RIGHT HEART HAEMODYNAMICS IN NORMAL MALAYSIAN SUBJECTS

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SUMMARY

The right heart pressures and saturations at different sites were measured in 87 normal individuals over a 16-year period during heart cardiac catheterisation. The right heart pressure measurements were comparable with normal values reported in Caucasian subjects. However, the total pulmonary vascular resistance and systemic vascular resistance were significantly different, though the pulmonary vascular resistance was comparable.

INTRODUCTION

The measurement of pressures from the right heart chambers and the great vessels is a routine and well established procedure in the cardiac catheterisation laboratory. Available data for normal subjects are those obtained from European and American subjects and information of this nature is not available in Asian subjects.

In 1968, cardiac catheterisation was commenced at the University Hospital, Kuala Lumpur. Over the past 16 years substantial data on the normal right heart haemodynamics have become available and hence this study was undertaken to establish the normal right heart haemodynamics amongst Malaysian subjects and to compare them with published normal data from the west.

MATERIALS AND METHODS

The study consisted of 87 patients comprising of 31 Malays, 40 Chinese and 16 Indians undergoing cardiac catheterisation for evaluation of functional systolic murmurs or for the purpose of excluding intracardiac shunts. Significant heart disease was excluded by normal oximetry, haemodynamics and angiography. 57 males and 30 females with ages ranging from four years to 59 years with a mean of 20.5 years were studied.

All patients underwent right heart catheterisation using percutaneous transfemoral approach or venous cutdown technique under local anaesthesia. Mild sedation was given either orally or intramuscularly one hour prior to the procedure. A commercially available end-hold venous catheter (Cournand or Lehman) was used to perform right heart catheterisation. Pressures and oxygen saturations at the various sites, namely pulmonary

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TABLE I
NORMAL RIGHT HEART AND ARTERIAL HAEMODYNAMICS IN MALAYSIAN SUBJECTS

	Male				Female				Total			
	mean	±SD	Range	n	mean	±SD	Range	n	mean	±SD	Range	n
Age (yrs)	20.6	±9	(4–59)	57	20.3	±7.8	(10–46)	30	20.5	±8.8	(4–59)	87
R.A. (mmHg) (mean)	3.5	±2.4	(1–10)	57	3.1	±2.3	(1–9)	30	3.4	±2.4	(1–10)	87
R.V. (mmHg)	27/5	±5/3	(16/3–40/12)	57	24/4	±6/2	(14/2–35/8)	30	26/5	±6/3	(14/2–40/12)	87
P.A. (mmHg)	26/9	±6/4	(9–23)	57	23/8	±5/3	(14/5–35/15)	30	25/9	±6/4	(14/5–42/18)	87
P.A. (mmHg) (mean)	14.5	±4	(6–15)	57	13.3	±2.7	(8–16)	30	14.2	±3.5	(8–23)	87
PAW (mmHg)	9.0	±3	(3–15)	46	6.4	±3	(1–11)	21	8.2	±3.3	(1–15)	67
F.A. (mmHg)	113/69	±13/8	(90/60–150/100)	46	110/63	±16/7	(96/58–120/70)	18	112/68	±14/10	(90/66–150/100)	64
F.A. (mmHg) (mean)	85	±9.5	(70–115)	46	80.5	±11	(66–99)	18	84	±10	(66–115)	64
TPVR (dynes-s-cm^{-5})	146	±69	(61–217)	57	130	±40	(55–184)	30	142	±56	(55–217)	87
PVR dynes-s-cm^{-5}	64	±42	(25–76)	43	71	±36	(10–103)	24	68	±40	(10–103)	67
SR dynes-s-cm^{-5}	813	±266	(434–1208)	48	787	±198	(493–1236)	16	797	±189	(434–1236)	64

R.A. = right atrium; R.V. = right ventricle; P.A. = pulmonary artery; PAW = pulmonary arterial wedge pressure; F.A. = femoral artery; TPVR = total pulmonary vascular resistance; PVR = pulmonary vascular resistance; SR = systemic resistance; n = number of subjects.

