The ethics of cardiopulmonary resuscitation.

II. Medical logistics and the potential for good response

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Cardiopulmonary arrest in a child or infant with a good capacity to respond needs to be matched by the timely availability of appropriate personnel and facilities. The provision of finance, adequacy of skill levels, hours worked, and sites covered by young doctors and the simultaneous demands made on staff in an emergency may all impinge on the availability of cardiopulmonary resuscitation (CPR) in hospital. Bystander CPR¹ and general practitioner² and paramedic services³ may also be relevant, while studies of outcomes in specific subgroups of children may enable better targeting of resources.

Economic aspects

Medical resources will inevitably continue to decrease in relation to demand and need^{4,5} so allocation and rationing is unavoidable.⁶ Yet \$16 million was awarded to a patient in Florida who sustained brain damage while nurses in a ward short of staff were busy attending to three other patients.⁷

A considerable excess of nocturnal perinatal mortality, noted in Lausanne in 1986, was partly attributed to reduced staff numbers, deterioration in medical functioning, and difficulty in organising resuscitation services at night.⁸ Mildred Stahlman pointed out ironically that 'the cheapest baby is a dead baby and the quicker the cheaper if death is inevitable'.⁹

Skilled medical availability

The availability of skilled paediatric staff varies considerably in different districts and regions of the UK.¹⁰⁻¹² Some maternity hospitals have tiers of resident paediatricians, some with several years' experience in the specialty,^{10,11} while others rely on general practitioner (GP) trainees on six month contracts with no previous experience to provide on site neonatal resuscitation.^{10,13} Many of these GP trainees work a one in three rota out of hours and many are supervised by consultants who are not on site 24 hours per day 365 days per year^{10,11,13}; many simultaneously cover emergency departments, children's wards and baby units, being on call up to 80 to 100 hours per week and with continuous spells of duty of up to 80 hours. Many consultant paediatricians still work in units with inadequate intermediate staff and make frequent out of hours calls to assist junior staff.¹⁴

A total of 19% of hospitals surveyed in Canada in 1987 had to summon help from outside the hospital if neonatal resuscitation was required.¹⁵

Recommended requirements for neonatal

resuscitation services include someone skilled in neonatal resuscitation being present at every delivery,¹⁶ or always in the maternity unit,¹⁷ or the doctor responsible for resuscitation being accompanied by a doctor skilled in resuscitation until competence is achieved,¹⁸ or a doctor skilled in resuscitation present at all 'high risk' deliveries.¹⁹ Applying such a criterion¹⁹ to a review of deliveries at a district general hospital in Sheffield²⁰ in 1984 would have required an 'advanced resuscitator of the newborn'¹⁷ to attend about 40% of all deliveries, though well under 1% of term infants had an Apgar score of 3 or less.

Surveys, of British house officers' skills²¹⁻²³ and retention of skills,²⁴ have consistently shown inadequacy at CPR. Surveys of 'office paediatricians' in the USA have shown inadequacies in relation to paediatric CPR.^{2,25,26} Similar surveys of training and equipment for American paramedics showed deficiencies in relation to children.³

Two hundred and one out of 367 British GP trainees felt incompetent to intubate a baby after 6 months' obstetric training²⁷ and another assessment of their training in paediatrics made no reference to resuscitation skills²⁸; indeed the relevance to general practice of experience in neonatal and much hospital paediatric practice has been questioned.²⁹

There may now be too few babies requiring intubation in many sizable maternity units to allow useful house officer experience to be gained if the more difficult intubations which need a very skilled operator are excluded,¹³ so that away from university centres doctors skilled in newborn resuscitation may be a relatively scarce resource in the UK in hospitals where middle grade staff are not employed.^{10,11,13} For example, there were 3111 deliveries in Grimsby Maternity Hospital in 1990 and a consultant paediatrician, in general, attended deliveries of babies 32 weeks' gestation or less where skilled intubation is frequently needed. Yet during a six month period only six other babies required intubation, nowhere near enough for four inexperienced house officers to become adept even by the end of their six months. In theory, however, they were liable to be predictably called for between 1000 and 1200 deliveries per annum at all times of day or night, in addition to calls to unpredictable problems. Imbalances in paediatric staffing in the UK ensure that a substantial number of babies may not have access to instant skilled resuscitation, which may have tragic and expensive consequences. Midwives or neonatal nurses who usually stay longer in post than most young doctors may be a better

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source of skilled resuscitators,^{13 15 30 31} but it may be necessary to reward those nurses with the skills.

Withholding CPR in neonates

There is consensus that withdrawal of intensive care and CPR may be considered in selected neonates³²⁻³⁵ due to specific congenital malformations,^{36 37} in infants with severe brain damage³⁸ and extreme prematurity³⁹; other justifications have included renal necrosis, bronchopulmonary dysplasia, and failure to respond.³⁴ Ethics committees³² and recourse to the law^{33 35} are not recommended by British paediatricians to solve these problems, but 'compassion, humility and courage' are required by the doctor.³²

Whitelaw considered 'near certainty of death' or 'no meaningful life'³⁵ as criteria for non-treatment and had he been able to predict the outcome in some of the worst of his multiply handicapped survivors he would have advised non-treatment. Such decisions must stand up to the most rigorous scrutiny³³ and Dunn said he would take the initiative in advising non-treatment, but if the parents disagreed after full discussion, he would continue full support.³²

Failure to establish respiration by 20^{40 41} to 30⁴² minutes of age is usually a bleak sign after birth asphyxia and may be considered an indication for cessation of treatment.^{40 42} There are many major uncertainties, however, regarding neurological prediction in newborn care.⁴³⁻⁴⁵

Modern methods of brain investigation including evoked responses,⁴⁶ computed tomography,⁴⁷ radionuclide imaging,⁴⁸ cerebral blood flow Doppler studies,⁴⁹ magnetic resonance spectroscopy,⁵⁰ intracranial pressure monitoring,⁵¹ and two dimensional ultrasound⁵² have increased our knowledge of pathological anatomy and physiology and may allow outcome predictions with varying degrees of reliability, particularly in the worst cases.

