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Pain: Time of Occurrence Following Temporary Coronary Occlusion.

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Lewis,¹ by an ingenious method, studied the time factor in the production of pain following temporary complete obstruction of the brachial artery. After an interval of 70 to 75 seconds, obstruction of the brachial artery caused unbearable pain. He thinks that during this interval a change in metabolites may be the factor in producing pain and has called this the "P-factor". Lewis used as a criterion of pain, that unbearable end point in order to eliminate the psychic factor. In our earlier experiments when the coronary artery was temporarily occluded, pain was observed immediately.^{2, 3} The question raised by Lewis as to the discrepancy apparent between the results by different methods of study suggested further investigation.

Method. 20 dogs were used. Briefly, the chest was opened under ether anesthesia, and artificial respiration given at once. The pericardium was exposed, opened, and a tough linen suture passed around the ramus descendens branch of the left coronary artery as close to its origin as was technically possible. This suture was passed through a flanged glass tube, a purse string suture held the tube firmly in place in the pericardium and prevented an open pneumothorax. The chest wall with the tube projecting was tightly sutured. After a period of not less than 4 hours following the completion of the operation, traction on the suture will occlude the vessel and produce a painful response. At the conclusion of all experi-

¹ Lewis, Sir Thomas, *Arch. Int. Med.*, 1932, **49**, 713.

² Sutton, Don C., and King, W. W., *PROC. SOC. EXP. BIOL. AND MED.*, 1928, **25**, 842.

³ Sutton, Don C., and Lueth, H. C., *Arch. Int. Med.*, 1930, **45**, 827.

ments the animals were sacrificed and the position of the ligature verified by postmortem examination.

Results. The typical result is that of immediate pain response to slowing of blood flow during constriction. The time interval is too short to be easily accurately measured. There is a variability in different animals as to the degree of response dependent upon a number of factors. The time of complete recovery from anesthesia varies in different animals. In those animals in which 4 hours or more elapsed from the time of operation a well-defined pain response occurred immediately, or within 3 seconds following operation. When less time was allowed for recovery the pain response was delayed and not as clearly defined. There is an occasional animal in which the response to any form of pain is slight or delayed. Under these conditions the longest interval recorded was 14 seconds in one dog, in the remainder the interval was not longer than 3 seconds. In most cases repeated attempts decreased the time of response, so that after many trials they so closely followed obstruction that the exact interval could not be measured. One animal showed an instantaneous painful response followed by a period of unresponsiveness, which lasted several minutes, after which the pain could be provoked as promptly as ever. Careful autopsy examination failed to furnish any clue to explain this reaction.

This apparent discrepancy in the time required to produce pain by the method of Lewis and that employed by us appears to be mainly the question of the definition of pain. The dog probably responds to a much less degree of stimulation than that endured by an individual during the experiment of Lewis; in fact, this is evident on sustained coronary vessel compression. Secondly, when one considers the difference in degree of shock observed in coronary occlusion and occlusion of a peripheral artery, it is not improbable that the pain of cardiac muscle differs from that of voluntary muscle.