ORIGINAL ARTICLE

Some Aspects of Pediatric Intensive Care Unit

by

RUSEPNO HASSAN and Y.A. KASIM

(From the Department of Child Health, Medical School University of Indonesia/Dr. Cipto Mangunkusumo General Hospital, Jakarta)

Abstract

A pediatric intensive care unit is a matter of fact indispensable for a pediatric hospital. The Pediatric Department of the Dr. Cipto Mangunkusumo General Hospital, although not really a pediatric hospital, has a capacity of 300 beds for infants and young children; therefore, it is only natural that the Department should acquire its own intensive care unit. On July 1, 1976, we established the Intensive Care Unit, furnished at first with simple equipments, and eventually with more modern ones. In the first ten months of operation we were able to treat 154 cases with a mortality rate of 51.9%. This high rate is mainly due to the severity of the cases treated and the delay of hospitalization.

Received 10th. October 1979.

Introduction

An intensive care unit is recognized today as an integral and essential component of any general hospital (Krishna, 1979). In 1971, in the Dr. Cipto Mangunkusumo Hospital Jakarta, a general ICU was established by the Department of Anesthesiology. At the beginning, the unit was designed for adult patients only, thus the facilities, equipments and staff were not available for children. At this time the unit is also meant for pediatric patients, both for medical and surgical cases.

A child is not a little adult. The child has different anatomy and physiology and different response to stress and treatment. A good environment for adult patients is not always good for children. Infants are very likely to sustain a severe physiological disturbance in the presence of respiratory illness because of the structural immaturity of their respiratory system and the narrowness of their airways (Stooks, 1973). Especially in the neonatal period, conditions are the result of immature or abnormal development, or of asphyxia or other injury sustained during birth.

The sternum is soft and it affords an unstable base for the ribs. These in turn are horizontally placed and the intercostal muscles are poorly developed, so the bucket handle motion upon which thoracic respiration depends is eliminated. Respiration is therefore almost entirely diaphragmatic and may readily be embarrassed by abdominal distention. Under physiological circumstances the tidal volume and vital capacity are comparable with older patients, but any disease process will cause disproportionate reduction, largely because of the markedly increased effort required to expand the chest. The airways are large in comparison with those of a adult, the trachea of a newborn is one third and the bronchioles are half in diameter of those of an adult which are 20 times his size. However, a given degree of swelling will have a much greater effect in early life.

For example, a one millimeter increase in the thickness of the mucosa at the subglottic level, will cause a 75% reduction in the cross sectional area of the airway in a neonate, but only a 19% reduction in an adult. Laryngotracheobronchitis and bronchiolitis are therefore serious diseases in the very young, but are of little importance in adults (Stocks, 1973). The susceptibility to infection is manifested in the high incidence of septicemia, pneumonia and meningitis. Progress of the illness is frequently so rapid that the diagnosis is difficult and respiratory failure and death often supervene before effective therapy can be established. Immature development is particularly common in premature infants; it may be expressed by the inability to breathe regularly, a lack of development of certain important reflexes, or deficiency of surfactant production. Irregular respiration occurs in nearly half of prematurely born neonates and may lead to apneic spells. Pharyngeal incoordination is common in the first 48 hours of

life and may result in inhalational pneumonia (Avery, 1968), occasionally it may persist for several months.

Developmental anomalies such as cardiac lesions, diaphragmatic hernia, etc., may affect part of the respiratory system or associated organs. Assisted ventilation with mechanical ventilation increases the complexity of the management and the incidence of complication, and is therefore usually reserved for patients unlikely to survive without it (Stoks, 1973). There are other reasons that can be put forward so that most people agree that children need a separate ICU.

On July 1, 1976, a Pediatric Intensive Care Unit was established in the Dept. of Child Health, Dr. Cipto Mangunkusumo General Hospital Jakarta. It is housed in a room measuring 13 × 13m² and divided into several rooms such as nursing care, laboratory, toilet, etc. Air flow is given from the central air conditioner with a room temperature of about 22° C and air humidity of about 55%. It is regulated in such a manner to enable the air to flow in one direction, so that the clean area does not mix with soiled area. Air borne bacterial contamination can be minimized by this method and it has been confirmed by bacterial examination. All methods and procedures in our unit enable us to isolate and to prevent cross infection. Gravely ill patients are especially vulnerable to this complication (Krishna, 1975).

