A simplified computer program for the performance of physiological calculations from cardiac catheterization data[1]

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The authors describe a computer program which can be programmed into a handheld computer with an eight-kilobyte memory. This program would enable a cardiologist to quickly and efficiently analyze hemodynamic data obtained from right and left heart catheterization. Laborious manual calculations are eliminated, and a permanent hard-copy printout is provided.

Index terms: Computers • Heart catheterization • Hemodynamics

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The performance of right and left heart catheterization yields much data which must be analyzed in view of the patient's pathophysiologic problems. Such data analysis usually entails laborious manual calculations by the cardiologist. We describe a computer program which can be used by any clinician, even one who is a tyro to computer operation and programming. Other computer programs have been devised, however, they are more elaborate and thus necessitate the use of tabletop computers which cost more ($300–$170,00), entail more elaborate programming, and are not practical for community-based cardiologists.[1–4] Previous programs for handheld computers have not been dedicated to this specific usage.[5,6]

Materials and methods

Hemodynamic parameters from right and left heart catheterization are obtained and recorded in standard fashion. Oxygen saturations are measured using standard oximetric

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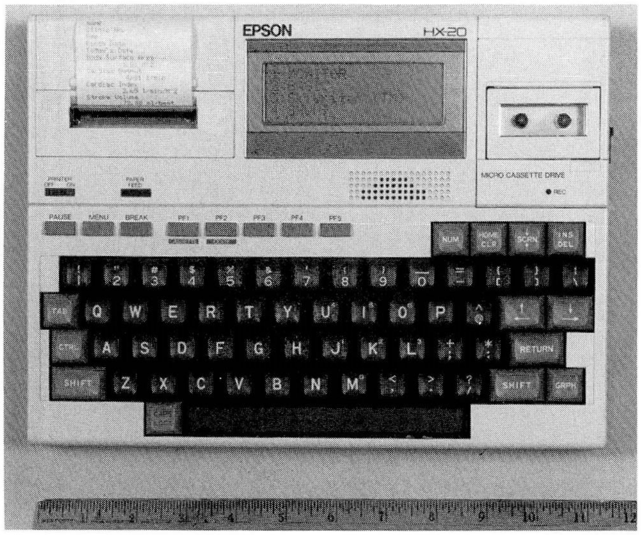

Fig. 1. Epson HX-20 programmable computer with built-in printer and cassette drive.

instruments. We selected an Epson HX-20 briefcase-sized computer (*Fig. 1*) for the following reasons:

1. Sixteen-kilobyte random access memory and thirty-two-kilobyte read-only memory,
2. Use of the beginner's all-purpose symbolic instruction code (BASIC),
3. A built-in printer,
4. A built-in cassette drive,
5. Portability and compactness, and
6. Reasonable cost (list price, $795).

Table 1 lists the formulas used to derive the various calculations. These formulas are standard and can be found in catheterization texts.[7–9] *Table 2* lists the computer inputs needed to arrive at the final printout. *Table 3* lists the derived parameters and their units of measure. *Figure 2* is a printout of the actual computer program employed.

Results

Figure 3 shows a case of mitral stenosis, illustrating inputs and data outputs. *Figure 4* shows a case involving an atrial septal defect, demonstrating shunt calculations.

Discussion

We believe we have designed a computer program to analyze cardiac catheterization data.

Abbreviations Used in Program:

