

of improved instruments for their own use, physicians should do the following things. They should work more consistently with currently available monitors. They should develop a more sympathetic understanding of the limitations of physical systems to discriminate pertinent from extraneous information. They should distinguish those parameters of circulation, respiration and reflex irritability which provide the most useful information. They should learn to recognize those modes of data presentation

which communicate to them maximum intelligence with minimum distraction. They should determine the type of instrument package which will provide maximum availability with minimum cost of time and energy to initiate its function. Finally, they should invite design engineers to work with them and to observe at first hand the nature of their problems.

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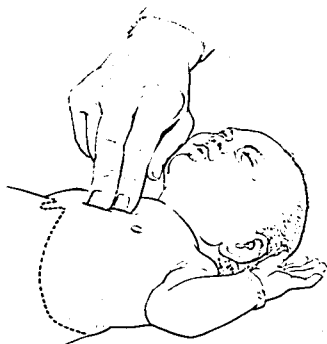
Closed Chest Cardiac Massage in the Newborn

To the Editor.—Though isolated cases of successful treatment of cardiac arrest in the newborn by thoracotomy and cardiac massage have been reported, an analysis of the experience of the Sloane Hospital for Women showed one survivor out of 10 cases of attempted cardiac resuscitation. This one survivor after 12 months has definite neurologic damage. Particular disadvantages of the open technique for the newborn lie in the additional burden of a thoracotomy superimposed upon the severe asphyxia of birth, as well as delays caused by doubt as to diagnosis, unpreparedness, or an understandable reluctance to initiate such an operation.

Cardiac massage without thoracotomy has been recently reintroduced by Kowenhoven, Jude, and Knickerbocker (*J. A. M. A.* 173: 1064, 1960), who, after experimental work with dogs, showed this to be a safe and effective method for patients. Clinical application of this technique by these workers on 20 patients aged from two months to 80 years has resulted in an over-all survival rate of 70 per cent. Although closed chest cardiac massage would appear to be especially advantageous for use in the newborn, there has been no previously reported experience with this technique in this age group.

Cardiac resuscitation through an intact chest has been used and studied at Sloane Hospital for Women in 4 babies during the first three days of life. Three of the infants developed cardiac arrest during or after birth; the fourth had received an overdose of digitalis on the third day of life. After the

babies' lungs had been properly ventilated via an endotracheal tube, sternal compression was usually provided by the use of two fingers.



Location of fingers for sternal compression in cardiac massage in the newborn.

However, the effectiveness of thumb pressure in maintaining adequate blood pressure was also evaluated and compared to the two finger technique.

Closed chest cardiac massage was maintained for periods ranging from 10 minutes to two and one-half hours. An effective spontaneous heart beat returned in the one infant who received sternal compression within 60 seconds of the diagnosis of cardiac arrest by auscultation. This newborn left the delivery suite in good condition and at three months

of age is healthy, developing normally and has no demonstrable neurologic sequelae. The other three infants who did not establish spontaneous heart beats, had been exposed to either severe asphyxia in utero or prolonged delays in instituting the cardiac massage.

Aortic and venous blood pressures were obtained during the massage in one of the infants by means of soft polyethylene catheters inserted into the umbilical artery and vein. It was found that two finger sternal compression could establish and maintain aortic systolic pressures exceeding 70 mm. of mercury. On the other hand, use of intermittent thumb pressure achieved a maximum of 40 mm. of mercury systolic pressure. Regardless of the method of compression a diastolic pressure of approximately 20 mm. of mercury was produced. Electrocardiograms recorded during the period of massage of two of the infants showed some improvement in the configuration and rhythm. The electrocardiogram would rapidly deteriorate upon temporary cessation of the cardiac massage.

Röntgenographic and post-mortem examination of two of the infants revealed no significant pathology of the chest walls, hearts, lungs and livers. There were no subcapsular hematomas of the liver noted. The examining pathologist made the observation that the myocardia in these cases were relatively free of any evidence of trauma when compared to the hearts of those infants who had undergone thoracotomy and massage.

This early experience with closed chest cardiac massage in the newborn has led to the formulation of the following tentative principles and recommendations for the management of cardiac arrest in the neonatal

period: (1) Closed chest cardiac massage should be instituted only after the baby's lungs have been properly ventilated via an endotracheal tube. (2) Ventilation of the lungs at a rate of 40-50/minute with an oxygen enriched atmosphere should be continued during the massage, with occasional short pauses in the compression of the sternum. (3) The infant should be placed upon a firm surface. Effective massage is obtained with vigorous compression of the middle third of the sternum using only two fingers. The rate of massage should be between 100 and 120 times per minute. (4) If the above measures prove ineffective CaCl_2 or epinephrine may be injected into one of the cardiac chambers. (5) Lastly, ventricular fibrillation in the newborn is rare, therefore, use of the external defibrillator will not usually be necessary.

It was concluded that closed chest cardiac resuscitation is effective in producing an adequate blood pressure and improvement of the electrocardiographic pattern without trauma to the bony structures or internal viscera. The initial results with this method are encouraging and warrant further serious consideration and investigation.

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