

crash involving a road or rail tanker containing toxic gas. Plumes from burning chemical warehouses, tyre dumps, or plastic stores are usually buoyant from the heat of the fire and may present little immediate risk, but whether they descend to ground level long enough to cause a hazard to the people indoors, and the range at which people could be affected, will depend on the management of the fire by the fire services, the type of materials involved, the wind and weather forecasts, and local topography.⁴ In warehouse fires, chemical fallout from the plume may contaminate nearby gardens and buildings.⁵ As these chemical fires can last for hours, or even days, temporary evacuation when conditions permit should always be considered, ideally with advice provided to the emergency services by a public health response team.⁴ More epidemiological studies with

good information on exposure will be essential to build the evidence base for decision making in chemical releases and for management after the incident.

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The role of healthcare delivery in the outcome of meningococcal disease in children: case-control study of fatal and non-fatal cases

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Abstract

Objective To determine whether suboptimal management in hospital could contribute to poor outcome in children admitted with meningococcal disease.

Design Case-control study of childhood deaths from meningococcal disease, comparing hospital care in fatal and non-fatal cases.

Setting National statistics and hospital records.

Subjects All children under 17 years who died from meningococcal disease (cases) matched by age with three survivors (controls) from the same region of the country.

Main outcome measures Predefined criteria defined optimal management. A panel of paediatricians blinded to the outcome assessed case records using a standardised form and scored patients for suboptimal management.

Results We identified 143 cases and 355 controls. Departures from optimal (per protocol) management occurred more frequently in the fatal cases than in the survivors. Multivariate analysis identified three factors independently associated with an increased risk of death: failure to be looked after by a paediatrician, failure of sufficient supervision of junior staff, and failure of staff to administer adequate inotropes. Failure to recognise complications of the disease was a significant risk factor for death, although not independently of absence of paediatric care ($P = 0.002$). The odds ratio for death was 8.7 (95% confidence interval 2.3 to 33) with two failures, increasing with multiple failures.

Conclusions Suboptimal healthcare delivery significantly reduces the likelihood of survival in

children with meningococcal disease. Improved training of medical and nursing staff, adherence to published protocols, and increased supervision by consultants may improve the outcome for these children and also those with other life threatening illnesses.

Introduction

Although treatment of meningococcal disease on a paediatric intensive care unit improves outcome,^{1 2} most patients present to their nearest emergency department and many deteriorate so rapidly that death from shock and multiorgan failure often occurs before transfer to a specialist paediatric intensive care unit. The speed with which the diagnosis is made, antibiotics administered, and the complications of shock and multiorgan failure treated is likely to be a major determinant of outcome.³ To test the hypothesis that outcome depends on the quality of health care early in the disease we undertook a national, blinded, case-control study of healthcare delivery in the first 24 hours after admission to hospital in children who died from meningococcal disease compared with those who survived.

Methods

We identified cases of meningococcal disease in children aged 0-16 years between 1 December 1997 and 28 February 1999. For each death (case) we identi-

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fied three survivors (controls) from the same region of the country matched for age, corresponding to different risks of mortality.⁴

A major problem in both the design and analysis of this study was how to control for the expected differences in severity of disease between fatal and non-fatal cases. The children who died were probably more ill than those who survived and would therefore require more medical interventions, which in itself could give rise to greater opportunity for treatment failure. At presentation to hospital, however, children who eventually die are not always sicker than those who survive (see bmj.com). To study failures of health-care delivery we identified children who initially presented with mild disease or severe illness and then controlled for the differences in severity of disease in multivariate analysis. To obtain a large enough group of survivors who were severely ill we recruited three controls for each case.

To control for disease severity we used the Glasgow meningococcal septicaemia prognostic score, which has been shown to predict outcome.⁵ We also controlled for known factors such as disease presentation (septicaemia or meningitis) and meningococcal serogroup. We included the presence of organ failure as a covariate in the multivariate analysis because it is a reliable indicator of disease severity. Finally we assessed failings of fluids and inotrope management in a subgroup of patients who developed cardiovascular failure. See bmj.com for details. Copies of the complete hospital medical and nursing records were received.