A$	**Name**
B$	**Clinic no.**
C$	**Age**
D$	**Birth date**
T$	**Today's date**
HT	**Height (cm)**
WT	**Weight (kg)**
S	**BSA**
SA	**Sys. art. sat.**
SV	**Pulm. art. sat.**
SC	**SVC sat.**
IC	**IVC sat.**
VS	**Pulm. vein sat.**
HB	**Hemoglobin**
R	**Heart rate**
A	**Mean aortic blood pressure**
B	**Mean pulm. art.**
C	**PCWP**
HC	**Oxygen capacity**
MV	**Mixed venous oxygen sat.**
AC	**Systemic artery content**
PC	**Pulm. art. content**
MB	**Mixed venous content**
IV	**IVC sat. content**
VC	**Pulm. vein sat. content**
OC	**Oxygen consumption**
CO	**Cardiac output**
CI	**Cardiac index**
V	**Stroke volume**
F	**Stroke volume index**
PF	**Pulmonary flow**
PI	**Pulmonary flow index**
QPS	**QP/QS**
RS	**Systemic resistance**
RP	**Total pulm. resistance**
RA	**Pulm. arteriolar resistance**
PLP	**Left-to-right %**
LP	**Left-to-right shunt**
PRL	**Right-to-left %**
RL	**Right-to-left shunt**
AVA	**Aortic valve area**
MVA	**Mitral valve area**
VPL	**LVms—left ventricular systolic mean pressure**
APS	**Aortic ms—aortic systolic mean pressure**
SEP	**sec/beat systolic ejection period**
DFP	**sec/beat diastolic filling period**
LA	**left atrial mean pressure or PCWP**
LV	**LVdm—measured left ventricular mean diastolic pressure**
PA	**pO_2**
PV	**pvO_2**
WX	**CaO_2—arterial oxygen content**
XW	**CVO_2—venous oxygen content**
RR	**A-V O_2—arteriovenous oxygen content difference**
O	**Oxygen delivery to the patient**
Z	**Direc. var.**
L	**Loop var.**

Table 1. Formulas for derived parameters

$$BSA = 0.0072 \times \text{weight}^{0.425} \times \text{height}^{0.725}$$

$$O_2 \text{ consumption} = CI \times \text{A-V } O_2 \text{ difference} \times 10$$

$$O_2 \text{ capacity} = \text{hemoglobin} \times 1.34$$

$$\text{Mixed venous saturation} = \frac{2(\text{SVC saturation}) + (\text{IVC saturation})}{3}$$

$$\text{Cardiac output (systemic flow or } Q_s) = \frac{O_2 \text{ consumption in mL/min}}{(\text{systemic artery content} - \text{mixed venous content}) \times 10}$$

$$O_2 \text{ content} = (\% \text{ saturation} \times O_2 \text{ capacity}) + \text{dissolved oxygen}^*$$

$$\text{Pulmonary flow } (Q_p) = \frac{O_2 \text{ consumption in mL/min}}{(\text{pulmonary vein content})^\dagger - (\text{pulmonary artery content}) \times 10}$$

$$CI = \frac{CO}{BSA}$$

$$PFI = \frac{Q_p}{BSA}$$

$$Q_p/Q_s = \frac{PFI}{CI}$$

$$SVR = \frac{\text{mean arterial pressure}}{CI}$$

$$PVR = \frac{\text{mean pulmonary artery pressure}}{PFI}$$

$$P_aVR = \frac{\text{mean pulmonary artery pressure} - \text{mean wedge pressure}}{PFI}$$

$$\% \text{ left-to-right shunt} = \frac{\text{pulmonary artery saturation} - \text{mixed venous saturation}}{\text{systemic artery saturation} - \text{mixed venous saturation}}$$

$$\% \text{ right-to-left shunt} = \frac{\text{pulmonary venous saturation} - \text{systemic artery saturation}}{\text{pulmonary venous saturation} - \text{mixed venous saturation}}$$

$$\text{Left-to-right shunt in L/min} = \left(\frac{O_2 \text{ consumption}}{[\text{arterial } O_2 \text{ content} - \text{pulmonary artery } O_2 \text{ content}] \times 10}\right) - \left(\frac{O_2 \text{ consumption}}{[\text{arterial } O_2 \text{ content} - \text{RV } O_2 \text{ content}] \times 10}\right)$$

$$AVA = \frac{\text{cardiac output}}{(\text{systolic ejection period [sec/beats]}) \times (\text{heart rate [beat/min]}) \times 44.5 \times (\sqrt{\text{mean LV systolic pressure} - \text{mean aortic systolic pressure}})}$$

$$MVA = \frac{\dfrac{\text{cardiac output}}{\text{diastolic filling period LV}}}{K^\ddagger \sqrt{\text{left atrial mean pressure} - \text{LV diastolic mean pressure}}}$$

