urea, serum creatinine, serum electrolytes); coagulation profile; and chest/abdomen X-rays. Sera from the patients were collected on the day of admission and tested for antibodies to DI. Hemoglobin estimation, hematocrit and platelet count was performed every day and liver-function tests were repeated every week until the values returned to normal.

Diagnosis of DI was confirmed by the serological presence of antibodies against flaviviruses, conducted at the National Institute of Communicable Diseases (NICD), Delhi. IgM haemagglutination antibody titres (>1:160) for dengue type 2 were interpreted as a positive result. Subjects were followed for at least 4 weeks after discharge

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TABLE 1
Age distribution and hepatomegaly

Age	Total ($n = 61$) No. of cases (%)	Group I (with hepatomegaly) ($n = 45$) No. of cases (%)[a]	Group II (without hepatomegaly) ($n = 16$) No. of cases (%)[a]
< 6 months	5 (8)	3 (60)	2 (40)
6 months– 1 year	5 (8)	2 (40)	3 (60)
1–5 years	17 (28)	12 (71)	5 (29)
> 5 years	34 (56)	28 (82)	6 (18)

[a]Percentage within the age group.

from the hospital. Statistical analysis was done by chi-squared test and unpaired *t*-test wherever applicable.

Results

Sixty-one children aged 2 months to 12 years with clinically suspected DI were enrolled, and included 37 cases (61 per cent) with DF, 16 (26 per cent) with DHF and eight (13 per cent) with DSS. Sera of 35 patients were sent to NICD for confirming the diagnosis of DI. Twenty out of these 35 cases (57 per cent) were positive for antibodies against DI and in others it remained a clinical diagnosis. The majority of our children (56 per cent) were more than 5 years old and most of them had hepatomegaly (Table 1).

Fever was the chief presenting complaint in all the cases followed by hepatomegaly (74 per cent), shock (31 per cent), epistaxis (26 per cent), pain in the right hypochondrium (25 per cent), jaundice (25 per cent), petechial rashes (18 per cent), hematemesis (8 per cent), and melena (8 per cent). Thirty-eight (84 per cent) out of 45 children with hepatomegaly (group I) had raised levels of AST on admission, the number increased to as many as 43/45 cases (96 per cent) during the second week and declined during the 3rd to 4th week. By the 4th week AST levels had returned to normal. A similar trend was observed for ALT, serum bilirubin and AP. The mean levels of AST, ALT, AP and serum bilirubin were highest during the 2nd week and gradually declined ($p<0.05$). It was interesting to observe that children without hepatomegaly (group II) followed a similar trend ($p<0.05$). Overall evaluation of the hepatic enzyme profile of all 61 children suggested a similar pattern (Fig. 1). Comparison of group I and group II did not

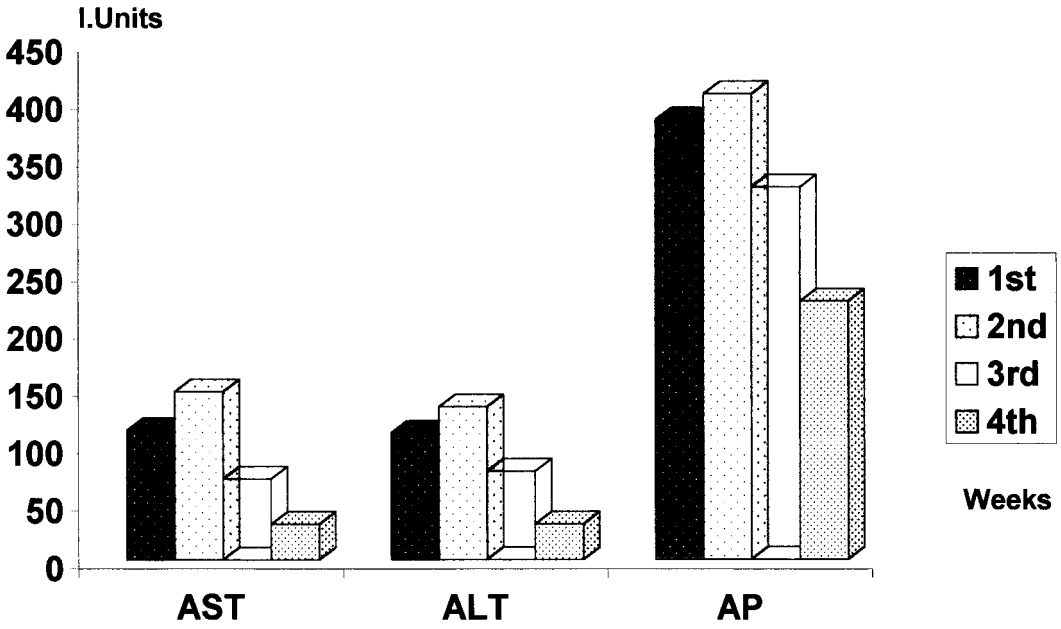

FIG. 1. Serial mean serum enzyme levels over 4 weeks.

