

transplants never reach the size of a full grown normal ovary and, although eggs are formed, they degenerate before reaching their full size. It makes no difference whether the ovaries are attached to the host oviducts or are free.

Transplantation of testes: Out of a total of 32 testes transplanted not one developed. In most cases the transplant was not found at all. In a few cases only a small vestigial part of it could be dissected out from the host. These failed to differentiate further.

Conclusions. The distinct but limited development of the transplanted ovaries shows that this organ still has developmental potencies at a time when other organs, such as the imaginal discs, degenerate. This means that *the lethal genetic constitution prevents further development in different organs at different periods of time.* Whether the further development of the ovaries is based on autonomous potencies or whether it is a result of a favorable influence coming from the genetically normal host cannot be determined from these experiments.

The striking difference found between the developmental potencies of transplanted ovaries and testes seems to be correlated with the fact that prior to transplantation, the testes during the third larval instar already show such deleterious changes brought about by the lethal conditions as to prevent their increase in size, whereas the ovaries seem not yet affected.

9339 P

Resuscitation of the Heart from Ventricular Fibrillation with Drugs Combined with Electric Shock.*

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Hoffa and Ludwig¹ demonstrated that electrical stimulation of the mammalian heart led to ventricular fibrillation and death. Prevost and Battelli² studied the effect of electric currents on the heart and reported that a brief countershock of sufficient strength applied directly to the heart through an electrode placed on the ventricles

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¹ Hoffa, M., and Ludwig, C., *Z. f. rat. Med.*, 1850, **9**, 107.

² Prevost, J.-L., and Battelli, F., *Comptes Rendus des Séances de L'Académie des Sciences*, 1899, **129**, 1267.

would produce a brief period of complete cardiac standstill from which coördinated ventricular beats might be resumed. Cardiac massage was found necessary preceding the countershock when the ventricular fibrillation had existed longer than 15 seconds. Hooker, Kouwenhoven and Langworthy³ found that currents of 0.4 amperes and less applied directly through the heart cause ventricular fibrillation, while currents of 0.8 amperes and over will stop the fibrillation. They advised the central carotid injection of calcium chloride and adrenaline after countershock as an aid in restoring a vigorous beat. Wiggers⁴ emphasized the importance of cardiac massage preceding the electric shock to improve the nutrition of the myocardium and he reported success in reviving 85% of fibrillating dog hearts.

The method of cardiac massage and electric shock with a current of approximately 1.5 amperes applied through the heart, with electrodes 3.5 by 9 cm. placed on each side of the heart, was used in the surgical laboratory in cases of ventricular fibrillation developing in the dog's heart during experimental cardiac surgery. Bare metal electrodes were used on the heart; they do not cause local burning if there is a large area of contact with the heart. It is preferable to make the electrodes of a metal that will not corrode. Success was obtained in about half the cases, but there were many failures, the cause of which was not apparent. After it was determined that procaine hydrochloride is a myocardial depressant⁵ and readily absorbed from the epicardium, this drug was applied over the surface of the heart in doses up to 20 mg. per kilo of body weight in the hearts difficult to revive, and it was found that a higher percentage could be revived. It was later found that by giving doses up to 10 mg. per kilo intravenously practically every case of ventricular fibrillation could be restored to a coördinated beat with the electric shock. No central nervous toxic effects were observed.

In the heart difficult to revive from ventricular fibrillation the following considerations are important: (1) Artificial pulmonary ventilation must be adequate to saturate the blood with oxygen. (2) Cardiac massage must be effective in producing sufficient circulation to nourish the brain, prevent intravascular clotting, maintain vigorous fibrillations in the myocardium, and prevent or overcome extreme cardiac dilatation. (3) If countershock is now unsuccessful, intravenous procaine will produce a coarser type of fibril-

³ Hooker, D. R., Kouwenhoven, W. B., and Langworthy, O. R., *Am. J. Physiol.*, 1933, **103**, 444.

⁴ Wiggers, C. J., *Proc. Am. Physiol. Soc.*, 1936, p. 161.

⁵ Mautz, F. R., *J. Thoracic Surg.*, 1936, **5**, 612.

lation which can more readily be restored to a coördinated beat with an electric shock. (4) In extreme dilatation which may follow a toxic dose of procaine, dilute solutions of calcium chloride and adrenaline in small doses are antagonistic and aid in producing the necessary condition for restoration of a coördinated beat. (5) When a feeble beat has been restored, gentle massage and, if this is ineffective, cautious administration of calcium chloride and adrenaline⁶ aid in restoring a vigorous heart beat. When procaine has been given previous to electric shock, there is little tendency to return to fibrillation unless excess calcium chloride is introduced. The heart must be carefully observed, for a period of about 20 minutes before the chest is closed, for acute dilatation during the recovery phase.

In summary, a proper state in the fibrillating ventricular myocardium can be obtained by the careful use of myocardial depressant drugs and their antagonists, which makes it possible almost routinely to revive the heart from ventricular fibrillation. The chances of permanent recovery depend upon the magnitude of the operative procedure. In 25 consecutive cases of ventricular fibrillation in dogs the author has been able to restore a normal heart beat by using the foregoing technique. Many of the hearts were severely damaged by contusions, stab-wounds, etc. As long as 30 minutes have elapsed before revival with complete postoperative recovery, and no signs of cerebral injury. Even though difficult to develop, this technique is feasible and should be available for use in the operating room in cases of ventricular fibrillation.

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Quantitative Studies on Nerve Regeneration in Amphibia. I. Factors Controlling Nerve Regeneration in Adult Limbs.

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Nerve regeneration is the result of a growth process starting from the cut ends of those parts of the severed neurones left in connection with their cell bodies. Extensive bifurcation of the outgrowing sprouts is supposed to provide for overabundance of peripheral terminations. To what extent the excess of innervation is kept within bounds, and by what factors, has not yet been deter-

⁶ Hooker, D. R., *Am. J. Physiol.*, 1930, **92**, 639.