* If 75%–85% saturation, add 0.1; if 85%–95% saturation, add 0.2; if >95% saturation, add 0.3. If O_2 delivery is 40%, add 0.7; if O_2 delivery is 60%, add 1.0; and if O_2 delivery is 100%, add 1.7.

† Same as systemic arterial content.

‡ Use 38 if left atrial pressure was actually measured. Use 31 if PCWP is used.

Whereas most medical computer programs are frustrating for the user because of their complexity, our program is user-friendly and requires no prior computer literacy. This program "leads" the user to every input. A nonphysician could easily load the program and perform the computations. In addition, our program permits use of a fairly low-memory capacity computer that is,

Table 2. Inputs needed

Name
Clinic number
Age
Birth date
Today's date
Height (cm)
Weight (kg)
Systemic arterial saturation
Pulmonary arterial saturation
Superior vena caval saturation
Inferior vena caval saturation
Pulmonary venous saturation
Hemoglobin
Heart rate
Mean aortic blood pressure
Mean pulmonary artery pressure
Pulmonary capillary wedge pressure
Oxygen administration or not? (If yes, give flow rate %)
Cardiac output or not? (If not, give oxygen consumption)
Hard-copy printout or not?
pO_2
pVO_2
LV mean systolic pressure
Systolic ejection period (sec/beat)
Diastolic ejection period (sec/beat)
Left atrial mean pressure (or mean PCWP)
LV diastolic mean pressure

Table 3. Derived parameters

Parameter	Abbreviation	Units
Body surface area	BSA	m^2
Cardiac output	CO	L/min
Cardiac index	CI	L/min/m^2
Stroke volume	SV	mL/beat
Stroke volume index	SVI	mL/beat/m^2
Pulmonary flow	PF	L/min
Pulmonary flow index	PFI	L/min/m^2
Systemic resistance	SVR	U/m^2
Total pulmonary resistance	PVR	U/m^2
Pulmonary arteriolar resistance	PaVR	U/m^2
Aortic valve surface area	AVA	cm^2
Mitral valve surface area	MVA	cm^2
Shunt	Q_p/Q_s	% or L/min/m^2

