CARDIAC MASSAGE FOR IMPENDING DEATH UNDER ANAESTHESIA

BY

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At every turn and in every walk of life it is becoming increasingly apparent that the only effective method of successfully meeting a sudden unexpected catastrophe is to have a preconceived plan and to be able to put it into action immediately. If that plan is comprehensive, and if it can be executed smoothly, it may succeed. To set the heart beating when, during general anaesthesia, it has suddenly and unexpectedly become still, indeed calls for a clear-cut plan of action, for it ranks even higher than the arrest of serious arterial haemorrhage as the most urgent surgical emergency. I have performed cardiac massage about 40 times. In 13 cases the heart has restarted in earnest; but too often, after giving hope for hours or days, disappointment has been the outcome: only 4 patients have survived.

The special point I wish to raise is that cardiac massage should be resorted to earlier. An analysis of published cases shows that cardiac massage has been relatively more successful when the catastrophe necessitating it occurred during the course of an abdominal operation. It is reasonable to assume that, the abdomen being open, massage was resorted to sooner than otherwise would have been the case. In 3 of my 4 successes the operation in progress was an abdominal one, and in 2 of these massage was conducted through the original laparotomy incision. The fourth, my only non-abdominal successful case, sheds some light on the problem before us.

I had completed the operation of epididymectomy for tuberculosis on a boy aged 12. No anxiety had been experienced. I happened to look through the window of the changing-room, and saw the anaesthetist performing artificial respiration. The child had white asphyxia, and we immediately put in operation the routine of having a timekeeper call out the passing minutes. At three and a half minutes I injected adrenaline into the heart. At four and a half minutes, after hastily scrubbing up, I opened the upper abdomen through a midline incision and performed cardiac massage from below the diaphragm. A full minute elapsed without any response. There was then one beat, a short interval, then three or four beats. The heart then restarted in earnest. By the time the abdomen had been closed with through-and-through sutures some colour had returned to the patient's blanched face, the pulse was full but very rapid, and oxygen was being administered. Next day the patient said he felt well.

On the third day the boy complained of dimness and double vision. On the fourth day he could only distinguish between light and darkness. There were other evidences of serious disturbance of the central nervous system, such as incoordination and some paresis. I am not competent to discuss these neurological manifestations, nor is that the purpose of this communication. Sufficient is it to say that it was obvious that the vital centres had been left too long without a blood supply, and during the period of blindness I wondered whether it would not have been better if the cardiac massage had failed. It was during this period I became determined to advocate earlier cardiac massage. By what I believe to be an unprecedented stroke of good fortune, the patient's vision gradually returned and all other untoward signs disappeared. At the present time he has regained his sight and has quite recovered in all other respects (see photograph).

This case in particular convinced me that, to be permanently effective, cardiac massage must be instituted earlier; three and a half to four and a half minutes ("under five minutes" is the generally accepted standard) is too long to wait. Had the patient not been young I feel tolerably certain he too would have joined the large band of disappointments. Equally am I convinced that if I had made

a stand against intracardiac injection taking precedence over cardiac massage before, I might have succeeded in some of the cases in which I have failed.

This is not a sudden change of front. With each succeeding disappointment I have analysed the details of resuscitation, seeking to improve them. On nearly every occasion I have deplored the time wasted in injecting

adrenaline. Inertia and unwillingness to face criticism have, I fear, been instrumental in my continuing to suggest in the works of reference for which I am responsible that cardiac massage is our last card. I wish to revise that view.

Intracardiac Injection of Adrenaline

Championed particularly by the late Harrington Sainsbury, the value of an intracardiac injection of adrenaline has received, and is receiving, pride of place in attempts to restart the heart's action. A study of the literature will show that the successes which have attended this expedient are in the main cases of cardiac arrest during chloroform anaesthesia. In my experience, not once in more than forty instances has an injection of adrenaline into the heart caused it to restart beating. In one case the prick of the needle as it traversed the chest wall (I do not think the heart muscle had been reached) apparently initiated the resumption of cardiac activity; none of the adrenaline in the syringe was injected. In spite of the fact that in every theatre in which I work I try to impress upon the staff that a "cardiac emergency outfit" should be in readiness, oftener than not several minutes have been wasted in getting together the necessary armamentarium. I suggest that the sterile syringe, a three-and-a-half-inch-long needle which fits the syringe, and a bottle of adrenaline should be kept in a sealed sterile jar on the anaesthetist's table. Here it will be in better keeping, and any benefit which adrenaline holds will still be available. But on the following point I am emphatic: adrenaline should be relegated to a subsidiary role.

Is the Heart Beating?

Those without practical experience of these catastrophes are inclined to pass this question by almost with contempt. On the contrary, so difficult and time-consuming is this all-important question that in white asphyxia the correct procedure is to assume the worst and to proceed with resuscitative measures according to a plan by which confirmation

of the necessity for heroic measures is provided by the most direct means available. I have seen an already over-occupied anaesthetist burdened with this question when all the surgeon had to do was to remove a few abdominal packs and put his finger on the abdominal aorta. It should be obvious that if the operation in progress permits access to a large artery it is the surgeon who should inform the anaesthetist. In the absence of direct access to a large artery but with an operative wound before him, the surgeon can at least state whether there is any bleeding, and in certain instances he may feel justified in cutting a moderate-sized artery in order to obtain the necessary information.

