The Value of Radiography in the Initial Grading of the Idiopathic Respiratory Distress Syndrome

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SUMMARY

The initial chest radiograph obtained in infants with idiopathic respiratory distress syndrome was evaluated in relation to the clinical and biochemical status of the infant as well as to the prognosis. In 101 neonates a statistically significant correlation was demonstrated.


The value of radiography in the diagnosis of neonatal respiratory distress is well recognized. It has been postulated that the initial chest radiograph of infants with idiopathic respiratory distress syndrome (IRDS) could be useful in predicting the course and the severity of the disease. The object of this study was to correlate the initial radiological grading of the disease with the initial biochemical data, and to assess whether either or both could be correlated with the outcome.

SUBJECTS AND METHODS

A retrospective review of the initial chest radiographs and the hospital records of 106 infants admitted with IRDS to the Intensive Care Unit of the Transvaal Memorial Hospital for Children from January 1976 to June 1977 was undertaken. Complete data were available for 101 patients. Although serial chest radiographs were available, only the initial radiographs were utilized for this study. For 101 patients, full data were available on the clinical and respiratory status of the infant, including the initial PaO₂, HCO₃, Pco₂ and initial concentration of oxygen administered. The infants were divided into three weight groups: 35 infants (19 males and 16 females) weighed under 1 500 g; 56 infants (34 males and 22 females) weighed between 1 500 and 2 500 g; and 10 weighed over 2 500 g, with an equal number of males and females. Gestational ages of these infants ranged from 28 to 36 weeks, with a mean age of 33 weeks.

Radiographs were taken in the intensive care unit, using a Toshiba Mobile Unit (48 KVP, 300 mA, 0.02 s).

On the initial chest radiographs only, the X-ray appearances were graded I - IV, using the criteria suggested by Tudor et al.:

Grade I: A ground glass appearance of the lungs, with well-expanded lungs and no evidence of an air bronchogram (Fig. 1).

Grade II: More prominent opacification of the lung fields, well-expanded lungs, a prominent air bronchogram with distinct heart and diaphragmatic borders (Fig. 2).

Grade III: Coarse granular opacification of the lungs and indistinct cardiac and diaphragmatic silhouette, widespread air bronchograms and poorly expanded lungs (Fig. 3).

Grade IV: Total collapse of the lungs with complete opacification, indistinct cardiac and diaphragmatic silhouettes, and distinct or occasionally absent air bronchograms (Fig. 4).

Fig. 1. Grade I.

The majority of the neonates had umbilical arterial catheters, to avoid errors of capillary sampling. When an umbilical arterial catheter could not be placed, capillary samples were checked frequently by direct arterial stabs, usually of the right radial or brachial arteries, obviating...
any significant right-to-left shunt through the ductus. Many infants had to be transported from outlying hospitals and were often hypothermic, hypoglycaemic or had intractable metabolic acidosis on arrival. Oxygen was delivered into a head box to keep a constant concentration. When there was deterioration, nasal prongs, facemasks or nasotracheal tubes were used in order to obtain a continuous distending pressure.

The patients were nursed in a neutral thermal environment, with adequate fluid replacement and early hyperalimentation if they could not be fed via a nasogastric tube. Antibiotics were given only if there had been prolonged rupture of membranes or other increased risk factors for sepsis. Neonates who required prolonged respirator support were invariably given a combination of penicillin and an aminoglycoside.

With this aggressive approach to blood volume replacement and support of blood pressure, together with increased tissue perfusion using isoprenaline, the mortality rate has dropped to less than 20%.

RESULTS

Comparison of all parameters in children of all weight groups who suffered from grades III and IV disease, and these were therefore assessed together as grade III/IV disease. However, comparison of the radiological grading of the disease with the weight groups demonstrated significant differences. Children with radiological evidence of grade I/II disease showed a higher mortality rate among the group who weighed less than 1 500 g, compared with those who weighed more than 1 500 g.

There were 42 children with grade I/II disease of whom 17 weighed under 1 500 g, with a mortality of 17 (41%). Of the 25 infants who weighed over 1 500 g, only 2 died (8%) ($P$<0.015, Fisher exact test). The radiological changes of grade III/IV disease were present in 59 children. Eighteen weighed under 1 500 g, of whom 8 died (44%). Of the 41 weighing over 1 500 g, 14 died (34%). These figures were not statistically significant.

In the weight group above 1 500 g, there was a statistically higher mortality rate in those children who had grade III/IV disease than in those with grade I/II disease. Only 2 of 25 with grade I/II disease died (8%) as against 14 out of 41 with more severe grading (34%) ($P$<0.05, Fisher exact test) (Fig. 5).

Significantly lower levels of serum standard HCO$_3$ (Fig. 6) and PaO$_2$ (Fig. 7) were noted in children with grade III/IV disease, when compared with those with grade I/II disease ($P$<0.05 and $P$<0.005 respectively, Fisher exact test). There was, however, no difference in the Paco$_2$ value with any grading of the disease.
Oxygen concentrations administered were significantly lower in children with grade I/II disease than in those with grade III/IV disease. In the children with grade I/II disease, an administered mean oxygen concentration of 62% resulted in a mean Pao2 of 63 mmHg. In children with grade III/IV disease, the mean inspired oxygen concentration was 81% with a mean Pao2 of only 50 mmHg (Fig. 8).

The incidence of pneumothorax in the three weight groups or in the different grades of disease was not significantly different. Of the 31 children who died, only 8 had had a pneumothorax, but 11 others who had had a pneumothorax survived.

**DISCUSSION AND CONCLUSION**

We conclude that the initial radiological grading of the disease, together with the weight of the infant, correlates fairly well with the course of the disease. Obviously, some cases graded as I/II initially progressed to III/IV, but these did not affect the outcome significantly, even though the initial radiographs were used as the prognostic factor.

It has been shown that infants who weighed more than 1500 g with grade III/IV disease had a significantly higher mortality rate than the children who presented with grade I/II disease. Similarly, when grade I/II disease was present, the infants weighing under 1500 g had a higher mortality rate than those weighing over 1500 g.

There was also a significant correlation between the biochemical status of the infant and the X-ray findings. The serum HCO3 and Pao2 were significantly lower in children with grade III/IV disease, despite the inspired oxygen concentration being significantly higher in the
children with grade III/IV disease, compared with those with grade I/II disease.

The initial X-ray grading is often useful in assessing the clinical status of the infant and predicting the prognosis.

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REFERENCES


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