therefore, easily affordable. There are handheld computers on the market today with eight-kilobyte memory which are less expensive than the Epson HX-20, but they do not have self-contained printers or cassette drives. The built-in printer is an asset in providing a hard-copy printout of the derived parameters which can then become a part of the patient's permanent record. Finally, such a program allows one to make these computations in one-tenth of the time necessary for longhand calculations, thus allowing more time for more important duties.

```
  1 REM COMPUTER PROGRAM FOR THE PERFORMANCE OF PHYSIOLOGIC CALCULATIONS
                    FOR CARDIAC CATHETERIZATION DATA
  5 REM PATIENT INFORMATION

 10        Input "Name";A$
 20        Input "Clinic No.";B$
 30        Input "Age";C$
 40        Input "Birth Date";D$
 50        Input "Today´s Date";T$
 55        REM Calculations of BSA (S)
 60        Input "HT in Cm";HT
 70        Input "Wt in Kg";WT
 80        S=.0072*HT^.725 *wt^.425
 85        REM Input parameters
 86        REM All 02 Sat, enter in as whole no.
 90        Input "Sys. Art Sat";SA
100        SA=SA*.01
110        Input "Pulm. Art Sat";SV
120        SV=SV*.01
130        Input "SVC Sat";SC
140        SC=SC*.01
150        Input "IVC Sat";IC
160        IC=IC*.01
170        Input "Pulm Vein Sat";VS
180        VS=VS*.01
190        Input "Hemoglobin";HB
200        Input "Heart Rate";R
210        Input "Mean Aortic BP";A
220        Input "Mean PA";B
230        Input "PCWP";C
235        REM CLS is used to clear only the LCD screen
240        CLS
250        Print "Are you giving O2
260        Input"Yes=1, No=2";Z:CLS
270        IF Z=1 then 1760
280        Gosub 1470
290        Gosub 2560
300        Print "Do you have a"
310        Print "Cardiac output?"
320        Input "1=yes, 2=No;Z:CLS
330        CLS
340        If Z=1 then 1350
345        REM Calculation of cardiac output
350        Input "O2 consumption";OC
360        OC = OC*S
370        CO = OC/((AC-MB)*10)
375        REM Calculations of output parameters
380        CI = CO/S
390        PF = OC/((AC-PC)*10)
400        PI = PF/S
410        V=CO*1000/R

420        F=CI x 1000/R
430        QPS = PI/CI
440        RS = A/CI
450        RP = A/PI
460        RA = (B-C)/PI
470        PLR = (SV-MV)/(SA-MV)
480        PLR = PLR*100
490        CP = OC/S
500        LR = (CP/((AC-PC)*10)) - (CP/((AC-IV)*10))
510        IF SA > .94 then 550
520        PRL = (VS-SA)/(VS-MV)
530        PRL = PRL*100
540        RL = (CP/((AC-PC)*10)) - (CP/((VC-PC)*10))
550        CLS
560        Print "Do you want a"
570        Print "Hardcopy print out"
580        Input "Yes=1, No=2"; Z
590        IF Z = 2 then 2010
600        CLS
605        REM Output parameter print out to microprinter:  Lprint is the
           code to send the data to printer
610        Lprint "Name";A$
620        Lprint "Clinic No.";B$
630        Lprint "Age";C$
640        Lprint "Birth Date";D$
650        Lprint "Today´s Date";T$
660        Lprint "Body surface Area"; TAB(8); :Lprintusing
           "##.##";S; :Lprint" M^2"
670        Lprint "Cardiac Output";TAB(8);:Lprintusing "###.##";CO;:L print"
           1/min"
680        Lprint "Cardiac Index";TAB(8);:Lprintusing "##.##";CI;:L print"
           1/min/M^2"
690        Lprint "Stroke Volume";TAB(8);:Lprintusing "###.##";v;:Lprint"
           ml/beat"
700        Lprint "Stroke Volume Index";Tab(4); Lprintusing "###.##";:Lprint"
           ml/beat/M^2"
710        Lprint "Pulmonary Flow";Tab(8);:Lprintusing "###.##";PF;:Lprint"
           1/min"
720        Lprint "Pulmonary Flow Index";Tab(8);:Lprintusing
           "##.##";PI;:Lprint" 1/min/M^2"
730        Lprint "QP/QS";TAB(9);:Lprintusing "##.##";QPS
740        Lprint "Systemic Resistance";Tab(8);:Lprintusing
           "###.##";RS;:Lprint" units M^2
750        Lprint "Total Pulm. Res.";TAB(9);1:Lprintusing "##.##";RP;:Lprint"
           units M^2"
760        Lprint "Pulm. Arteriolar Res.";Tab(9);:Lprintusing
           "##.##";RA;:Lprint" units M^2
770        Lprint "left-to-right %";Tab(8);:L printusing
           "###.#";PLR;:Lprint"%"
780        Lprint "left-to-right shunt";Tab(8);:L printusing
           "##.##";LR;:Lprint" 1/min/M^2
790        If SA > .94 then 820
800        Lprint "right-to-left %";Tab(8);:Lprintusing
           "###.#";PRL;:Lprint"%"
810        Lprint "right-to-left shunt";TAB(8);:L printusing
           "##.##";RL;:Lprint" 1/min/M^2"
820        CLS
830        Print "Do you want to do"
```

```
840   Print "Aortic Valve Area?"
850   Input "yes=1, no=2";Z:CLS
860   IF Z=1 Then 1060
870   CLS
880   Print "Do you want to do"
890   Print "Mitral Valve Area?"
900   Input "yes=1, no=2:;Z:CLS
910   If Z=1 then 1200
920   Goto 1030
930   CLS
940   Lprint "Aortic Valve Area";Tab(8);:Lprintusing
      "###.##";AVA;:Lprint" cm^2"
950   Goto 870
960   CLS
970   Lprint "Mitral Valve Area";Tab(8);:Lprintusing "###.##";
      MVA;:Lprint" cm^2"
980   CLS
990   Lprint:Lprint
1000  Lprint "Copyright 1984"
1010  Lprint "Schaber/Carangio
1020  Lprint:Lprint:Lprint:Lprint:Lprint
1030  Print "Program is over"
1040  Print "Go back to menu"
1050  Print "or type run to start": End
1055  REM Calculation for Aortic Valve Area
1060  Input "Heart Rate";R
1070  Input "Cardiac Output";CO
1080  Input "Aortic ms";APS
1090  Input "LVms";VPL
1100  Input "SEP sec/beat";SEP
