A STUDY OF THE VALUE OF

PHONOCARDIOGRAPHY

IN CLINICAL MEDICINE

by E. V. B. Morton, M.B., Ch.B., M.R.C.P.Ed.

Thesis submitted to the Faculty of Medicine of the University of Edinburgh for the degree of Doctor of Medicine

April, 1958

VOL. II
(RECORDINGS)
INTRODUCTION

This volume contains the recordings which illustrate the cases presented and discussed in Volume I of this thesis. These cases and their corresponding phonocardiograph records have been numbered from 1 to 151, and a selection of the more interesting recordings have been mounted and are presented in this volume.

A table of contents is included, which also provides cross-references for Volume I and Volume II. In this way, the pages on which each case is discussed in the text of Volume I and the page on which the recordings are to be found in Volume II can be located at a glance.
As examples of this system:

A recording taken from the apex with the low frequency band 1 of the Elmquist instrument Type I amplifier will be labelled APEX.

A recording taken from the pulmonary area with the low frequency band of Type II or III amplifier will be labelled P.A.

L.F.

A recording from the fourth intercostal space near the left sternal edge with the amplifier Type I high frequency band 3 will be labelled 4.L.S.E.

and with the Type II or III amplifier high frequency band 4.L.S.E.

H.F.

and so on.

It is not necessary to distinguish between Type II and Type III amplifiers as they are so similar. Each has three comparable filter positions - low, medium and high frequency.

The Boullitte phonocardiograph has no variable filter positions and the records are easily distinguished from those taken with the Elmquist machine.

Recordings made with the Elmquist instrument are recognised by the fact that they are all recorded on paper which is 10 c.m. in breadth and has no perforation. Most of them have three or four tracings on each strip, the upper one being either jugular pulse or electrocardiogram, and the lower tracings are always the phonocardiogram.

Recordings made with the Boullitte instrument are recognised by the fact that the photographic recording paper is 6 c.m. in breadth, has perforated edges, and is marked with both horizontal and vertical lines. All the recordings with this instrument consist of two tracings only, the upper being the electrocardiogram and the lower a phonocardiogram.

In certain cases short strips of standard Cambridge electrocardiogram records have been mounted to facilitate accurate measurement of the electrocardiograph complexes.

Time Marker

Unless specifically noted on the tracing, the Elmquist recordings all have a time marker system in which the thick black vertical lines measure intervals of 0.1 second. In a small number the time marker has been to register 0.2 second, but this has been noted on the relevant tracings.

The Boullitte instrument has a time marker which may measure either 0.10 for the main division and 0.02 for the sub-division or 0.12 for the main, and 0.024 for the subsidiary division. The particular timing employed is noted on the individual recordings. In a small number of cases recorded with this instrument, however, no time marker speed has been noted, because of uncertainty and variability in the setting of the time marker mechanisms. These recordings have not been used for measuring the timing of events in the cardiac cycle.

Each individual tracing is described fully in the text.
Reference tracings

J.P. - jugular venous pulse. The deflections of the venous pulse tracing are labelled as "a", "c", and "v" waves in the conventional way.

E.C. - electrocardiogram - Roman numerals are used in the conventional way and the leads specified as Lead I, II, or III, and the major E.C.G. deflections as P, Q, R, S, and T waves.

Heart sounds

P.C. - phonocardiogram

Site of recording will be designated as:

- APEX - microphone placed over the cardiac apex.
- A.A. - " aortic area.
- P.A. - " pulmonary area.
- 3.L.S.E. - " third intercostal space near left sternal edge.
- 4.L.S.E. - " fourth intercostal space near left sternal edge.
- Epig. - " on " epigastrium.

The phonocardiograph deflections are labelled as follows:

1 - First heart sound.
2 - Second heart sound.
3 - Physiological third heart sound or protodiastolic sound.
A - Auricular sound, or presystolic sound.
G - Gallop sound, whether it be auricular, rapid filling, or summation gallop.
O.S. - Opening snap of mitral stenosis.

S.M. - Systolic murmur.
F.S.M. - Pre-systolic murmur.
M.D.M. - Mid-diastolic murmur.
E.D.M. - Early diastolic murmur.
X - Artefact or extra-cardiac sound.
M - Murmur, diastolic, systolic, or continuous.
22' - Split second sound.
11' - Split first sound.

To distinguish between the various amplifiers used with the Elmquist machine and the frequency bands employed, the following abbreviations will be used and written opposite the particular tracing to which they refer. Particular frequency bands and amplifiers used will only be noted where it is of interest or significance, or where two or more different recordings of the same sounds are presented for comparison.

Type I - The first type of amplifier described in the text and used with the Elmquist Triplex instrument, which has five filter bands specified as 1, 2, 3, 4, & 5.

Type II - The second type has three filter positions specified as L.F. (low frequency), M.F. (Middle frequency), and H.F. (high frequency).

Type III - The third type also has three similar filter positions - L.F., M.F., and H.F.
ABBREVIATIONS and NOMENCLATURE

For convenience certain abbreviations have been used in labelling the records. The generally accepted conventional nomenclature has been adopted, and a list of abbreviations used, together with the key to the labelling of the tracings is set out below. A spare, detachable copy of this list of abbreviations is also included, which can be taken out and referred to as the records are being studied.

