tubocurarine, even when prolonged diaphragmatic paralysis was desirable. . . It has been stated that when ether is being used the dose of curare should be reduced by one-third, ether itself being said to have a curariform action. This, in our opinion, is a wrong approach to a correct clinical observation. . . .

"We had employed curare in only a few cases when it became obvious that some form of synergism existed between the drug and the barbiturates, and a further synergism between this combination and any inhalational agent which might be used, such as ether or cyclopropane. Four facts led us to this conclusion: (1) From experience we know the dose of barbiturate required to prevent 'movement response' to painful stimuli (incision of the skin) in the average patient. For convenience let us call this the minimal anaesthetic dose (M.A.D.). (2) Curare is not an anaesthetic, and in small doses does not prevent movement. 17.5 mg. were given to a conscious patient. He was still able to react by movement to a noxious stimulus. (3) The administration of the combination of 15 mg. of curare and a dose of barbiturate less than the M.A.D. produces a completely anaesthetic and motionless patient. (4) If any inhalation anaesthetic is used to supplement this barbiturate-curare combination, only a minimal amount is required to produce deep anaesthesia. . . .

"One of our first observations was that here one is deprived of all the ordinary classical signs for estimating the depth of anaesthesia. The eye reflexes, corneal and conjunctival, owing to paralysis, are absent or sluggish, and the ordinary respiratory signs are modified, for at any rate in upper abdominal operations sufficient curare must be given to paralyse the intercostals. The three criteria which do remain are the pulse, respiratory rate, and the anaesthetist’s experience. Frequent observation of the pulse is essential; the first sign of inadequate anaesthesia is a rising pulse-rate and failure to notice this may result in the onset of severe shock due to inadequate narcosis. An increase in respiratory rate will also give warning, provided the patient is not apnoeic. The anaesthetist’s experience is often the best guide as to the amount of any particular anaesthetic required to keep a patient in a light plane, and the necessity for the would-be user of curare to have this experience cannot be over-emphasized. . . .

"There are two signs of curarinization which must be mentioned. The first is the typical respiration characterized by a pushing-out of the lower part of the chest and of the abdomen with each diaphragmatic contraction, and accompanied by a jaw and tracheal tug. This is not the same as the gasping respiration seen in deep ether anaesthesia, when a partially paralysed respiratory centre is endeavouring to cope with the situation. It is at this point that all effort should be concentrated on ensuring full ventilation of the lungs. Should this not be maintained, the condition will deteriorate, and the surgeon will be embarrassed by the exaggerated diaphragmatic excursion. In this event control of the respiration with the rebreathing bag is easily attained. The second sign, and a most valuable one, is the ease with which the lungs may be inflated by pressure on the rebreathing bag. The absolute intercostal and abdominal relaxation, with the complete absence of laryngeal spasm, makes this manoeuvre easy and satisfying." 22 references.

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"The determination of the systolic and diastolic pressures and, perhaps to
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an even greater extent, the determination of their difference—the pulse-pressure—form one of the anesthetist's most important guides to the condition of his patient during an operation. The customary method of determination by the aid of a stethoscope strapped to the arm of the patient has a number of disadvantages, not the least of which is that it is usually inaccessible beneath the sterile coverings which drape the patient. The manipulations of the surgeon may easily displace the stethoscope, unknown to the anaesthetist, and failure to hear the sounds properly may be attributed to this cause, when in fact they should be interpreted as a sign of a deterioration in the condition of the patient. Further, the auscultatory method of blood-pressure determination may be rendered difficult and uncertain by the intrusion of small sounds due to any one of a multitude of causes.

"It is therefore clear that a visual record of, for example, the pulse-pressure would have considerable advantages, and if, in addition, this record could be arranged to be independent of the manipulations of the anaesthetist, it would have the further important advantage of leaving him free to devote all his attention to his patient at just those moments of crisis when it is most important for him to assess accurately the effects of his clinical procedures. . . . In approaching the problem of the measurement of blood-pressure de novo, two main methods suggest themselves. The first is to employ the Korotkov sounds; the second to employ the pressure-pulsations taking place in an inflated cuff bound round a limb. . . . The employment of the pressure-pulsations in a cuff seems to offer a simpler approach and to promise a final product of a less complicated and expensive type. It is true that oscillometers of various kinds are already on the market, but these are not entirely satisfactory because there is no indication of the physical or physiological significance of their readings or records except what can be deduced empirically by experimentation.

"We first made a simple analysis of the pressure pulsations which would be observed in a cuff bound round the limb and inflated to various constant pressures. Our conclusions were as follows: If the external pressure exerted by the cuff is always greater than systolic pressure, i.e. if the cuff-pressure is above systolic, then the section of artery beneath the cuff will be occluded and no blood will flow. On the other hand, if the cuff-pressure is not too far above systolic, there will be small pressure-pulsations in the cuff due to the impact of the pulse-wave on the upper edge of the occluded section. Each wave will open the artery a little, but the depth of penetration of this 'edge-effect' will be small. If, now, the cuff-pressure is lowered to a value intermediate between systolic and diastolic pressures, then, during some part of each heart-cycle, the artery will be occluded, and during another part of the cycle the artery will be fully patent. For cuff-pressures in this region, therefore, the arterial volume-changes will be large and these will lead to relatively large pressure-pulsations in the cuff. Finally, if the cuff-pressure is below diastolic pressure, then at no time does the external pressure exceed the internal, and the only volume-changes which occur during the heart-cycle will be the small changes consequent upon the elastic response of the artery to the varying pressures within it. . . . The sphygmoscope which we developed was based on these principles. . . . The gratifying results . . . show that it is possible within astonishingly wide limits, to make use of a simple physical model amenable to mathematical treatment, for the elucidation of somewhat complex clinical conditions." 5

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