1110  C=1;CO=CO*1000
1120  AVA=CO/(SEP*R*C*44.5*SQR (VPL-APS))
1130  CLS
1140  Print "Do you want a"
1150  Print "hardcopy printout"
1160  Input "yes=1, no=2;Z:CLS
1170  IF Z=2 then 2340
1180  CLS
1190  Goto 930
1195  REM Calculation for Mital Valve Area
1200  Input "Heart Rate";R
1210  Input "Cardiac Output";CO
1220  Input "DFP sec/beat";DFP
1230  Input "LAm or PCWP";LA
1240  Input LVdm";LV
1250  CO=CO x 1000
1260  DFP=DFP*P
1270  MVA=(CO/DFP)/(.85*44.3* SQR ((LA-LV)))
1280  CLS
1290  Print "Do you want a"
1300  Print "hardcopy printout"
1310  Input "yes=1, no=2;Z:CLS
1320  If Z=2 then 2370
1330  CLS
1340  Goto 960
1345  REM Calculation for O2 consumption
1350  Input "Cardiac Output";CO
1360  CI=CO/S
1370  Input "PO2";PA
1380  PA=PA*.01
1390  Input "PVO2";PV
1400  PV=PV*.01
1410  WX=HC*SA + (PA* .0031)
1420  XW=HC* SV + (PV* .0031)
1430  RR=WX-XW
1440  OC=CI RR*10
1450  OC=OC*S
1460  Goto 390
1465  REM Calculations for O2 content where the added dissovled oxygen
      is determined by percent O2 saturation
1470  MV=((2*SC)+IC)/3
1480  HC=HB*1.34
1490  If SA<.85 then 1580
1500  If SA=>.85 <.95 then 1600
1510  If SA=>.95 then 1620
1520  If SV=<.85 then 1640
1530  If SV=>.85 <.95 then 1660
1540  If SV=>.95 then 1680
1550  If MV<.85 then 1700
1560  If MV=>.85 <.95 then 1720
1570  If MV=>.95 then 1740
1580  AC=SA*HC + .1
1590  Goto 1520
1600  AC=SA*HC + .2
1610  Goto 1520
1620  AC=SA*HC + .3
1630  Goto 1520
1640  PC=SV*HC + .1
1650  Goto 1550
1660  PC=SV*HC + .2
1670  Goto 1550
1680  PC+SV*HC + .3
1690  Goto 1550
1700  MV=MV*HC + .1
1710  Goto 1750
1720  MB=MV*HC + .2
1730  Goto 1750
1740  MB=MV*HC + .3
1750  Return
1755  REM Calculations for O2 content where the added dissolved oxygen
      is determined by oxygen delivery
1760  MV=((2*SC) + IC)/3
1770  HC=HB*1.34
1780  Input "O2% using";9:CLS
1790  Q=Q*.01
1800  If Q=.4 then 1830
1810  If Q=.6 then 1890
1820  If Q=1 then 1950
1830  AC=SA* HC+.7
1840  PC=SV* HC+.7
1850  MB=MV* HC+.7
1860  IV=IC* HC+.7
1870  VC=VS* HC+.7
1880  Goto 300
1890  AC=SA* HC+1
1900  PC=SV* HC+1
1910  MB=MV* HC+1
1920  IV=IC* HC+1
1930  VC=VS* HC+1
1940  Goto 300
1950  AC=SA* HC+1.7
1960  PC=SV* HC+1.7
1970  MB=MV* HC+1.7
1980  IV=IC* HC+1.7
1990  VC=VS* HC +1.7
2000  Goto 300
2010  CLS
2015  REM Output parameter print out to LCD screen
2020  Print "Body surface Area";Tab(8);:printusing "##.##";S;:print M^2
2025  REM loop statement for time delay for LCD screen display
2030  For L= 1 to 200:next L:CLS
2040  Print "Cardiac Output";TAB(5);:printusing
      "###.##";CO;:Print"1/min"
2050  For L= 1 to 200: next L:CLS
2060  Print "Cardiac Index";TAB(4);:printusing "##.##";CI;:print"
      1/min/m^2"
2070  For L= 1 to 200: next L:CLS
2080  Print "Stroke Volume";TAB(5);: printusing "###.##";V;print"
      ml/beat"
2090  For L= 1 to 200: next L:CLS
2100  Print "Stroke volume index";TAB(2);printusing "###.##";F;:Print"
      ml/beat/M^2"
2110  For L = 1 to 200:next L:CLS
2120  Print "Pulmonary flow";TAB(5);:printusing "###.##";PF;:print"
      1/min"
2130  For L= 1 to 200:next L:CLS
2140  Print "Pulmonary flow index";TAB(4);:printusing "##.##";PI;:print"
      1/min/M^2
2150  For L=1 to 200:Next L:CLS
2160  Print "QP/QS":Tab (9);:Print using "##.##";QPS
2170  For L=1 to 200:Next L:CLS
2180  Print "Systemic Resistance";Tab (4);:Print using
      "###.##";RS;:Print "  units M^2"
2190  FOR L = 1 to 200:Next L:CLS
2200  Print "Total Pulm. Res."; TAB (4);: Print using "##.##"; RP;:Print
      "  units M^2"
2210  For L=1 to 200:Next L:CLS
2220  Print "Pulm. Arteriolar Res."; Tab (4);:Print using
      "##.##";RA;:Print "  units M^2"
2230  For L=1 to 200:Next L:CLS
2240  Print "Left-to-Right %"; Tab (8);: Print using "###.#";PLR;:Print
      "%"
2250  For L = 1 to 200:Next L:CLS
2260  Print "Left-to-Right Shunt"; Tab (4);:Print using
      "##.##";LR;:Print "1/min/m^2"
2270  For L = 1 to 200:Next L:CLS
2280  If SA >.94 then 2400
2290  Print "Right-to-Left %"; Tab (8);:Print using "###.#";PRL;:Print
      "%"
2300  For L = 1 to 200:Next L:CLS
2310  Print "Right-to-Left Shunt"; Tab (4);:Print using
      "##.##";RL;:Print "1/min/m^2"
2320  For L = 1 to 200:Next L:CLS
2330  Goto 2400
2340  Print "Aortic Valve Area"; Tab (8);: Print using
      "###.##";AVA;:Print " cm^2"
2350  For L = 1 to 200:Next L:CLS
2360  Goto 2460
2370  Print "Mitral Valve Area"; Tab (8);: Print using
      "###.##";MVA;:Print " cm^2"
2380  For L = 1 to 200:Next L:CLS
2390  Goto 2510
2400  CLS
2410  Print "Do you want"
2420  Print "to repeat"
2430  Input "Yes = 1, No = 2"; Z:CLS
2440  If Z = 1 Then 2010
2450  Goto 820
2460  Print "Do you want"
2470  Print "to repeat"
2480  Input "Yes = 1, No = 2"; Z:CLS
2490  If Z = 1 then 2340
2500  Goto 870
2510  Print "Do you want"
2520  Print "to repeat"
2530  Input "Yes = 1, No = 2"; Z:CLS
2540  If Z = 1 then 2370
2550  Goto 1030
2555  REM Calcutions for O2 content were the added dissolved oxygen is
      determined by percent O2 sat.
2560  If IC<.85 then 2590
2570  If IC = >.85 <.95 then 2610
2580  If IC = >.95 then 2630
2590  IV = IC * HC + .1
2600  Goto 2650
2610  IV = IC * HC + .2
2620  Goto 2650
2630  IV = IC * HC + .3
2640  Goto 2650
2650  If VS < .85 then 2680
2660  If VS = >.85 < .95 then 2700
2670  If VS = > .95 then 2720
2680  VC = VS * HC + .1
2690  Goto 2730
2700  VC = VS * Hc + .2
2710  Goto 2730
2720  VC = VS * Hc + .3
2730  Return
```