When the integument is intact it is the anaesthetist who must settle this point by the means he thinks best. In my view the carotid pulse is the best indicator. The majority consider that a stethoscope applied to the praecordium is the method of choice. My reasons for devaluing the latter are: (1) the patient's head must be left unattended; (2) artificial respiration must be stopped; (3) on at least three occasions the anaesthetist has left his stethoscope in the anaesthetic room, and twice the courier sent for it has returned empty-handed; (4) with the spectre of the coroner before him and the knowledge that by applying the stethoscope he is preventing the continuation of artificial respiration, I submit that even a cardiologist might be unable to answer this all-important question with assurance.

Distribution and Duties of Personnel

With but three to three and a half minutes at our disposal each must know his or her duty; providing they know exactly what to do, even semi-skilled and unskilled members of the theatre team can perform most useful parts.

Timekeeper.—In 1927 I suggested that a junior nurse, a student, or a porter should be detailed to cry loudly each passing minute from the time the anaesthetist sounds the warning note of danger. This plan has proved invaluable, for anxiety masks a correct estimation time.

Provider of Hot Packs.—If in addition to a timekeeper there is a junior nurse available, her duty should be to get a bowl of really hot water and some packs, and be prepared to place the packs, wrung out in hot water, on the praecordium at frequent intervals while the artificial respiration is in progress. This worker is not essential. She should go about her duties without asking questions or distracting the attention of the theatre sister. Her services should be at the disposal of the surgeon's assistant if he should require them.

The surgeon's assistant is dismissed immediately by the surgeon, and relegated to the sole task of performing artificial respiration under the direction of the anaesthetist. He carries out Sylvester's procedure—if necessary, single-handed—but sends for the most suitable helper available.

The theatre sister comes forward and takes on the duties of the surgeon's assistant. Her essential objective is to have in readiness the simplest requirements for a mid-line upper laparotomy.

The anaesthetist takes sole charge of the respiratory apparatus. His first and at all times his most important duty is to be perfectly satisfied that there is a clear airway. His other essential parts can be played without moving from his position at the patient's head.

A (Revised) Plan of Action

Artificial respiration must be started at once, and continued throughout the endeavour. Intrathecal insufflation of oxygen and CO₂ is the ideal form of artificial respiration. Sylvester's method is efficient if the airway is kept clear.

FIRST MINUTE

Anaesthetist.—Clears airway; tilts the table, even slightly, so as to lower the head; breaks a capsule of amyl nitrite under the patient's nostrils.*

Surgeon.—Appoints a timekeeper; dismisses his assistant; with the help of the theatre sister, attends to his operation so that it can be abandoned temporarily; if possible, directly palpates a large artery.

SECOND MINUTE

Anaesthetist.—Administers oxygen; passes an intratracheal tube if circumstances permit and he is particularly skilled in this manœuvre.

Surgeon.—Supervises sterilization of the skin of the upper abdomen and lower thorax while he scrubs up or changes his gloves, as necessary.

Theatre Sister.—Prepares the skin of the upper abdomen and lower thorax.

THIRD MINUTE

Anaesthetist.—If asked to do so, palpates the carotid artery; when free from duties of the second minute opens the cardiac emergency jar and places it within reach of the theatre sister.

Surgeon.—If the information received is that the heart is not beating, makes an incision in the midline through the linea alba, large enough to insert the hand; starts cardiac massage from below the diaphragm, at first with a quick forcible movement for half a minute—the base of the left hand over the lower thorax aids in the manœuvre; if there is no response after thirty seconds, changes the movement to a slower rate of about eighty per minute.

Theatre Sister.—Fills the syringe with 1 c.cm. of adrenaline and fixes the needle firmly to the barrel.

FOURTH MINUTE

Surgeon.—Removes his left hand from the thoracic wall while the adrenaline is injected into the heart by the anaesthetist; immediately afterwards, with renewed hope, continues massage as in the first instance—i.e., quickly.

FOUR-AND-A-HALF MINUTES

Surgeon.—Detaches diaphragm from left costal margin with a stroke of the scalpel; opening stretched to take hand; rhythmically squeezes the heart within the pericardium (this seldom fails to give at least a temporary response).

If the last manœuvre is successful the opening in the diaphragm must be closed with catgut stitches. It is quite sufficient to close the upper midline incision with strong interrupted through-and-through sutures traversing all layers.

Conclusion

I have avoided detailed reference to the literature, not from any wish to minimize the contributions of others, but to simplify the message I would convey. Since Darling and Lane published the first successful case in 1902, I was surprised to find that only 50 permanently successful cases had been reported. In several of these both adrenaline and cardiac massage had been used. It would appear that the combination is useful. One case in particular supports this hypothesis; for after two minutes of massage with no response, adrenaline followed by more massage resulted in recovery (Fiddian, 1936).

"Massage—adrenaline—more massage—supradiaphragmatic massage" is, I believe, the watchword which will save more patients. Massage—earlier massage—is the life-giver; adrenaline is its handmaiden.

REFERENCES

- Fiddian, J. V. (1936). *British Medical Journal*, 1, 641.
Primrose, W. B. (1935). *Ibid.*, 2, 540.

* This valuable suggestion was made by Primrose (1935); the object of administering this drug is to distinguish between cardiac depression and cardiac arrest.