TABLE II
COMPARISON OF NORMAL RIGHT HEART DATA

	Yang, *et. al.*,[1]		Grossman[2]	McIlroy[3]	Barrett-Boyes[4]	University Hospital Kuala Lumpur	
	mean	Range	Range	mean	mean ± SD	mean ± SD	Range
R.A. (mmHg) (mean)	2.8	(1–5)	(0–8)	10	6 ± 2.3	3.4 ± 2.4	(1–0)
R.V. (mmHg)	25/4	(17–32/1–7)	(15–30/0–8)	25/0/7	27/4 ± 4.3/2.7	26/5 ± 6/3	(14–40/12)
P.A. (mmHg)	25/9	(17–32/4–13)	(15–30/4–12)	25/15	22/12 ± 3.7/2.6	25/9 ± 6/3.5	(14/5–42/18)
P.A. (mmHg) (mean)	15	(9–19)	(9–16)	18	17 ± 3.1	14 ± 3.5	(8–23)
P.A.W. (mmHg)	9	(4.5–13)	–	–	12 ± 2.0	8 ± 3.5	(1–15)
L.A. (mmHg) (mean)	7.9	(2–12)	–	–	–	–	
Systemic Arterial (mmHg)	130/70	(90–140/6090) BA	(100–140/60–90)	120/7–12 (LV)	–	112/68 ± 14/10	(90/66–150/100)
Systemic Arterial (mmHg) (mean)	85	(70–105) BA	(70–105)		–	84 ± 10	(66–115)
TPVR dynes-sec-cm^{-5}		100–300	–		205 ± 51	142 ± 56	(55–217)
PVR dynes-sec-cm^{-5}		20–200	–	100	67 ± 23	68 ± 40	(10–103)
SR dynes-sec-cm^{-5}		770–1500	–	160	1130 ± 178	797 ± 189	(434–1236)

R.A. = right atrium; R.V. = right ventricle; P.A. = pulmonary artery; F.A. = femoral artery; P.A.W. = pulmonary arterial wedge pressure; L.V. = left ventricle; B.A. = brachial artery; TPVR = total pulmonary vascular resistance; PVR = pulmonary vascular resistance; S.R. = systemic resistance.

capillary, pulmonary artery, right ventricle, right atrium and the vena cava were obtained in rapid succession on catheter withdrawal. The foramen ovale was probed in all the subjects and was found to be patent in nine. The femoral artery was punctured percutaneously at the end of the procedure for pressure and oxygen saturation measurements. The zero point for all pressure measurements was taken at mid-chest level. Oxygen consumption was obtained by spirometry and cardiac output calculated by the Fick equation. Pressure measurements were made with a strain gauge transducer coupled with an eight channel Mingograf 81 recording system and more recently a Honeywell computer assisted data acquisition system.

The systemic resistance (SVR), total pulmonary vascular resistance (TPVR) and pulmonary vascular resistance (PVR) were calculated using the following formulae and expressed in dynes-s-cm^{-5}.

$$TPVR = \frac{\bar{P}A}{CO} \times 80$$

$$PVR = \frac{\bar{P}A \quad (\bar{P}AW \text{ or } \bar{L}A)}{CO} \times 80$$

$$SVR = \frac{\bar{F}A}{CO}$$

$\bar{P}A$ = Mean pulmonary artery pressure

$\overline{PAW}$ = Mean pulmonary arterial wedge pressure

$\bar{L}A$ = Mean left atrial pressure

$\bar{F}A$ = Mean femoral artery pressure

CO = Cardiac output

RESULTS

There were 57 males and 30 females. This discrepancy in the sex incidence is mainly due to more males being studied for pre-employment medical certification and insurance coverage.

The haemodynamic data were analysed separately for males and females and by the age group. Using the t-test, we found that there was no significant differences in the results between the sexes. There was also no statistical difference between the age groups. These are presented in Table I. The overall results are summarised in Table I and compared with other published values (Table II).[1,2,3]

DISCUSSION

In the course of diagnostic right heart catheterisation, we noted that there were some variations in pressure recordings from the various chambers. We believe these variations to be due to the type of catheters used, their diameter, nature of the holes in the tip, flicking of catheters across the valves, length of the pressure connections and the physiologic state of the subjects. Attempts were made to reduce any pitfalls and artifacts by standardising our procedures and techniques. Right heart pressures from our study are comparable to previously published data.[1,4] However the total pulmonary vascular resistance and the systemic vascular resistance differ from those obtained on Caucasian subjects ($p < 0.05$ and < 0.001 respectively). This probably is due to the higher cardiac output noted in our subjects. It is worth noting that the pulmonary vascular resistance remains comparable. We believe that these normal right heart haemodynamics will provide basic physiological data in Asians for other cardiac catheterisation laboratories in this region instead of merely using data obtained from a Caucasian population.

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