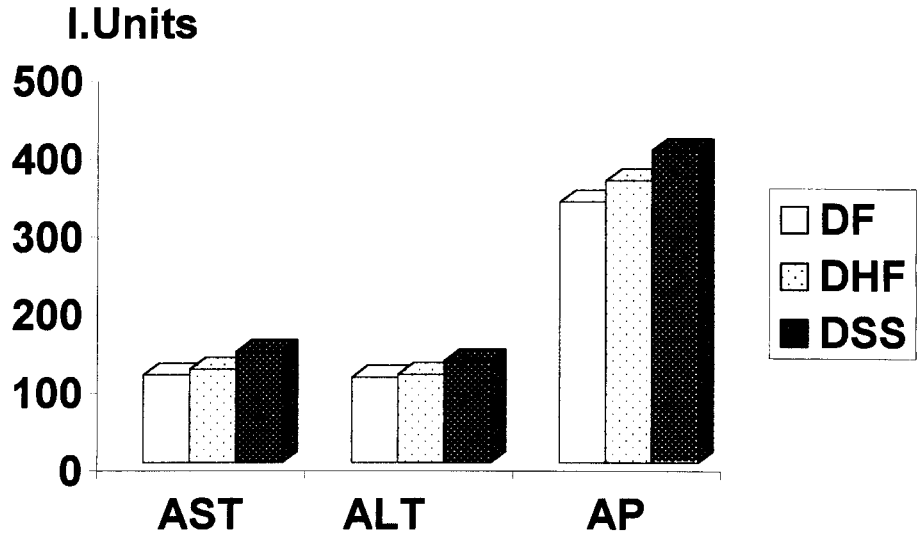

FIG. 2. Mean serum enzyme levels in DF, DHF and DSS.

reveal any significant difference ($p>0.05$). All the eight cases with DSS had raised AST, ALT and AP levels during the 1st and 2nd week. Twenty out of 37 (54 per cent) cases of DF and 14/16 (88 per cent) with DHF had raised AST, ALT and AP levels during the 1st week and the number increased to 30/37 (81 per cent) cases with DF and all the cases with DHF during the 2nd week. Mean values of these enzymes were significantly higher in children with DSS as compared to DF ($p<0.05$) (Fig. 2).

Jaundice was present in as many as 15 patients (25 per cent). All jaundiced patients had hepatomegaly, pain in the right hypochondrium and deranged liver enzyme levels. Platelet count was markedly decreased and hematocrit increased in all the cases during the 1st week and gradually returned to normal in the 2nd week. Follow-up over the next 3 weeks after DI revealed reduction in liver size, disappearance of jaundice, and the levels of serum enzymes and bilirubin returned to normal in all the cases.

Discussion

Generally vital organs are not primarily involved in DI. Signs and symptoms of various organ involvement are usually secondary to plasma leakage into serous spaces and abnormal hemostasis that leads to hypovolemic shock and/or hemorrhage. Cases with prolonged shock and evidence of DIC have been more frequently associated with multiple organ involvement.[4] The liver is one of the target organs of DI and the clinical manifestations of hepatic dysfunction may appear during the course of DI, more serious disturbances being reported with DHF and DSS. Hepatic involvement of a mild degree has been observed in the past, but in recent years more severe involvement, including fulminant hepatitis with high mortality, has been reported in pediatric patients. This is attributed to patients surviving the acute stage of DI and demonstrating severe manifestations which consequently occur. Severe manifestations may result from primary as well as secondary infections. In infants, maternal antibodies could cause immune enhancement leading to severe manifestations.[8]