The Dept. of Child Health, Dr. Cipto Mangunkusumo General Hospital Jakarta has 300 beds (including surgical and neonatal ward), and on the basis that 3% of the patients would require intensive care, 10 beds are considered adequate, 4 for newborns and 6 for infants and older children. Each bed is completely equipped with oxygen outlet, air outlet, suction unit, sphygmomanometer, electrical knob, examination lamp, etc. We started to work only with the most essential equipments. As time went on and we had some experiences on the type of cases to be managed, better equipments were gradually filled up. In children respiratory emergencies seem to predominate and everything needed must be available such as laryngoscopes, endotracheal tubes, selfinflating bag and mask, CPAP system, respirators such as Bird Mark VII, Mark VIII, Baby Bird Respirator, Loosco Amsterdam Infant Ventilator and RCF 4 Respirator. And also heartscope monitor, Apnoe monitor and the other alarm system.

Laboratory equipments for routine, electrolyte and blood gas examination, etc. are kept in our laboratory. The most important requirement for an ICU is an adequately trained nursing and medical staff (Krishna, 1975). On the base of nurse/patient ratio of about 1 : 2, our unit has 20 trained nurses.

Discussion

During the first 10 months, 154 patients of various age and disease were admitted to our unit. The mortality rate was 51.9% or 80 out of 154 cases.

Table I THE FIRST 154 CASES ADMITTED TO THE ICU

Neonates		< 1 year		1 - 3 year		3 - 6 year		> 6 year		Total	
S	D	S	D	S	D	S	D	S	D	S	D
9	21	24	21	20	13	14	12	7	13	74	80 (51.9%)
30		45		33		26		20		154	

S = Survived
D = Dead

Table II : DIAGNOSIS OF CRITICALLY ILL PATIENTS

	Neonates		< 1 Year		1 - 3 Year		3 - 6 Year		> 6 Year		Total	
	S	D	S	D	S	D	S	D	S	D	S	D
Tetanus	8	6	1	-	1	1	2	1	3	2	15	10
Pneumonia	5	4	27	15	10	8	5	2	2	2	49	31
Encephalitis	-	-	10	5	9	7	5	3	2	1	26	16
Gastroenteritis	7	6	7	4	2	1	1	-	1	1	18	12
Dengue Hemorrhagic Fever	-	-	-	-	9	3	10	5	9	6	28	14
Bronchial asthma	-	-	-	-	3	1	3	-	-	-	6	1
Laryngitis	-	-	6	2	4	1	1	-	-	-	5	4
IRDS	5	4	-	-	-	-	-	-	-	-	5	4
Pneumothorax	3	1	-	-	2	1	-	-	-	-	5	2
CHD	3	3	5	3	1	1	-	-	1	1	10	8
Meningitis	1	1	2	2	-	-	-	-	-	-	3	3
Renal Desease	-	-	3	2	-	-	-	-	2	1	5	3
Post Craniotomy	1	-	1	-	-	-	-	-	4	1	6	1
Post Operative	4	2	4	1	1	-	1	-	-	-	10	3
Introduction	-	-	1	-	-	-	-	-	1	1	2	1
Others	-	-	2	-	-	1	-	3	1	1	7	1

S = Survived D = Dead

Table III : CAUSE FOR ADMISSION TO ICU

	Neonates	< 1 Year	1-3 Year	3-6 Year	> 6 Year	Total
Respiratory Distress Respiratory Failure	25	33	24	18	16	116
Water/Electrolyte and acid base balance disturbances	20	29	18	13	18	98
Severe convulsions	11	13	10	8	6	48
Shock	1	1	9	12	10	33
Hemorrhage	1	-	9	9	10	29
Tracheostomy	-	4	4	1	-	9
Heart failure	3	5	-	-	2	10
Post operative care	4	3	2	1	4	14
Hyperpyrexia	-	-	2	1	1	4
Arrhytmia	-	1	-	4	5	10
Renal failure	-	1	-	-	3	4
Parenteral nutrition	1	1	-	-	-	2

This high mortality rate was due to the severity of the patient's condition on admission to the ICU and usually it had been given all kinds of treatment. For example, a child who suffers from bronchial asthma, will be first seen by a general practitioner and the doctor will try to give a treatment. When no good result is observed, the patient will be referred to the hospital in status asthmaticus, and then oxygen inhalation as well as other various treatment are given. If the patient becomes worse then he will be referred to the Pediatric ICU.

