volving the anterior wall of the left ventricle and one who had an in-
ferior aneurysmal bulge confirmed by ventriculography. As Wey-
man et al. correctly have noted, the M-mode scan frequently failed
to show the tapering that normally occurs as the beam traverses
the peri-apical region. However, in addition to that finding (which we
could not consistently obtain) we noted that in the eight patients
with anterior aneurysm there was a convex systolic anterior motion
of the mitral valve which resembled, yet was distinctly different
from, the so called SAM usually seen in IHSS. This finding was
absent in the patient who had the inferior wall aneurysm. Although
SAM is nongeneric, it does provide a definite clue, when correctly
related with the clinical findings, toward the diagnosis of ven-
tricular aneurysm. For these echocardiographers who have yet
to acquire cross-sectional capability this information should prove
useful.

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Reference

mitral systolic motion in left ventricular aneurysm. Br Heart J 37: 684,
1975

Effect of Electrode Area on V ECG

To the Editor:

It was with some concern that I read the article by Hughes et al.
"Failure of Demand Pacing with Small Surface Area Electrodes"
(Circulation 54: 128, 1976). The authors correctly point out that
decreasing surface area of electrodes is associated with decreasing
energy requirements for cardiac stimulation but add, incorrectly,
that "small" area electrodes are associated with poor detection
of the ventricular electrogram and that failure of QRS sensing by a
pulse generator will occur. They make the statement "Recent
reports indicate a failure rate (sic. sensing) as high as 15%." Two
publications were cited. One, from 1968 (authors' ref. 9) addressed
itself solely to the problem of poor development of the intra-
cardiac potential in the specific instance of and as a complication
of acute myocardial infarction and pointed out that with clinical
improvement the amplitude of the intracardiac potential increased
and sensing was restored, without electrode change. No informa-
tion aside from the unipolar nature of the electrode was given and
no inference concerning the electrode size is possible. It was in this
publication that the failure of sensing of 15% (of 60 patients with
acute myocardial infarct) was given. The second reference, from
1970, (authors' ref. 11) concerns itself with the operation of a pace-
maker clinic, in which no electrode is listed by model number or
size and in which, on two occasions the reversion of a pacemaker to
a fixed rate, insensitive mode of operation was used as an indica-
tion of "...the first sign of battery failure," and not of a problem
with the electrode or its size. Again no evidence is given in that
paper to indicate the incidence of sensing failure or that such
failures were other than indicators of a depleted and thus failing
pulse generator. Neither reference supports the contention in the
Hughes paper and thus neither reference was correctly used.

The evaluation of sensing failure in a specific clinical situation
can involve a complex analysis, only one factor of which may be
the pacer and/or electrode. The title suggests a clinical experience
or one with immediate clinical relevance but except for the
literature review, no illustrative clinical situation was addressed.
The differences between the clinical and animal laboratory cir-
cumstances were not adequately addressed.

The conclusions of the study are faulty because of an error
signalled in the first sentence of the "Discussion." "This study
shows that the ability to detect R-wave potentials in low im-
pedance systems..." (The authors used 1000 ohm load). They
correctly state "...with small surface area electrodes, pacemaker
circuit impedance becomes a major determinant of the amplitude
of the R-wave signal recorded." Then the study proceeds with a
pulse generator input impedance appropriate to low impedance,
large surface area electrodes discontinued by the manufacturer
(Medtronic, Inc., Brennan, T. — Personal Communication —
August 30th, 1976) and disregards the input impedance ap-
propriate for the presently available small electrodes. The
pacemaker industry has not used sensing input impedances less
than 4000 ohms for the past five years or more. The authors state
"...the current trend is toward high pacemaker circuit im-
pedance (20,000 ohms or greater)." That is now and has been the
design practice for the past five years. They quote one manu-
facturer who suggested that the Cordis ball tip electrode not be
used with his unit but not the change in recommendation. Once
the design characteristic of low input impedance was recognized, it was
altered by an increase in input impedance and elimination of that
recommendation. (Cardiac Pacemakers Inc. — Maki, K. — Per-
sonal Communication — August 26th, 1976).

In effect, the problem of poor sensing of the QRS complex was
one of mismatch between the high impedance of a smaller electrode
with the lower pacer sensing impedance, suitable for a larger, lower
impedance electrode (from an earlier era) but not suitable for the
smaller. That problem was addressed and has been corrected, but
not by the flat statement that the signal from the small electrode is
poor. The signal is not poor, but its sensing is affected by proper (or
improper) match of the input amplifier impedance of the pacer and
the impedance of the electrode.

Seymour Furman, M.D.
New York

The authors reply:

In response to Dr. Furman's questions regarding "Failure of De-
mand Pacing with Small Surface Electrodes," Circulation 54: 128,
1976:

1) Small surface area electrodes very definitely decrease the size
of the R-wave detected by a pacemaker sensing circuit —
regardless of the sensing circuit impedance. Even at infinite im-
pedance, small surface area electrodes reduce the cardiac elec-
trogram a minimum of 25%. Dr. Furman presents no data to
support his contrary opinion.

2) The references quoted in the introduction and objected to by
Dr. Furman verify that sensing problems were not infrequent even
with large surface area electrodes. No attempt was made by us to
link all past sensing failures to small surface area electrodes.

3) We were, however, led to perform our study by the increased
incidence of sensing failures in our own clinical practice, of from
approximately 1% prior to the introduction of the small surface
area electrode to in the range of from 3 to 5% following their in-
trduction (see page 131). Others have noted a similar association.

4) Dr. Furman's comments regarding what he calls matching of
circuits and electrode impedances are oversimplified. High im-
pedance (low load) circuits result in less attenuation of the R-wave
signal regardless of electrode size. But the high impedance sensing
circuits become critical and essential with small surface area elec-
trodes and as the discussion section of our paper points out, this
high impedance cannot be assured in a potentially wet and shorted
system. Recent problems with the Xytro® offer ample evidence of
the development of low impedance pathways within implanted
pacemakers. Dr. Furman is incorrectly assuming that the circuit
impedances measured on the bench prior to pacemaker implanta-
tion will be the same as the impedances present following implan-
tation into the hostile biological environment. Even hermetic seal-
ing does not totally eliminate this problem as connector leaks may,
under certain circumstances, severely load the R-wave trans-
mision-sensing circuit system. As far as the earlier and now cor-
Effect of electrode area on V ECG.
S Furman

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