Hepatomegaly is one of the commonest associated features of DF ranging from 79 to 100 per cent. [1,4] Forty-five out of 61 (74 per cent) of our cases had hepatomegaly, which appeared to be a common association of the more severe form of DI since an earlier epidemic of DI in Delhi in 1985 was not associated with any hemorrhagic manifestation and was without hepatomegaly.[9] In a large series from Malaysia, hepatomegaly was observed less frequently in DF (21 per cent) than DHF (48 per cent).[10] A severe form of hepatic involvement presenting as fulminant hepatitis with encephalopathy and Reye's syndrome has been frequently observed in Thailand.[4,11–14] The appearance of jaundice in cases of DF/DHF/DSS may be multifactorial. Most commonly associated conditions found in these cases are prolonged shock with metabolic acidosis and severe DIC that leads to hypoxia/ischemia and results in hepatic dysfunction.[4] Jaundice has been reported in 15–62 per cent cases of DI by several workers.[4,8] We observed jaundice in 15 (25 per cent) of our cases.

Marked disturbance of liver functions indicating hepatocellular involvement were observed in all cases by Nimmannitya *et al.*[4] Elevated levels of AST have been observed from the 3rd day of illness in most cases, which reach a peak on the 7/8th day of illness and then gradually decline and become normal in about 3–8 weeks.[8,15] In our study, levels of AST/ALT were also

raised in 84 per cent and 96 per cent of cases during the 1st and 2nd week, respectively. The mean levels of these enzymes reached a peak and remained significantly higher during the 2nd week, and declined towards normal in the 3rd week. Serum AP levels also showed a similar trend. These enzymes were raised even in the absence of hepatomegaly. All the children with DSS and DHF had elevated enzymes and the mean values were significantly higher than those with DF.

We conclude that hepatic dysfunction with increased levels of serum enzymes is a common feature of an acute attack of DI with or without hepatomegaly. Derangement of hepatic functions was more marked in DSS and DHF. Hepatic dysfunction was observed to be transient as the abnormal values of serum enzymes and bilirubin returned to normal, liver size regressed and jaundice disappeared by the end of the 3rd week.

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Perinatal Mortality in Rural Punjab—A Population-based Study

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Summary

The results of a population-based case-control study are reported to examine the factors affecting perinatal mortality in rural Punjab, during the period 1991–1996. There were 91 perinatal deaths in 2424 of the pregnant women registered. The perinatal mortality rate was 34.57/1000 and the still-birth rate was 30.94/1000. Odds ratio, 95 per cent confidence interval, prevalence and population attributable risk percent were calculated for the various risk factors; of the risk factors studied, material weight less than 40 kg, height less than 152 cm, body mass index <20, illiteracy, a birth to conception interval less than 100 weeks, prematurity, late registration and home delivery were found to be significant on univariate analysis. When subjected to multiple logistic regression, the full model identified the significance of all the risk factors except late registration. However on the final model, only prematurity and short birth-interval were found to be significant. The highest population attributable risk, 35.16 per cent, was observed for prematurity.

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Introduction

With declining infant mortality, attention now focuses on the perinatal period. Perinatal mortality is a direct reflection of the maternal health and maternal care services available in a particular community.

Most of the information on perinatal mortality in this part of the world is hospital based and does not reflect the true picture of the situation in the community. There have been some community-based enquiries into this problem in this subcontinent.[1–4] However, no detailed community-based enquiry has been made in rural north-west India.

The present study was undertaken to provide information on the extent and variables affecting perinatal mortality in rural Punjab, which is one of the most developed states in north-west India.

Materials and Methods

Pregnant women registered during the period 1991–1996 in field practice villages of the Department of Community Medicine of Dayanand Medical College Ludhiana, Punjab, with known outcome of pregnancy as a singleton birth (with gestational age ≥28 weeks) and known status of the newborn at 7 days after birth formed the study sample. The women who had an unfavourable outcome of pregnancy (i.e. a stillbirth or the infant died within 7 days) formed the cases. The controls comprised women who delivered a live baby with the newborn surviving for 7 days.

The odds ratio, i.e. the estimated relative risk, along with confidence intervals (CI) were calculated for the various risk factors. Population attributable risk per cent (PAR%) was used to estimate the contribution of the risk factor to perinatal mortality after quantifying the prevalence of the risk factor in the entire study population, i.e. cases as well as controls.

The risk factors which were found to be significant on univariate analysis were subjected to forward conditional multiple logistic regression analysis. The risk factors identified to be significant at an α of 0.05 were included in the final model of logistic regression analysis.

Results

A total of 2424 of the registered women carried their pregnancy beyond 28 weeks of gestation. Table 1 shows the pregnancy outcomes and the perinatal deaths. Table 2 shows the odds ratio, 95 per cent CI, prevalence and PAR% for various risk factors. Table 3 shows the result of multiple logistic regression.

