amounts of strong anti-A hæmolysin of immune type was shown in the sera of the majority of a random group of O donors, all R.C.A.F. personnel, after a "booster dose" of prophylactic vaccines such as T.A.B.T.D. Similar results have been reported in England by Crawford *et al.* (1952).

The stimulus from such bacterial toxoids appears to be specific and a probable source is traceable. Hog stomach pepsin is used to digest the horse serum constituent of the media used for production of both diphtheria and tetanus toxoids. It has been shown by Morgan and Watkins (1944) that type A substance is present in considerable quantities in hog gastric mucin, but is of hapten nature and without significant antigenicity when injected alone. This substance becomes highly antigenic when combined with certain bacterial protein components. Davidsohn (1938) had already called attention to the sharp rise in anti-A titres after injections of horse serum. It is therefore likely that the antigenic A substance of prophylactic toxoids is derived from culture media used in their preparation. New culture media are being developed to avoid this source of dangerous immunization.

The period of persistence of such immune antibody is not yet widely investigated. Chown (1953) did not find any abnormally high anti-A or anti-B titres in testing a random group of some thirty group O R.C.A.F. personnel. This preliminary study suggests that the high titre anti-A which develops as a result of inoculations is not necessarily permanent.

It would appear also that this mechanism is not the only source of dangerous immunization. In our case, following some unknown antigenic stimulus which caused the high titre at the time of donation, a gradual fall of the titre has taken place with return to common values. This may explain why "dangerous universal donors" are not more prevalent in transfusion panels.

SUMMARY

1. A case is reported of fatal transfusion reaction, with nephron nephrosis in a group A_1 MN Rh positive (Rh genotype CDe/CDe) recipient, following donation of 250 ml. of group O MN Rh positive (Rh genotype CDe/cde) blood. The latter contained exceptionally high titre anti-A iso-agglutinins. The donor had no history of immunization by injection of blood or prophylactic vaccines.

2. The dangerously high anti-A titres in this donor proved to be a temporary state over the twenty-one months' observation.

I am most grateful to Dr. Bruce Chown of the Children's Hospital, Winnipeg for his serological studies and to Dr. G. E. Large, Provincial Medical Director, Red Cross Blood Transfusion Service, Province of Manitoba, for ready co-operation in the follow-up investigation.

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Clinical and Laboratory Notes

THE CLINICAL APPLICATION OF RADIOELECTROCARDIOGRAPHY

H. F. MACINNIS, M.D., *Camrose, Alta.*

IT IS PROPOSED to present in brief some demonstrations tending towards the clinical application of radioelectrocardiography. For this purpose we were afforded the facilities of Holter's laboratory in June 1952, and as far as we are aware this was the first time that the electrical potential from a diseased heart was broadcast from the source, the heart muscle, received on a television screen and photographed.

The remote recording of myocardial potential by radio was first demonstrated as feasible by

Holter[1, 2] in 1949; additional development work was reported in 1952.[3] The resultant radioelectrocardiogram (RECG) reproduced in Fig. 1 resembled the conventional complex produced by the ordinary electrocardiograph.

The RECG of course, as the term implies, is produced without the aid of wires connecting the subject to the recording apparatus. The distance between the subject and the receiving set is mainly governed by the strength of the miniature transmitting equipment. Holter in his laboratory situated in the business district of Helena could receive on his television screen a readable radioelectrocardiogram emanating from a subject walking down the street a distance of some six hundred feet away. This demonstration was in the nature of a pure electronic experiment

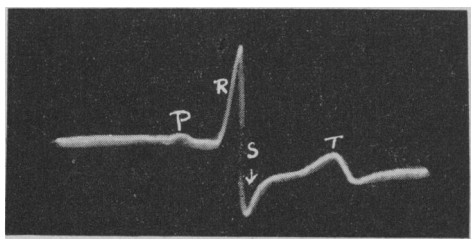

Fig. 1.- Radioelectrocardiogram (Holter)

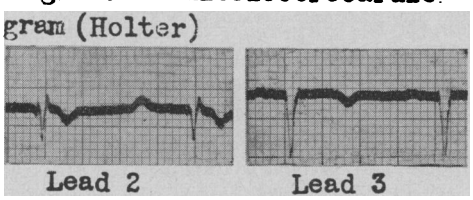

Fig. 2.- Patient P. L., ECG

but as Holter pointed out it was not devoid perhaps of clinical application.