In such a manner, the shock patient will be referred to the ICU after prolonged or recurrent shock and various treatments have been given. Table 1 shows that the mortality of neonatal patients is higher than of infants and older children. This is due to difficulty to manage the neonatal problems. The mortality rate is also higher in children more than 6 years of age. May be the critically ill child at this age is not so worrying than in infant. In infants and young children a common disease sometimes seems to be critical. Intensive care could be required for other conditions in the pediatric age group. These include status epilepticus (Carter and Gold, 1969), endotoxin shock (Hodes, 1969), respiratory arrest (Smith, 1970), and others.

Table 2 shows the diagnosis of critically ill patients admitted to our unit. The major problems in neonates and infants are pneumonia, tetanus, gastroenteritis, encephalitis, IRDS, CHD, and pneumothorax. Whereas in older children the main problem is dengue hemorrhagic fever. Usually pneumonia cases are referred to if they are associated with impaired ventilation. When the impairment of ventilation is sufficient to pose an immediate threat to life, acute respiratory failure exists (Downes and Raphaely, 1975).

Gastroenteritis is still one of the major causes of morbidity and mortality in children in Indonesia. If it is complicated with shock or severe acid base/electrolyte disturbances, intensive care will be clearly needed. Infants with idiopathic respiratory distress syndrome (IRDS), the leading cause of respiratory failure in the newborn period, frequently require ventilatory assistance. By using continuous positive airway pressure (CPAP), only 5 out of 9 cases survived. Whereas Gregory et al. (1976) reported that the mortality rate was 8%. Dengue hemorrhagic fever, one of the serious problems in our department is usually referred to due to prolonged shock with or without bleeding tendency.

Congenital cardiovascular lesion such as tetralogy of Fallot cause severe tissue hypoxemia and eventual myocardial and central nervous system failure. Many of these children require intensive care (Downes and Raphaely, 1975). Post operative cases such as craniotomy and other major surgical cases have minimal mortality. The other cases admitted to our unit are epilepsy, tracheomalacia,

empyema thoracis, atelectasis, paralytic ileus, hydrocephalus and carditis, one case each.

Table 3 shows the cause for admission to the ICU. The leading reason for admission are respiratory distress/failure, water/electrolyte and acid base balance disturbance. According to Levin (1976), over 75% of patients admitted to the pediatric ICU have respiratory distress to some degree. Subha Rao et al. (1973) reported that respiratory involvement comprised 66.6% of the indication for admission to his pediatric ICU.

Severe convulsion is also a leading factor for admission in our unit. Usually it is correlated with respiratory problems. Acute nervous system failure poses an immediate threat to life to :

1. coma, with upper airway obstruction or pulmonary aspiration of gastric contents.
2. disturbed respiratory control secondary to medullary depression.
3. increased intracrianal pressure, causing brainstem and cortical compression (Downes and Raphaely, 1975).

Hyperpyrexia (body temperature more than 41° C) will become a problem if it cannot be lowered by common hibernation procedures because it may develop to malignant hyperpyrexia. It seems that there is no different problem in our unit in connection with patient's age.

ICU has never been an economical object, because the costs of equipments and maintenance are extremely expensive. In spite of all these expenditures there is an outstanding benefit that is to give immediate and effective help at all time to those who need it.

REFERENCES

1. AVERY, M.E. : The lung and its disorder, in the newborn infant, 2nd ed. (Saunder, Philadelphia/London/Toronto 1968).
2. CARTER, S. and GOLD, A.P. : Status epilepticus. Pediatrics 44 : 73 (1969).
3. DOWNES, J.J. and RAPHAELY, R.C. : Pediatric intensive care. Anesthesiology, 43 : 238 (1975).
4. GREGORY, G.A.; KITTERMAN, J.A.; PHIBB, R.H.; TOOLEY, W.H. and HAMILTON, M.K. : Continuous positive airway pressure as treatment in the idiopathic respiratory distress syndrome; in Stetson et al. 's Neonatal intensive care (Green, 1976).
5. HODES, H.L. : Endotoxin shock. Pediatrics 44 : 248 (1969).
6. KRISHNA, S.R. : An intensive care unit in a rural area. Anesth. intensive care 3 : 122 (1975).
7. LEVIN, R.M. : Pediatric respiratory intensive care handbook (Toppan, Singapore 1976).
8. SMITH, R.M. : Respiratory arrest. Pediatrics 46 : 108 (1970).
9. STOCKS, J.G. : The management of respiratory failure in infancy. Anaesth. intensive care 1 : 486 (1973).
10. SHUBHA RAO, SHENAI, J.P. and BHARUCHA P.E. : Intensive care in pediatrics. Ind. Pediat. 10 : 27 (1973).