Standardised evaluation of emergency medical care *Development of a standardised assessment tool*

To provide an objective assessment of the promptness and quality of emergency medical care provided, we developed a standardised assessment tool using published and widely accepted criteria for diagnosis and management of meningococcal disease and its complications.⁶ We defined the following disease com-

plications (organ failures) namely: cardiovascular failure (shock), respiratory failure, neurological failure, raised intracranial pressure, and haemorrhagic rash.

Panel

An assessment panel—comprising a consultant in paediatric emergency medicine, a consultant in paediatric infectious diseases, and two consultants in paediatric intensive care—reviewed data on all cases.

Blinded evaluation of patient records using the standardised assessment tool

Vital signs and laboratory results recorded in each patient's notes in the first 24 hours after admission were transcribed on to flow charts in one hour time periods with the time of arrival at hospital taken as time 0 hours. The treatments initiated were also recorded for each hour. The clinical findings and laboratory results were then presented to the panel by revealing the information available at each hour after admission. On the basis of the information available at each hour, the panel members assessed each patient for the presence of diagnostic features of meningococcal disease and its complications. Using the agreed protocol⁷ they recommended standard management of each complication. The panel members became aware of the outcome (fatal or not) only after their scoring had been recorded.

We evaluated the actual hospital management, both in terms of timing and the actions undertaken. Delay of more than an hour between the action recommended by the panel and what actually occurred was defined as a failure of care and delay of more than 24 hours in being seen by a consultant as a failure in supervision. The panel assessed whether the failure in care resulted from a failure to recognise the complication or a failure to recognise the severity and to adhere to the protocol. The panel scored all patients on admission with the Glasgow meningococcal septicaemia prognostic score,⁵ and patients were assigned to three groups based on objective clinical features: meningitis, septicaemia, or a mixed picture. We also recorded what sort of team (paediatric or adult) primarily cared for the child.

Statistical methods

We used multivariate conditional logistic regression on matched data with death/survivor status as the outcome variable and failures of care as explanatory variables. We evaluated a "full" model, which included all the failures of care as well as the effects of potential confounders. We then used the likelihood ratio test to compare this full model with nested models comprising a subset of failure variables.

Results

During the study period 190 deaths and 755 survivors were notified of which 143 cases and 355 controls were included in the study. Organ failure was present in 141 children who died and 169 survivors.

Univariate analysis

Failures in management were significantly more common in children who died than in survivors. With the exception of serogroup, probability of death was significantly correlated with Glasgow meningococcal

Table 1 Multivariate model of treatment of children with meningococcal disease who died or survived (R²=79%). Odds ratios (OR) are for death

Variable	OR (95% CI)	P value
Potential confounders		
GMSPS:		
6-10 v 0-5	8.53 (1.4 to 53)	0.021
11-15 v 0-5	18 (2.3 to 139)	0.006
Septicaemia v meningitis	0.1 (<0.01 to 3.9)	0.19
Both v meningitis	0.01 (<0.01 to 0.8)	0.039
Serogroup C v B	2.1 (0.6 to 8.1)	0.27
Other serogroup v B	1.6 (0.5 to 5.1)	0.45
Organ failure	1070 (0.7 to ∞)	0.063
Need inotropes	19.6 (2.5 to 151)	0.004
Need fluid	18.9 (0.2 to 1490)	0.19
Management failures		
Not under care of paediatrician	66.0 (3.6 to 1210)	0.005
Failure of supervision by consultant	19.5 (1.8 to 213)	0.015
Patient assessment failures		
Recognise complications	3.33 (0.7 to 17)	0.14
Recognise severity	0.51 (0.1 to 2.5)	0.40
Clinical practice failures		
Administration of inotropes	23.7 (2.6 to 213)	0.005
Administration of fluids:		
Too little v adequate	1.49 (0.2 to 12)	0.59
Too much v adequate	19.4 (0.2 to 1560)	0.19

GMSPS=Glasgow meningococcal septicaemia prognostic score.

septicaemia prognosis score, presence of organ failure, and disease type. Failure to recognise complications, failure to appreciate disease severity, failure in supervision, lack of involvement of a paediatric team in care, and inadequacies of fluid and inotrope administration were all significantly associated with death. Multiple treatment failures significantly increased the risk of death (see [bmj.com](#)).