TABLE 1
Pregnancy outcomes and perinatal deaths (n = 2424)

Number of pregnant women at gestation (≥28 weeks)	2424
Normal singleton live births	2349
Stillbirths	75
Deaths under 1 week	16
Stillbirth rate	30.94 per 1000
Perinatal mortality rate	37.54 per 1000

Discussion

Perinatal mortality rate in the present study was found to be 37.54 per 1000 which is much lower than the 55 per 1000 estimated for the developing countries by WHO.[5] For all the risk factors studied, the odds ratio was greater than unity, except for institutional delivery, where logically it was expected to be less than unity. However, only the odds ratio for the variables 1–9 (Table 2) were statistically significant since the CIs of variable 10 onwards included the null value. The full model of conditional multiple logistic regression, found all the nine risk factors statistically significant except for registration in the second and third trimester of pregnancy. However, in the final model only short birth-interval and prematurity were found to be significant.

In the present study prematurity carried the greatest risk of perinatal loss. Another community study from Lucknow, India[2] also reported a high relative risk for prematurity. The importance of this risk factor is confirmed by it having the highest population attributable risk, i.e. 35.16 per cent (Table 2). These findings clearly underline the need for providing basic community-based perinatal care services. The prevalence of prematurity was only to the extent of 5 per cent; hence by taking care of these few women, large numbers of perinatal loss can be prevented.

A short birth interval emerged as the second significant risk factor. It had a low prevalence of under 4 per cent and a population attributable risk of 6.15 per cent. Since there is a very high preference for sons in this area, women who have no sons or just one son waste no time in becoming pregnant again. This has already been well documented by the authors.[6]

Although a low BMI (<20) did not figure significantly in the multivariate analysis, its high prevalence (28 per cent) and consequently a high PAR% (32.65 per cent) in the present study merits discussion. This shows that nearly every third woman needs to put on more weight. These 28 per cent of women who are malnourished are mostly the ones who have too many children too quickly. It is disheartening to note that in the state of Punjab which is referred to as the 'granary of India' and has the second highest per capita income in the country, 28 per cent of the women in the reproductive age group should have a low BMI bordering on malnutrition.

In conclusion it can be said that there is an urgent need to identify factors that lead to preterm labour in addition to promoting contraception for adequate spacing of children. Maternal malnutrition also needs to be checked.

TABLE 2
Odds ratio (OR) 95% CI, prevalence and population attributable risk per cent (PAR%) for risk factors for perinatal mortality (n = 91)

Parameters (risk factor)	OR	95% CI	Prevalence	PAR%[b]
1. Weight <40 kg	2.58[a]	1.45–4.59	0.074	9.34
2. Height <152 cm	1.89[a]	1.08–3.29	0.104	7.99
3. BMI <20	2.85[a]	1.87–4.34	0.281	32.65
4. Illiterate	8.58[a]	5.00–14.72	0.045	20.52
5. Birth to conception interval <100 weeks	2.82[a]	1.37–5.79	0.039	6.15
6. Prematurity (gestation <37 weeks)	15.87[a]	9.9–25.39	0.051	35.16
7. Registered in third trimester	2.01[a]	1.38–2.93	0.139	11.12
8. Registered in second trimester	1.73[a]	1.26–2.37	0.398	20.95
9. Home delivery	1.67[a]	1.01–2.76	0.684	31.24
10. Parity 3+	1.34	0.84–2.14	0.270	8.15
11. MUP score <20	1.03	0.59–1.78	0.171	0.53
12. Age >30 years	1.24	0.70–2.19	0.117	5.34
13. Age <20 years	1.50	0.84–2.65	0.118	12.53
14. H/o Abortion	1.75	0.62–4.90	0.026	1.807
15. H/o Stillbirth	1.20	0.37–3.86	0.027	0.51
16. Post maturity (gestation >42 weeks)	1.28	0.63–2.59	0.079	2.05
17. Institutional delivery	0.77	0.56–1.06		

[a]Statistically significant.
[b]Total >100 because of non-mutually exclusive risk factors.