Fig. 2. Computer program.

INPUTS	PRINTOUT
Name	NAME
Clinic number	Clinic No.
Age	Age
Birth date	Birth Date
Today's date	Today's Date
Height = 170 cm	Body Surface Area 1.81 M^2
Weight = 70 kg	Cardiac Output 4.20 l/min
Syst. art. sat. = 98	Cardiac Index 2.32 l/min/M^2
Pulm. art. sat. = 87	Stroke Volume 48.84 ml/beat
SVC sat. = 87	Stroke Volume Index 26.93 ml/beat/M^2
IVC sat. = 87	Pulmonary Flow 4.20 l/min
Pulm. vein sat. = 98	Pulmonary Flow Index 2.32 l/min/M^2
Hemoglobin = 12.5 g	QP/QS 1.00
Heart rate = 86 beats/min	Systemic Resistance 38.00 units M^2
Mean aortic blood pressure = 88	Total Pulm. Res. 38.00 units M^2
Mean PA pressure = 30	Pulm. Arteriolar Res. 3.89 units M^2
PCWP mean = 21	Left-to-Right % -0.0 %
Cardiac output = 4.2 L/min	Left-to-Right Shunt 0.00 l/min/M^2
Diastolic filling period = 0.39 sec/beat	Mitral Value Area 0.83 cm^2
LV diastolic mean pressure = 5	

