Prognostic score in acute meningococcemia

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A prognostic score for children with acute meningococcemia is proposed. We reviewed 176 consecutive patients with acute meningococcemia with ten fatalities admitted to our pediatric ICU in the last 3 yr. The score was obtained from patients in shock, using a stepwise linear discriminant analysis of 18 clinical and laboratory variables on admission. Nine variables showed a significant discriminant power in predicting survival and death: coma, base excess, platelets, glucose, temperature, WBC, sex, purpura, and CSF. The score predicted survival in 100% and death in 91%. The predictive values were significantly better than evaluation by the frequencies of the usual clinical and laboratory variables.
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Acute meningococcemia (AM) is a frequent condition in our country with an uncertain prognosis and has been studied to define its severity and predict its outcome. Apart from the unquestionable clinical interest of outcome prediction, this study may affect allocation of health care resources. The purpose of this report is to describe a predictive model for outcome of pediatric AM in our hospital.

PATIENTS AND METHODS

We reviewed 176 cases of AM admitted to our pediatric ICU (PICU) from January 1983 to December 1986. Ours is the sole PICU serving a population of 700,000. All children were referred by primary care units, and none of them had been treated previously in a hospital.

Diagnosis was made on a positive blood or CSF culture of *Neisseria meningitidis* in 107 (60.8%) children. In children with negative cultures (n = 69), diagnosis was based on the presence of hyperthermia and purpura-petechiae of sudden onset, hemodynamic changes consistent with endotoxic shock, absence of previous data, and exclusion of other infectious diseases. This clinical picture was identical to that demonstrated by children with positive cultures.

Ages ranged from 1 month to 12 yr (mean 3 11/12 yr), and 96 (55%) were males. Ten (5.7%) children died within the first 12 h after admission. The therapeutic approach was uniform: ampicillin, blood volume replacement, dopamine, dobutamine, mechanical ventilation, and extrarenal depuration, depending on the patient's condition. There were no significant changes in nursing or medical staff.

On admission to the PICU, the following clinical variables were studied: age; sex (coded as 0 - male, 1 - female); delay from onset of symptoms to admission in hours; shock, coded as 0 (absent), 1 (normotension, tachycardia, drowsiness/irritability, prolonged capillary-refilling time, oliguria), and 2 (hypotension and anuria); coma (0 - absent, 1 - S. Glasgow <8); central temperature; meningeal signs (0 - absent, 1 - present); and purpura (0 - absent, 1 - present).

The following laboratory variables were studied: fibrinogen, potassium, CSF, WBC, peripheral WBC, platelets, calcium, glucose, pH, bicarbonate, and base excess.

Statistical analysis was performed using the discriminant program of the SPSS-tm package (version M, release 8.0A). Missing data were substituted by the mean value of the sample. Cases were divided into two groups by either the presence (group A) or the absence (group B) of shock coded as 2. Clinical and laboratory data of group A patients were processed. Variables to elaborate a prognostic score were selected, applying the stepwise method and using the criterion of minimization of Wilks' lambda. Coefficients (Fisher's linear discriminant function) were obtained for the variables selected. Validation of the score was done by applying it to group B patients. The predictive accuracy of the score was compared with outcome

RESULTS

A summary of statistical analysis is presented in Table 1. Discriminant function is: $Y = (-4.764) \times \text{coma} + 0.433 \times \text{base excess} - 0.00001 \times \text{platelets} +$

TABLE 1. Statistical analysis, showing the step and the variables, with their Wilks' lambda

Step	Entered	No. of Variables	Wilks' Lambda
1	Coma	1	0.634
2	Base excess	2	0.484
3	Platelets	3	0.419
4	Glucose	4	0.381
5	Temperature	5	0.344
6	WBC	6	0.331
7	Sex	7	0.316
8	Purpura	8	0.307
9	CSF, WBC	9	0.299

TABLE 2. Classification results for patients in shock (group A) and those not in shock (group B)

Actual Prognosis	No. Patients	Predicted Prognosis	
Group A			
1 Survival	41	40	1
		(97.6)	(2.4)
2 Death	10	0	10
			(100)
Group B			
1	125	125	0
		(100)	(0)
2	0	0	0
		(0)	(0)

Percentages are given in parentheses.

$0.0777 \times \text{glucose} - 1.342 \times \text{temperature} + 0.0001 \times \text{WBC} - 2.548 \times \text{sex} - 4.075 \times \text{purpura} - 0.0003 \times \text{CSF WBC} + 59.778$. For a positive Y-value, the outcome is survival; if it is negative, the outcome is death. The classification results for group A (in shock) and group B are shown in Table 2. Patients in shock were correctly classified in 98%, and those not in shock were classified in 100%.

The predictive values (PV) for survival and death were compared with the results of random distribution: PV for survival = 1 vs. 0.8 ($p < .01$); PV for death = 0.909 vs. 0.2 ($p < .01$).

DISCUSSION

Since Stiehm and Damrosch (1) reported the prognostic criteria of meningococcal infections, there have been several studies (2–5) concerning individual factors as prognostic determinants. As far as we know, only the multivariate methodology enables us to reach good PV. In our study, no single variable, independently considered, has an acceptable prognostic value.

The accuracy of outcome prediction in group A (those in shock) was high (98% correctly classified) and statistically different from the expected value at random. Predictive accuracy remained very high when we applied the score to group B (100% correctly classified), although that seemed to be less significant because shock was one of the main prognostic factors (no one died in group B). According to Bayes' theorem, outcome prediction will depend on the mortality rate of the sample and the sensitivity (0.975) and specificity (1) of the score. Thus, the absence of death in group B results in a severe bias.

These predictive results can be obtained in groups with characteristics similar to those of the index group that provided the database. The immediate availability of these variables and score on PICU admission is of prognostic value in AM patients.

REFERENCES

1. Stiehm ER, Damrosch DS: Factors in the prognosis of meningococcal infection. *J Pediatr* 1966; 68:452
2. Leclerc F, Beuscart R, Guillois B, et al: Prognostic factors of severe infectious purpura in children. *Intensive Care Med* 1985; 11:140
3. Gardlung B: Prognostic evaluation in meningococcal disease. *Intensive Care Med* 1986; 12:302
4. Kahn A, Blum D: Factors of poor prognosis in fulminating meningococcemia. *Clin Pediatr* 1978; 17:680
5. Lewis LS: Prognostic factors in acute meningococcemia. *Arch Dis Child* 1979; 54:44