TABLE 3
Results of conditional multiple logistic regression analysis

Parameter (risk factor)	Odds ratio (OR)	95% CI for OR	*p* value
Full model			
1. Weight <40 kg	1.09	0.67–1.78	<0.0001
2. Height <152 cm	0.69	0.38–1.25	<0.0001
3. BMI <20	0.86	0.55–1.34	0.0049
4. Illiterate	0.97	0.61–1.52	0.0470
5. Birth to conception interval <100 weeks	1.61	1.04–2.48	0.0049
6. Prematurity (gestation <37 weeks)	4.65	4.18–5.17	<0.0001
7. Registered in third trimester	0.74	0.47–1.16	0.7925
8. Registered in second trimester	1.44	1.16–1.79	0.74499
9. Home delivery	0.70	0.45–1.09	0.0053
Final model			
1. Weight <40 kg	1.10	0.67–1.79	<0.0001
2. Height <152 cm	0.69	0.38–1.24	<0.0001
3. BMI <20	0.85	0.54–1.33	0.0023
4. Illiterate	0.96	0.61–1.52	0.0444
5. Birth to conception interval <100 weeks	1.62	1.05–2.51	0.0040
6. Prematurity (gestation <37 weeks)	4.97	5.53–4.47	<0.0001
7. Home delivery	0.74	0.47–1.51	0.0142

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Risk Factors Associated with Neonatal Hypothermia During Cleaning of Newborn Infants in Labour Rooms

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Summary

Cleaning newborn infants with coconut oil shortly after birth is a common practice in Malaysian labour rooms. This study aimed: (1) to determine whether this practice was associated with a significant decrease in the core temperature of infants; and (2) to identify significant risk factors associated with neonatal hypothermia. The core temperature of 227 randomly selected normal-term infants immediately before and after cleaning in labour rooms was measured with an infrared tympanic thermometer inserted into their left ears. Their mean post-cleaning body temperature (36.6°C, SD = 1.0) was significantly lower than their mean pre-cleaning temperature (37.1°C, SD=1.0; $p < 0.001$). Logistic regression analysis showed that the risk factors significantly associated with pre-cleaning hypothermia (< 36.5°C) were: (1) not being placed under radiant warmer before cleaning ($p = 0.03$); and (2) lower labour room temperature ($p < 0.001$). Logistic regression analysis also showed that the risk factors significantly associated with post-cleaning hypothermia were: (1) lower labour room temperature ($p < 0.001$); (2) lower pre-cleaning body temperature ($p < 0.001$); and (3) longer duration of cleaning ($p = 0.002$). In conclusion, to prevent neonatal hypothermia, labour room temperature should be set at a higher level and cleaning infants in the labour room should be discouraged.

Introduction

In recent years, many labour rooms in tropical Malaysia have been air-conditioned. This produces a cool comfortable environment for labour-room staff and mothers-in-labour. However, it was suspected to be a predisposing factor of neonatal hypothermia.[1] Cleaning newborn infants with coconut oil shortly after birth is a common practice in Malaysian labour rooms. This practice has been suspected to be an aggravating factor of neonatal hypothermia. In this study, we aimed: (1) to determine whether there was a significant decrease in neonatal core temperature immediately after cleaning with oil in labour rooms; and (2) to identify significant risk factors associated with neonatal hypothermia immediately before and after cleaning.

Methods

This study was carried out in the Kuala Lumpur Maternity Hospital over an 8-month period (1 December 1994 to 31 July 1995). The inclusion criteria were normal term infants of gestation between 37 and 42 completed weeks (based on maternal last menstrual period) delivered by spontaneous vertex delivery with an Apgar score of at least 8 at 1 min of life. The exclusion criteria were: preterm infants (< 37 weeks), outborns, those requiring resuscitation after birth, gross congenital abnormalities, infants of mothers who were unsure of their last menstrual period, infants of diabetic mothers, and history of maternal sedation within 2 h before delivery.

There were two labour rooms in the hospital. During the study period, the air-conditioner in one of the labour rooms was not functioning (the warm labour room), with a resultant higher mean environmental temperature of 29.8°C (SD = 1.0). The air-conditioner of the second labour room (the cool labour room) was functioning normally with a significantly lower mean environmental temperature of 20.7°C (SD = 1.1; $p < 0.01$). Eligible infants born in these two labour rooms on randomly selected days were recruited in the study.

The infants were further randomly assigned to one of two groups: (1) the early cleaning group, when cleaning was performed up to 40 min of life; and (2) the late cleaning group, when cleaning was performed between 40 and 90 min of life. Assignment of an infant to the early or late cleaning group was carried out randomly by one of us (FCC) immediately after the infant was born.