Reference tracings

J.P. - jugular venous pulse. The deflections of the venous pulse tracing are labelled as "a", "c", and "v" waves in the conventional way.

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Heart Sounds

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Site of recording will be designated as:

APEX - microphone placed over the cardiac apex.
A.A. - "" "" "" "" aortic area.
P.A. - "" "" "" "" pulmonary area.
3.L.S.E. - "" "" "" "" third intercostal space near the left sternal edge.
4.L.S.E. - "" "" "" "" fourth intercostal "" left sternal edge.
Epig. - microphone placed on the epigastrium.
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1.
A recording from the pulmonary area with the low frequency band of the Type II or III amplifier will be labelled

PA.
L.F.

A recording from the fourth intercostal space near the left sternal edge with the amplifier Type I high frequency band 3 will be labelled

4.L.S.E.
3

and with the Type II or III amplifier high frequency band

4.L.S.E.
H.F.

and so on.

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Each individual tracing is described fully in the text.
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CASE NO. I

A

B

J.P.

E.C. II

P.C. APEX 1.

1 2

APEX 2.
CASE NO. 10

CASE NO. 11
CASE No 18  'A'

E.C. II

APEX
H.F.

I. S.M. 2.

CASE No 18  'B'

II

APEX
L.F.

A 1.  2.  3.
CASE No 20

A

B

C
CASE No 22.

CASE No 23.
CASE No. 30  'A'

'A'

'B'

E.C.
CASE 32.  'A'

CASE 33

CASE 33
CASE No. 47

CASE No. 48

No. 48
CASE No 50. 'A'

'B'

J.P.

II

P.A.
L.F.

A1 2 MDM A1 2

EPIG.
I.
CASE No. 51.
CASE No. 56

CAROTID PRESSURE

APEX
CASE No 60
CASE No. 63.
CASE No 71.

'\( A \)'

'\( B \)'

'\( C \)'

ECG readings are shown with various waveforms and annotations indicating specific heart rhythms or abnormalities. The images also include specific labeling for different perspectives or views of the heart activity.
CASE NO. 77

A

I

P.A.
H.F.

APEX.

B

I

II

P.A.
H.F.

APEX.

SM
0.2 SEC.
CASE No 84  'E'

TWO MONTHS LATER.
CASE No 84
CASE No 90

'A'

I

SM

A.A.
L.F.

APEX.
L.F.

1 SM 2 EDM

'B'

I

SM

A.A.
M.F.

L.S.E.
M.F.

1 SM 2 EDM
CASE No. 94 'c'

D'
CASE No. 94

'E'

APEX

'F'

APEX
CASE No 94.

'G'

I

\[ \text{PQRS} \]

II

\[ \text{PQRS} \]

APEX 2.

\[ \text{PSM EOM} \]

'H'

I

\[ \text{PQRS} \]

II

\[ \text{PQRS} \]

APEX 2.

\[ \text{SM EDM} \]
CASE NO 95.
CASE No 96. PRE-OPERATIVE RECORDS. 'A'

CASE No 96. PRE-OPERATIVE RECORDS. 'B'
CASE No. 96  Post-operative Records

C'

D'
CASE No. 97.
CASE No 102.

PRE-OPERATIVE RECORDS

A

B

POST-OPERATIVE RECORDS

C

D
CASE No 103.

**PRE-OPERATIVE RECORDS**

**POST-OPERATIVE RECORDS**
CASE NO. 108

PRE-OPERATIVE RECORDS
CASE NO. 109

A  PRE-OPERATIVE

B  POST-OPERATIVE

TIME MARKER REGISTERS 0.2
CASE NO. 110 D POST-OPERATIVE

[Graphs and waveforms from the electrocardiogram (EKG) showing different leads (I, II, P.A.M.F., Apex)]

E
CASE No. III

'A' PRE-OPERATIVE RECORDS

'B'

'C' POST-OPERATIVE RECORDS

'D'

TIME MARKER 0.2 SEC.
CASE No 112

A
CASE NO. 112.

'F'

I

II

III

PA 2.

2.03

'G'

I

II

III

PA 3.

2.05
CASE No 113. 'A'

CASE No 113. 'B'

CASE No 113. 'C'
CASE No 114. 'A'

'B'

'C'

'D'
CASE No 130.

'A'

'B'

L.S.E.
L.F.

APEX.

I

4. L.S.E.

I

2.
CASE No 131.
CASE No 136.

CASE No 137.
CASE No 139
CASE No 144

E.C.I.
P.C. L.I.S.E.
P.C. APEX.

PRESSURE APPLIED.

X
RESPIRATORY SOUNDS.

- RELEASED.
CASE No. 144.

Fig. 11.

Drawing of the specimen to show the portal epigastric anastomosis along the falciform ligament.
CASE NO. 151

A

JP

II

APEX

SM 2

3.

B

C

JP

II

APEX

SM 2

3.

A.A.

3.