Relation Between Accommodation and Minimal Gradient.* (26984)

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It is well recognized that tissues have a minimal gradient requirement (lambda)(1,2) which must be satisfied if applied pulses are to stimulate nerve, cardiac or skeletal muscle(2,3). Current pulses which have too slow a rise time do not stimulate, supposedly because accommodation has occurred(2). The term accommodation is also used to describe the decrease in facilitatory effects of long lasting subthreshold conditioning pulses(4). The terms catelectrotonus and anelectrotonus are well known to physiologists and it is generally recognized that the effectiveness of the applied current decreases somewhat because of accommodation. The purpose of the present paper is to give evidence indicating that it is unsafe to assume that "accommodation" is the same in both cases.

Method. Dog ventricle trabecular muscles were used in this work. They were maintained in a tissue bath and perfused with Tyrode's solution. Rectangular pulses and pulses with a controlled rate of linear rise were used in determining thresholds and minimal gradient requirements. Long duration conditioning pulses could also be applied. The methods of such studies have been described fully elsewhere(3) but Fig. 1 gives a diagram of the devices employed.

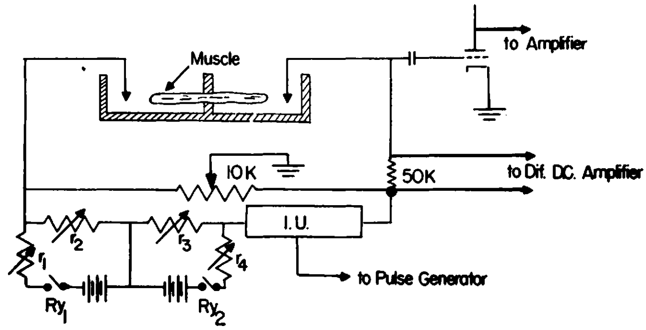
Results. Fig. 2 shows the changes in threshold to testing stimuli which occurred during and following application of a 280 msec conditioning pulse of half-rheobasic strength. It can be seen that an initial facilitatory action was not fully sustained. Threshold rose slightly during the first 100 msec of the cathodal current flow and then remained relatively constant until break of the current. The postcathodal rise in threshold which lasted somewhat more than 50 msec is the typical postcathodal depression. This decrease in facilitatory action of the conditioning pulse is the accommodation referred to and the experiment demonstrates that the phenomenon does occur in this type of cardiac tissue.

It has been recognized for some time that slowly rising pulses excite when they reach a rheobase determined by rectangular testing pulses(5,6). This in itself gives some indication that accommodation, in the sense of a rise in threshold during continuing current flow, does not occur. However, it seemed reasonable to test the possibility of accommodation to linearly rising currents by applying test pulses at various intervals after commencement of the current. Fig. 3 presents the result of an experiment in which a linearly rising pulse that just failed to stimulate was used as the conditioning current flow. In (A) the upper tracing shows a pulse of rheobasic strength and the lower tracing the response evoked. In (B) is shown a pulse which rose to rheobasic strength at too slow a rate to stimulate. In records C to H the minimal intensities of applied short-duration pulses which stimulated the muscle are indicated by an arrow. No adaptive or accommodative change occurred since it was found that addition of conditioning and test pulse strengths came to the same total during the rising phase of the "conditioning stimulus." At the break of this conditioning pulse, however, threshold requirements rose.

Fig. 4 was made by superimposing a series of tests such as were portrayed in the preceding figure. The conditioning pulse is shown in the lower tracing. The upper line shows the threshold as determined by addition of testing and conditioning pulse. Again it is seen that since the sum of the 2 did not change, threshold did not change and there is no evidence of accommodation. The postcathodal depression, or threshold elevation, however, is nicely demonstrated.

Whatever the "accommodation" shown in Fig. 2 may be, it certainly does not explain minimal gradient requirements. The process

* Supported in part from research grant from Inst. of Neurol. Dis. and Blindness, N.I.H., U.S.P.H.S.



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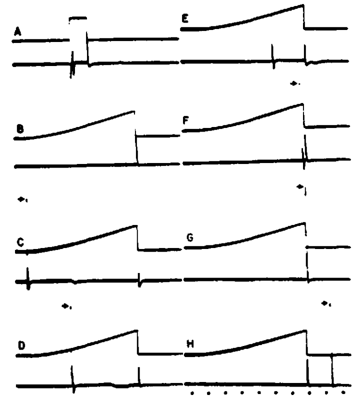

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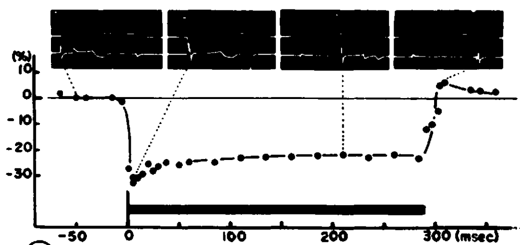

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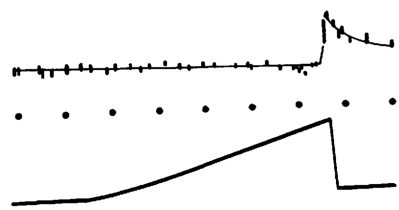

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FIG. 1. Experimental arrangement for testing accommodation and minimal gradient in perfused muscle bundle.

FIG. 2. Showing accommodation to conditioning pulse (0 to 280 msec). Threshold (•——•) shown in percentage of normal. Upper records show the applied pulses and the resulting response (spike potential).

FIG. 3. Determination of threshold (→) by summed linearly-rising and test pulses. Lower trace shows evoked response (spike potential). Time intervals 100 msec.

FIG. 4. Diagram drawn from superimposed tests. Lower tracing an ineffective linearly-rising pulse. Upper tracing shows thresholds to testing pulse alone or summed pulses. Middle dots show time intervals of 100 msec.

which is responsible for the failure of slowly rising currents to stimulate can be called accommodation but it differs from the failure of facilitatory action seen when conditioning and testing currents are paired as in Fig. 2.

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Received Sep. 5, 1961. P.S.E.B.M., 1961, v108.