The object of the experiment was to determine the feasibility of broadcasting the bioelectric potential of a diseased heart over a distance and receiving the graphic pattern with enough clarity to be readable and useful for diagnosis.

EQUIPMENT AND METHOD

In a clinical report of this nature only a brief account of the gross equipment will be given. Complete details have been published elsewhere.[3] Electrodes are applied to the limbs in the usual manner depending on the lead desired. The lead is connected to a battery operated amplifier not much larger than an ordinary hearing aid and carried on the back or chest or even in the trousers pocket of the subject. This amplifier increases the signal strength about 5,000 times. The amplifier has four stages of vacuum tubes and terminates in a frequency modulated transmitter (contained in the same small unit) broadcasting at 100 million cycles. The receiver situated at any chosen distance from the subject is a modified commercial type terminated with a cathode ray screen. An electrical system sweeps a light spot in a horizontal line along the screen taking about a second to traverse it, thus making the PQRS and T waves visible. This wave record persists until the next sweep and can either be studied directly on the screen or be photographed for a permanent record. In this particular experiment an ordinary camera was used with a time exposure of one second or approximately the duration of one complete sweep or trace on the screen.

A patient with a previously known heart lesion was selected for study. This patient P.L. had a healed posterior myocardial infarction. Leads 2 and 3 of the conventional electrocardiogram are shown in Fig. 2. Fig. 3 shows a radioelectrocardiogram (leads 2 and 3) of the same patient received at a distance of thirty feet. It can be seen that the RECG closely resembles the ordinary electrocardiogram. The Q wave in RECG lead 3 is strikingly illustrated.

The barely visible background shadows in RECG 3 are fading complexes from the previous sweep. The grid lines on the screen are about one fifth second apart in time.

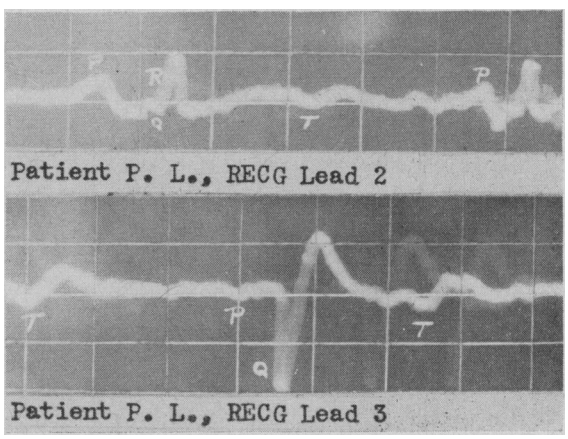

Fig. 3

COMMENT

The photographs are admittedly crude but serve we think to bear out the feasibility of the idea. It is felt however that even with refined technique and equipment no clinical advantage could be achieved by this method over present day procedure at least in "still" electrocardiography. In the field of exercise tolerance tests radioelectrocardiography would appear to offer many advantages over the conventional method. In a severe exercise tolerance procedure such as that involved in furiously pedalling a stationary bicycle a normal subject emanated a typical myocardial injury pattern (elevated ST segment) on RECG at the zenith of activity which reverted to normal immediately on termination of the exercise. Suspected angina patients were not studied in this experiment but this isolated observation would tend to support our opinion that by the very nature of the medium employed the RECG could provide a most sensitive index of myocardial tolerance using for instance the ordinary Master's two step procedure. Here the ST deviation and T changes *during* as well as after exercise can be visualized. The patient too is unencumbered with wires and thus can perform the exercise in a more natural manner.