Upon delivery, the infants were routinely dried and then wrapped with a piece of clean linen. During the

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study period, just before a midwife cleaned a studied infant, the pre-cleaning core temperature of the infant was measured with an infrared thermometer (Firsttemp Genius Model 3000A, Sherwood Medical, St. Louis, MO, USA) by one of us (FCC). The midwife assisted by turning the infant's head to the right and holding it firmly to allow the infrared tympanic thermometer probe with its disposable ear-cover to be inserted snugly into the infant's left external auditory meatus. The midwife was not allowed to read the infant's pre-cleaning temperature displayed on the thermometer. After the infant's pre-cleaning core temperature was measured, the midwife cleaned the head, trunk and limbs of the infant in the usual manner with cotton swabs soaked with coconut oil. Next, the infant's eye lids and periorbital skin were cleaned with normal saline. Lastly, the umbilical stump of the infant was cleaned with hibitane-spirit. The oil and normal saline were not routinely warmed before use. The duration of cleaning was timed with a digital stop-watch. Immediately after cleaning, the infant was wrapped with another piece of clean linen and the post-cleaning core temperature was measured similarly. Infants who were hypothermic (< 36.5°C, based on the definition of World Health Organization[2]) were warmed under a radiant warmer.

Statistical analysis

Paired *t*-test was used for the analysis of changes of infants' body temperature following cleaning. Unpaired *t*-test (or Mann–Whitney *U*-test for skewed distribution) was used for analysis of other continuous variables. The chi-squared test (or Fisher's exact test for expected values of less than 5) was used for the analysis of categorical variables. Logistic regression analysis was used to determine significant risk factors associated with hypothermia before and after cleaning. *p* values of ≤ 0.05 were considered to be statistically significant. Statistical programme Epi-Info version 6 was used for the calculation of 95 per cent confidence intervals (CI) of unadjusted odds ratios (OR) of categorical variables. SPSS for Windows version 7.0 was used for the rest of the statistical analysis.

Results

During the study period, 15 222 liveborn term infants were delivered by spontaneous vertex delivery in the hospital and 227 (1.5 per cent) were recruited in the study. The mean birthweight and mean gestational age of the 227 infants were 3195 (SD = 402) g and 39.4 (SD=1.3) weeks, respectively. The mean pre-cleaning body

TABLE 1
Comparison of clinical data of infants of early cleaning with those of late cleaning group

Clinical data	Early cleaning group ($n = 117$)	Late cleaning group ($n = 110$)	*p* values
Mean age of cleaning, minutes (SD)	18.7 (9.2)	64.4 (9.8)	0.000[a]
Males (%)	54 (46.2)	45 (40.9)	0.5
Ethnic groups (%)			
Malay	82 (70.1)	78 (70.9)	Reference
Chinese	11	11	
Indians	11 (29.9)	9 (29.1)	1.0
Others	13	12	
Mean gestation, weeks (SD)	39.4 (1.3)	39.4 (1.2)	0.8
Mean birthweight, g (SD)	3184 (391)	3206 (415)	0.7
Mean pre-cleaning body temperature, °C (SD)	36.8 (0.9)	37.5 (1.0)	0.000[a]
Mean post-cleaning body temperature, °C (SD)	36.3 (0.9)	36.9 (1.0)	0.000[a]
Mean change in body temperature following cleaning, °C (SD)	−0.5 (0.6)	−0.6 (0.5)	0.06
Mean duration of cleaning, minutes (SD)	2.5 (1.4)	2.1 (1.0)	0.01[a]
Number of pieces of linen used to cover infants prior to cleaning (%)			
0	1	5	
1	106 (91.5)	96 (91.8)	Reference
> 1	10 (8.5)	9 (8.2)	1.0
Under radiant warmer prior to cleaning (%)	109 (93.2)	107 (97.3)	0.2
Under radiant warmer during cleaning (%)	64 (54.7)	55 (50.0)	0.5
Median temperature of labour rooms, °C (range)	27.5 (19.5–31.5)	23.8 (18.5–32.5)	0.3

[a] Denotes statistical significance.

temperature of these 227 infants was 37.1°C (SD=1.0, range 33.5–39.5). The mean post-cleaning temperature was 36.6°C (SD=1,0, range 33.5–38.7). The mean body temperature of these infants decreased significantly following cleaning (mean difference: −0.52°C, 95 per cent CI of difference between means: −0.60, −0.45; $p < 0.001$). The mean duration of cleaning was 2.3 min (SD=1.2; range 0.5–6.8). There were 119 (52.4 per cent) infants in the early cleaning group and 108 (47.6 per cent) in the late cleaning group. A total of 114 (50.2 per cent) infants were born in the cool labour room and 113 (49.8 per cent) in the warm labour room.