Withdrawal of treatment due to extreme prematurity must depend on the prospect of a successful outcome for the given maturity and pathology of the baby, in that unit or elsewhere. There is evidence that different units have different definitions of live birth as opposed to abortion at very low gestation,⁵³⁻⁵⁵ so that not only is initial assignment for possible treatment variable but statistics may be distorted⁵⁶: there seems to be a secular trend in these respects.^{57 58} Recording total perinatal wastage might address this problem.⁵⁹ At present, obstetricians may try to ensure that pregnancies with a potentially good outcome deliver in the labour wards and allow abortions to occur in the gynaecology wards,⁵⁶ where CPR is not routine, so their decisions have a major impact on viability.

CPR in the labour wards

Significant birth asphyxia may manifest as Apgar scores 0 to 3. Babies with an Apgar score of 4 or more should, in most cases, respond to basic CPR, whereas those with an Apgar score of 1 to 3 often require intubation for a good result. An infant with Apgar score of 0 if not resuscitated

becomes a fresh stillbirth with no handicap. Review of resuscitation of 126 babies with an Apgar score of 0 showed 48 survivors but only 24 were normal at follow up and nine had severe handicap,^{40 42 60 61} so resuscitators must appreciate that treating babies with an Apgar score of 0 has definite risks.

CPR in the neonatal intensive care unit

Two large series reporting the outcome of CPR in a neonatal intensive care unit showed 11 survivors, out of 133 infants, with four apparently normal.^{62 63} Cardiac arrest is usually a terminal event in very low birthweight infants receiving full intensive care and CPR may be considered futile unless the arrest is very brief or associated with a blocked or misplaced endotracheal tube or the need for intubation.⁶³

Failure of CPR or decisions to terminate treatment may result in varying combinations of bereavement, guilt, and anger. As well as the short term anguish, long term psychological distress is quite common but can be minimised by various strategies which have been well reviewed recently.^{64 65}

Paediatric CPR

Apart from very rare acute arrhythmias, cardiac arrest is usually terminal in children and where possible better prevented than treated. Certain severe conditions may herald incipient prearrest such as acute epiglottitis, obstructed airways, severe hypovolaemia, diabetic coma or adrenal crisis, tension pneumothorax, haemopericardium, and anaesthetic mishaps.

Prompt treatment of the primary cause plus pulmonary and circulatory resuscitation may abort a cardiac arrest, but once it occurs the prognosis is frequently grim,⁶⁶⁻⁶⁸ and not much improved by transfer to hospital,⁶⁷⁻⁶⁹ though acute respiratory problems such as smoke inhalation, drowning,^{69 70} and choking may respond well to expeditious and competent CPR.^{66 68} In hospital the outcome for respiratory arrest is better than for cardiopulmonary arrest.^{71 72} Where cardiac arrest occurs, despite increasing supportive care, the outcome is usually proportionately poor,⁷³ and a poor outcome is likelier with prolonged or delayed CPR⁶⁶ and the need for drug treatment.^{1 72 74}

Paediatric drowning

Review of four series of children brought to emergency departments apnoeic and pulseless after drowning showed 20 dead children, 20 severely damaged, and no intact survivors.^{1 67 75 76} In contrast, bystander CPR was followed by 19 deaths, 23 cases of brain damage, and 88 intact survivors out of 130 children. Bystander CPR may be unnecessary in milder cases, is more timely in more serious cases, and acts as a triage in the worst cases. Twenty of the 23 children with severe brain damage were in fact resuscitated in hospital, though occasionally remarkable survival is described,⁷⁰ and CPR should not be abandoned in nearly drowned children until they have been rewarmed.⁷⁷

More research is needed into preventing immersion, parental training in CPR for those at risk, and the medical management of drowning.⁷⁸

Near-miss sudden infant death syndrome

The risk of sudden infant death syndrome (SIDS) is greater after near-miss SIDS⁷⁹ and hospital admission is indicated.⁸⁰ Parents should be provided with a monitor, taught CPR and given support,⁸¹ although SIDS continues to occur in the face of these measures.⁸² It may be possible to identify subgroups at particular risk.⁸³

Cardiac arrhythmias

The long QT syndrome may be lethal,⁸⁴ is rare,⁸⁵ but may respond well to electrical treatment,⁸⁶ drugs,^{86 87} or surgery.^{88 89} Other causes of serious ventricular arrhythmias and cardiac arrest in children include drugs^{69 90} and cardiac tumours.⁸⁸ Although these arrhythmias are rare, doctors need to be aware of the possibility of, and means to achieve, a good prognosis and parents of children at risk should be taught CPR.⁹¹

Summary

Mismatches between provision of paediatric cardiopulmonary resuscitation (CPR) and potential to benefit are examined. Deficiencies are most likely to occur in peripheral maternity units but futile CPR is more common in emergency departments where the child is unknown. Decision making in individual cases is best retained by the medical profession for the sake of the child and family. American style intervention by the legislature is likely to dissipate scarce resources and perhaps harm infants not capable of benefiting.

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