Multivariate analysis

The full model indicates that not being under the care of a paediatrician, failure of supervision, and failure to administer inotropes are independent risk factors for death (table 1). Not being under paediatric care was highly correlated with a failure to recognise complications ($P=0.002$; Fisher's exact test). When we removed absence of paediatric care from the model, failure to recognise disease complications became highly significant (6.1, 1.7 to 22; $P=0.006$, table 1). This association suggests that failure to recognise complications is one of the consequences of absence of paediatric care. Using the risk factors identified in the multivariate analysis, we found the odds ratio for death with one failure increased with additional failures (table 2).

Discussion

We found a highly significant increase in the frequency of departures from optimal care in children who died compared with those who survived. Significant independent risk factors for death included not being treated by a paediatric team, not being supervised by a consultant, and inadequate inotrope therapy. Our multivariate analysis also suggests that failure to recognise complications was a significant risk factor for death, although not independently of absence of treatment by a paediatric team. Given that these two failures are highly correlated we suggest that failure to recognise complications is one of the consequences of absence of paediatric care.

The criteria used by the panel to diagnose the complications of meningococcal disease were based on widely accepted and published criteria, which depend on clinical observation easily determined by any medical and nursing team. They also use simple biochemical (blood gases) or monitoring (pulse oximetry) technologies, which are readily available in all district hospitals. All treatments recommended by the panel were based on published protocols of management.^{7 8 9} The panel used objective findings recorded in the clinical notes to assess the disease and its complications. It therefore seems that when the panel decided failures had occurred, these resulted from a medical team either not appreciating the importance of clear physical signs or laboratory results or not following published management protocol.

Why care may be suboptimal

Vital signs were often inadequately documented in the nursing records. If signs of compensated shock were recorded but not appreciated, delays in diagnosis and treatment were inevitable. Many children with signs of shock were not recognised as seriously ill. Often this seemed to be due to their care being undertaken mainly by doctors trained to recognise serious illness in adults.

We found that children being looked after by doctors without paediatric training were at increased risk

Table 2 Multivariate model for multiple failures, with odds ratios for death in children presenting with meningococcal disease

Variable	OR (95% CI)	P value
Potential confounders:		
GMSPS:		
6-10 v 0-5	8.15 (1.8 to 37)	0.007
11-15 v 0-5	17.6 (3.4 to 92)	0.001
Septicaemia v meningitis	0.16 (0.01 to 2.1)	0.16
Both v meningitis	0.02 (<0.01 to 0.6)	0.024
Serogroup C v B	1.76 (0.5 to 6.0)	0.37
Other serogroup v B	1.50 (0.5 to 4.6)	0.48
Organ failure	245 (2.4 to ∞)	0.019
Need inotropes	15.6 (3.1 to 79)	0.001
Need fluid	5.33 (0.3 to 99)	0.26
No of failures:		
0	1.0	—
1	8.74 (2.3 to 33)	0.001
2	34.2 (5.9 to 198)	<0.001
>2	113 (8.4 to 1510)	<0.001

GMSPS=Glasgow meningococcal septicaemia prognostic score.

of dying. Lack of supervision by a consultant was also an independent risk factor for death. The significantly increased odds ratio for death associated with failure to administer appropriate inotrope therapy emphasises the importance of protocols for management of meningococcal disease.