Fig. 3. Mitral stenosis (inputs and computer printout).

INPUTS	PRINTOUT
Name	NAME
Clinic number	Clinic No.
Age	Age
Birth date	Birth Date
Today's date	Today's Date
Height = 159 cm	Body Surface Area 1.55 M^2
Weight = 54 kg	Cardiac Output 4.30 l/min
Syst. art. sat. = 97	Cardiac Index 2.78 l/min/M^2
Pulm. art. sat. = 91	Stroke Volume 48.89 ml/beat
SVC sat. = 76	Stroke Volume Index 31.59 ml/beat/M^2
IVC sat. = 76	Pulmonary Flow 15.42 l/min
Pulm. vein sat. = 97	Pulmonary Flow Index 9.97 l/min/M^2
Hemoglobin = 14.6 g	QP/QS 3.59
Heart rate = 88 beats/ min	Systemic Resistance 26.98 units M^2
Mean art. pressure = 75	Total Pulm. Res. 7.52 units M^2
Mean PA pressure = 16	Pulm. Arteriolar Res. 0.80 units M^2
PCWP mean = 8	Left-to-Right % 71.4 %
Oxygen consumption = 117 mL/min/m^2	Left-to-Right Shunt 7.19 l/min/M^2

Fig. 4. Atrial septal defect (inputs and computer printout).

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