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Many interesting phenomena meet the eye in studying the "live" complex on the screen. Here can be seen a continuous undulating fluid motion begetting myriads of miniature waves never appreciated in the ordinary electrocardiogram and finally culminating in the well recognized PQRS and T pattern.

The author would like to express his indebtedness and thanks to Norman J. Holter, M.A., M.S., and Wilford R. Glasscock, of the Medical Physics Laboratory, Holter Research Foundation, Inc., Helena, Mont., for providing the laboratory facilities as well as their invaluable technical direction. We are also grateful to Dr. O. T. Skouge, Medical Superintendent of Fort Harrison Military Hospital, Helena, Mont., for his providing patients for this project and to Dr. Donald Wilson, Assistant Professor of Medicine, University of Alberta, for his advice and encouragement in the preparation of this paper.

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Smith Clinic.

MEDICO-LEGAL

LEGAL POT-POURRI*

T. L. FISHER, M.D.,* *Ottawa*

A DOCTOR reporting medico-legal cases in a medical journal encounters—and no doubt falls into—many pitfalls. He learns that cases of current interest often cannot be reported because they are *sub judice*. He finds that by the time some decisions have been rendered the cases have lost their immediate interest. Other cases of great importance are dropped by plaintiffs in such ways and at such times that any comment on them might harm doctors. He finds himself trying to report others which are so involved that not one but several legal points must be dealt with.

Such a case is the one to be discussed; the excuse for reporting it is the importance of the several issues which had to be decided.

In October 1949, at a large general hospital, a patient was admitted to the service of a recognized surgeon to have a fusion of a fractured right thumb. After adequate consideration the anæsthetic decided upon was a brachial plexus block. The anæsthesia and the operation were uneventful. Six hours later however acute respiratory symptoms supervened and it became obvious there had been a collapse of the right lung. To re-expand the lung catheter suction of the pleural space was necessary but recovery was fast and the patient was able to leave the hospital four days later.

In July 1950, through a lawyer, the anæsthetist received a demand for $20,000 damages because of the pneumothorax. He refused to consider settlement at all and in October 1950 a writ was issued charging malpractice.

At this hospital the Department of Anæsthesia was under the direction of a director of anæsthesia, a full-time paid servant of the hospital. He and eleven associates were responsible for all anæsthetics given in the hospital. They either gave them themselves or gave permission to doctors uncertified in anæsthesia, whether practising physicians or anæsthetists-in-training, to administer them. If such permission were given anæsthetics were administered only in the presence of and under the supervision of one of the twelve. In this case the anæsthetic actually was administered by a graduate licensed physician who was taking the training course in anæsthesia and she was supervised by one of the anæsthetist partners.

Though the original writ claimed damages from all the doctors for negligence in performing the operation it was obvious that the main complaint had to do with the anæsthetic services. In September 1951 the plaintiff applied for the right to amend the writ. He wished to add a claim for assault. The application was opposed by counsel for the defendant-doctors and was argued in October 1951 before Chief Justice Farris of the Supreme Court of British Columbia. After argument Chief Justice Farris noted that the complaint actually was about the anæsthetic and not about the operation and that, if it existed at all, any assault would have been "only a very highly technical assault". He stated that to grant permission for the amendment would deny the surgeon the benefit of the Statute of Limitations contained in the Medical Act, that is, the amendment would have allowed a claim for common assault rather than one for negligent or careless medical services. Therefore, the application was refused.

In January 1952 the plaintiff applied to have a jury trial. This application, similarly, was opposed and after argument was refused. The reasons for refusal involved somewhat larger issues than were at stake in the claim itself. In ordinary cases of claims for negligence a trial by jury is a right but in some provinces, and in the one in question, a Supreme Court rule allows a judge to "direct a trial without a jury of any cause, matter or issue requiring any scientific investigation which cannot, in his opinion, conveniently be made with a jury, or where the issues are 'of an intricate and complex nature'."

*Secretary-Treasurer, Canadian Medical Protective Association.