Table 1 shows the relationship between age of cleaning and clinical data of infants. Infants of the early cleaning group were cleaned significantly earlier than those of the late cleaning group ($p < 0.001$). The former, however, had significantly lower pre-cleaning and post-cleaning mean body temperature, and a significantly longer mean duration of cleaning.

Table 2 compares the clinical data of infants born in the two labour rooms. In the cool labour room, a significantly higher proportion of the infants were Malays, infants were cleaned significantly later, and the mean duration of cleaning was significantly shorter. Furthermore, significantly higher proportions of infants in the cool labour room were placed under radiant warmers both before and during cleaning. However, the pre-cleaning and post-cleaning mean temperatures of infants in the cool labour room were significantly lower than those in the warm labour room.

Before cleaning began, 58 (25.6 per cent) infants were hypothermic. The mean body temperature of these hypothermic infants (35.8°C, SD=0.6) was significantly lower than that of the non-hypothermic infants (37.5°C, SD=0.7). The difference in mean body temperature between these two groups of infants was 1.7°C (95 per cent CI of difference between means were: 1.5, 1.9; $p < 0.001$). There was no significant difference in the proportions of infants who were small-for-gestational age (SGA, birthweight below 10th percentile of gestational age[3]) between the hypothermic (1.7 per cent) and non-hypothermic infants (1.2 per cent, $p = 0.6$). Table 3

TABLE 2
Comparison of clinical data of infants born in the two labour rooms

Clinical data	Cool labour room ($n = 114$)	Warm labour room ($n = 113$)	p values
Mean labour room temperature, °C (SD)	20.7 (1.1)	29.8 (1.0)	0.000[a]
Males (%)	52 (45.6)	47 (41.6)	0.6
Ethnic groups (%)			
Malay	100 (87.7)	60 (53.1)	Reference
Chinese	8	14	0.000[a]
Indians	8 (12.3)	14 (46.9)	
Others	0	25	
Mean gestation, weeks (SD)	39.3 (1.1)	39.5 (1.4)	0.3
Mean birthweight, g (SD)	3232 (408)	3158 (394)	0.2
Median age of cleaning, minutes (range)	39 (3–88)	30 (2–84)	0.008[a]
Mean pre-cleaning body temperature, °C (SD)	36.5 (0.8)	37.7 (0.8)	0.000[a]
Mean post-cleaning body temperature, °C (SD)	35.9 (0.8)	37.2 (0.8)	0.000[a]
Mean change in body temperature following cleaning, °C (SD)	−0.5 (0.6)	−0.5 (0.6)	0.7
Mean duration of cleaning, minutes (SD)	2.1 (1.1)	2.6 (1.2)	0.001[a]
Number of pieces of linen used to cover infants prior to cleaning (%)			
0	1	5	Reference
1	94 (83.3)	108 (100)	
> 1	19 (16.7)	0 (0)	0.000[a]
Under radiant warmer prior to cleaning (%)	113 (99.1)	103 (91.2)	0.005[a]
Under radiant warmer during cleaning (%)	110 (96.5)	9 (8.0)	0.000[a]

[a] Denotes statistical significance.

TABLE 3
Potential risk factors associated with hypothermia before cleaning of infants

Potential risk factors	Hypothermic infants ($n = 58$)	Not hypothermic infants ($n = 169$)	p values
Males (%)	29 (50.0)	70 (41.4)	0.3
Ethnic groups (%)			
Malay	48 (82.8)	112 (66.3)	Reference
Chinese	5	17	
Indians	4 (17.2)	16 (33.7)	0.02[a]
Others	1	24	
Mean gestation, weeks (SD)	39.2 (1.1)	39.4 (1.3)	0.2
Mean birthweight, g (SD)	3168 (436)	3204 (391)	0.6
Mean labour room temperature, °C (SD)	21.3 (2.8)	26.6 (4.4)	0.000[a]
Number of pieces of linen used to cover infants prior to cleaning (%)			
0	1	5	
1	51 (89.7)	151 (92.3)	Reference
> 1	6 (10.3)	13 (7.7)	0.6
Not under radiant warmer prior to cleaning (%)	3 (5.2)	8 (4.7)	1.0