Conclusions

Earlier recognition of the signs and symptoms of meningococcal infection may lead to earlier diagnosis, earlier treatment intervention, and reduced risk of a fatal outcome. Meningococcal disease shares many features with other life threatening acute illnesses. The difficulties in recognition of the seriously ill child and

What is already known on this topic

Overall mortality from meningococcal disease has not changed significantly in the past few decades, though recent studies have shown improved outcomes in children treated aggressively in paediatric intensive care units

Meningococcal disease can progress very rapidly

Most children with meningococcal sepsis present to their local hospital and many die before they can be transferred to specialist intensive care units

What this study adds

The quality of healthcare delivery in hospital for children with meningococcal disease differs in fatal and non-fatal cases

Optimal early management of septicaemia and meningitis at the admitting hospital can improve outcome

Improved outcome is associated with children being managed by paediatric teams and junior doctors being supervised by consultants

Doctors should follow published protocols of care for fluid resuscitation, inotrope therapy, and referral to paediatric intensive care units

in treatment of shock and organ failure that we have examined in the context of meningococcal disease might be equally apparent in the management of children with other life threatening disorders.

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Methods of hysterectomy: systematic review and meta-analysis of randomised controlled trials

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Abstract

Objective To evaluate the most appropriate surgical method of hysterectomy (abdominal, vaginal, or laparoscopic) for women with benign disease.

Design Systematic review and meta-analysis.

Data sources Cochrane Menstrual Disorders and Subfertility Group Trials Register, Cochrane Central Register of Controlled Trials, Medline, Embase, and Biological Abstracts.

Selection of studies Only randomised controlled trials were selected; participants had to have benign gynaecological disease; interventions had to comprise at least one hysterectomy method compared with another; and trials had to report primary outcomes (time taken to return to normal activities, intraoperative visceral injury, and major long term complications) or secondary outcomes (operating time, other immediate complications of surgery, short term complications, and duration of hospital stay).

Results 27 trials (total of 3643 participants) were included. Return to normal activities was quicker after vaginal than after abdominal hysterectomy (weighted mean difference 9.5 (95% confidence interval 6.4 to 12.6) days) and after laparoscopic than after abdominal hysterectomy (difference 13.6 (11.8 to 15.4)) days, but was not significantly different for laparoscopic versus vaginal hysterectomy (difference -1.1 (-4.2 to 2.1) days). There were more urinary tract injuries with laparoscopic than with abdominal hysterectomy (odds ratio 2.61 (95% confidence interval 1.22 to 5.60)), but no other intraoperative visceral injuries showed a significant difference between surgical approaches. Data were notably absent for many important long term patient outcome measures, where the analyses were underpowered to detect important differences, or they were simply not reported in trials.

Conclusions Significantly speedier return to normal activities and other improved secondary outcomes (shorter duration of hospital stay and fewer unspecified infections or febrile episodes) suggest that vaginal hysterectomy is preferable to abdominal hysterectomy where possible. Where vaginal hysterectomy is not possible, laparoscopic hysterectomy is preferable to abdominal hysterectomy, although it brings a higher chance of bladder or ureter injury.

Introduction

Three main types of hysterectomy are now used—abdominal, vaginal, and laparoscopic. The proportion performed laparoscopically has gradually increased, and, although the procedure takes longer than abdominal and vaginal hysterectomy, proponents have emphasised several advantages: the opportunity to diagnose and treat other pelvic diseases and to carry out adnexal surgery; the ability to secure thorough intraperitoneal haemostasis at the end of the procedure; and a rapid recovery time.¹

Three subcategories of laparoscopic hysterectomy have been described.² In laparoscopic assisted vaginal hysterectomy (LAVH), the procedure is done partly laparoscopically and partly vaginally, but the laparoscopic component does not involve uterine vessel ligation. In uterine vessel ligation laparoscopic hysterectomy (LH(a)), although the uterine vessels are ligated laparoscopically, part of the operation is done vaginally. In total laparoscopic hysterectomy, the entire operation is done laparoscopically; this requires the highest degree of surgical skill and is currently done



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