New Electrode for Taking Electrocardiograms of Animals

By George R. Herrmann, M.D.

In the experimental animal, the taking of 12-lead electrocardiograms has been troublesome, especially if the electrocardiograms were to be taken in prone as well as in supine positions. The coat of oily fur has usually been responsible for very high skin resistances or condenser effects between the skin and the German silver electrodes. This has resulted in overshooting or fling in the electrocardiograms which has been a source of much annoyance, distortion, and inaccuracy. The preliminary removal of the grease from the hair and the skin with alcohol has reduced the skin resistance some, but has added more work. A shaving and thorough wetting and rubbing of the skin and of the extremities with hot saturated salt solutions of 40°C or 105°F have been fairly successful, but require a great deal of effort. The modern salt jellies for electrodes are moderately effective but are messy. The difficulties are greatly increased when one desires to apply the precordial electrodes over the chest of the animal and make repeated observations with the animal in different positions.

In recent years, needle electrodes made of "nonpolarizable" steel by Fred Liechti A.G. and Becton, Dickinson & Co. have been quite generally used with some but not complete success. However, it is very difficult to place these 2.5- to 3.75-cm. needle electrodes in sharply circumscribed precordial areas and to hold them on certain points in the standard V-lead positions V1 to V6. The needles extend under the skin for short distances of 1, 2, or 3 cm., and therefore the hub acts as a fulcrum; the shaft and point move through the arc. The precordial points are thus not fixed, and each needle accepts potentials from wide areas of the heart. Electrodes directly attached and fixed at points V1 through V6 on the chest record intrinsicoid deflections from the heart surfaces. Intrinsicoid deflections are taken 1.5 to 2.5 cm. from the surface of the heart and are not absolutely comparable to the intrinsic deflections that are obtained from electrodes placed directly on the surface of the heart. The chest surface electrodes, although removed usually 1.5 to 3 cm. from the surface of the heart, subtend much wider solid conical angles, and therefore gather dipole potentials from a wider area than just the area of the heart beneath the electrode.

In carrying out experimental work on baboons in which repeated 12-lead electrocardiograms were to be taken in supine and prone positions at intervals of weeks, I found most of the usual electrodes, including the steel needle electrodes of Fred Liechti A.G. only moderately satisfactory. On the living animal under Sernyl (Parke, Davis & Co.) and pentobarbital anesthesia, it was felt that needle electrodes were not held firmly enough fixed at the various precordial areas. It seemed desirable and necessary to devise a more satisfactory and practical electrode that could be easily applied, was nonpolarizable and would reduce local skin resistance, and at the same time be a simple, sturdy electrode that could be attached through the hair and would remain in place, especially when the animals were rotated in various positions.

The New Clip Electrodes

It occurred to me to try the standard test and battery clips with short needles in the jaws, as electrodes, with receptacles soldered...
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on for quick connections to the plug of the lead wires of the electronic equipment that we were using. The Mueller Electric Company of Cleveland, Ohio,* kindly offered to supply any of their complete line of alligator, micro-gator, minigator, and crocodile clips in various sizes for trial. The clips alone were not completely satisfactory even after they were covered by the flexible insulators supplied by the same company. They also supplied a specially designed cable piercing solid copper crocodile clip, no. 50C, which contained a needle that was placed far back, namely, at the angle of the jaw. I tried out various types of insulated clips, nos. 27, 30, 45, 48, 50C, 60S, 60HS, 60PR, and 63C, but none of these functioned entirely satisfactorily. Even the 50C needle clip was inadequate because the needle was recessed so far back in the jaw that it was not effective.

I had our chief machinist in the technical apparatus department, Mr. Carl Schuster, place one or two fine old steel phonograph needles in between the jaws of each flat-nosed no. 45 clip and one needle 1 mm. from the chin of each of 10 no. 50C, 60HS, and 63C alligator clips (fig. 1). Receptacles 1/8 inch or 3 mm. in diameter for banana plugs were already a part of 60HS and 60PR2 clips but had to be attached to clips no. 45 and 50C after the needles had been inserted. Adaptors for the banana receptacles had to be made for American standard electrocardiographic lead wire plugs which are 3/64 inch or 2 mm. in diameter. These various types of needle clips covered with flexible insulators functioned satisfactorily as electrocardiographic electrodes. Mr. Carl Schuster first placed two needles in each of 10 square flat-nosed no. 45 clips and a forward single stainless steel needle in the anterior part of the jaws of 10 no. 50C solid copper needle clips and attached receptacles for the plugs of lead wires of the electrocardiograph.

*Mueller Electric Company, Cleveland, Ohio, supplied the various types of test and battery clips, and Fred Liechti A. G., Berne, Switzerland, supplied the receptacles, 1/8 inch or 3 mm. in diameter, for the European banana plugs.

These needle electrodes have been used successfully for taking electrocardiograms not only on baboons in various positions, but also on dogs and rats as well as in smaller experi-
mental animals. The crocodile no. 50C insulation piercing clips, with a stainless steel needle placed just behind the front tooth, were found to be best for large animals such as baboons and large dogs. No. 45C flat-nosed clips with two phonograph needles placed in the jaw, and insulation above, were found to be best for small dogs and rabbits. Alligator clips no. 60S or the no. 63C insulated alligator solid copper clip with stainless steel phonograph needles in the tip of the jaw have been found to be more satisfactory electrocardiographic electrodes for rats and mice.

**Summary**

New types of electrodes for taking electrocardiograms on lightly or locally anesthetized animals of various sizes from baboons to mice have been developed and are herewith described.

**Reference**


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**Book Review**


The general acceptance of arteriography during the last decade has been associated with improvements in technique and in contrast media which are described in detail in this monograph. The author's personal experience in arteriography over the last 14 years has been very extensive and has been documented by excellent published radiograms. The clinical aspects of the extremities, head and neck, abdomen, and the thorax are adequately covered. The chapter devoted to the latter includes recent developments in coronary arteriography which is expected to be more widespread in use.

The clinician will be gratified to have the diagnostic uses and limitations of arteriography in one volume. The investigator will find a number of problems which require serious consideration. The hypotension, which is known to occur immediately after aortography, peripheral arteriography, and angiography, is maximal in about half a minute after injection, but the pressure starts to rise again in one minute. The exact mechanism is not understood. Occasionally, a more serious fall in blood pressure is encountered which may be an allergic reaction.
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