[a] Denotes statistical significance.

shows the various potential risk factors associated with pre-cleaning hypothermia. Univariate analysis showed that the Malay ethnic group, and lower labour room temperature were significant risk factors associated with pre-cleaning hypothermia. However, logistic regression analysis of the factors listed in Table 3 showed that only two risk factors were significantly associated with pre-cleaning hypothermia: (1) infant not placed under radiant warmer before cleaning (adjusted OR=6.8; 95 per cent CI 1.2–38.1; $p = 0.03$): and (2) lower labour room temperature (for every 1.0°C increase in environmental temperature, adjusted OR=0.7; 95 per cent CI 0.6–0.8; $p < 0.001$).

Immediately after cleaning, 99 (43.6 per cent) infants were hypothermic with a mean body temperature of 35.7°C (SD=0.6), while 128 (56.4 per cent) infants were normothermic with a mean body temperature of 37.3°C (SD=0.6). The difference in mean body temperature between these two groups of infants was 1.6°C (95 per cent CI of difference between means, 1.5–1.8; $p < 0.001$). The incidence of hypothermia increased significantly from 25.6 to 43.6 per cent following cleaning ($p = 0.00005$). Between the hypothermic (1.0 per cent) and non-hypothermic infants (1.6 per cent), there was no significant difference in the proportions of infants who were SGA ($p = 0.6$). Table 4 shows the various potential risk factors associated with post-cleaning hypothermia. Univariate analysis showed that Malay infants, lower labour room temperature, the use of radiant warmers and a lower pre-cleaning temperature were significantly associated with post-cleaning hypothermia. However, logistic regression analysis of the factors listed in Table 4 showed that only three risk factors were significantly associated with post-cleaning hypothermia. These were: (1) lower labour room temperature (for every 1.0°C increase in labour room temperature, adjusted OR=0.8, 95 per cent CI 0.7–0.9; $p < 0.001$); (2) lower pre-cleaning temperature of infants (for every 1.0°C increase in pre-cleaning body temperature, adjusted OR=0.2; 95 per cent CI 0.1–0.3; $p < 0.001$); and (3) longer duration of cleaning infants (for every 1 min increase in duration of cleaning, adjusted OR=1.9; 95 per cent CI 1.3–2.8; $p = 0.002$).

Discussion

Our study confirmed the findings of other workers that low environmental temperature and cleaning infants in the labour room were significant risk factors associated with neonatal hypothermia, and that the use of radiant warmers significantly reduced this risk.[4–7] However, unlike the findings of previous studies,[4,8,9] we found that neither cleaning infants with oil nor a delay in cleaning them prevented hypothermia. Furthermore, the risk of hypothermia increased with the duration of cleaning.

Based on the results of this study, we recommend that, to prevent neonatal hypothermia, (1) hospitals should maintain the labour room temperature within the range recommended by WHO,[2] (i.e. a minimum of 25°C when skin-to-skin contact between infants and mothers is practised, or else a minimum of 28–30°C); (2) cleaning newborn infants in labour rooms should be discouraged.

TABLE 4
Potential risk factors associated with hypothermia immediately following cleaning of infants

Potential risk factors	Hypothermic infants ($n = 99$)	Not hypothermic infants ($n = 128$)	p values
Males (%)	41 (41.4)	58 (45.3)	0.6
Ethnic groups (%)			
Malay	81 (81.8)	79 (61.7)	Reference
Chinese	9	13	
Indians	6 (18.2)	14 (38.3)	0.000[a]
Others	3	22	
Mean gestation, weeks (SD)	39.3 (1.3)	39.4 (1.3)	0.7
Mean birthweight, g (SD)	3167 (384)	3216 (416)	0.4
Mean labour room temperature, °C (SD)	21.9 (3.4)	27.8 (3.7)	0.000[a]
Under radiant warmer prior to cleaning (%)	93 (93.9)	123 (96.1)	0.5
Under radiant warmer during cleaning (%)	81 (81.8)	38 (29.7)	0.000[a]
Mean age of cleaning, minutes (SD)	38.7 (24.7)	42.5 (24.9)	0.3
Mean pre-cleaning body temperature, °C (SD)	36.3 (0.7)	37.7 (0.8)	0.000[a]
Mean duration of cleaning, minutes (SD)	2.4 (1.3)	2.2 (1.1)	0.3

[a] Denotes statistical significance.

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