CARDIAC RESPONSE OF NIGERIAN HYPERTENSIVES TO ANAESTHESIA AND SURGERY

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UNTIL RECENTLY medical opinion was that hypertension was relatively rare in negroes, particularly in the developing countries. In a two-year period in Kenya, Donnison¹ did not find a single case of hypertension in 1,800 Africans. Vint² reviewed 1,000 necropsies in Nairobi and did not find pathological changes due to hypertension. In a study of high blood pressure in West Africans Shattuck³ found it to be less common among the negroes than in American Whites. More recently, however, the incidence of hypertension has been found to be quite high. In a three-year autopsy study in Panama, Taylor⁴ found hypertension three times as common in negroes as in caucasians. Our experience confirms that the incidence of hypertension in Nigeria is quite high. It is the most common cardiovascular illness and a significant number of these patients come to surgery for a variety of reasons.

Clinical evidence from various centres indicates that the prognosis of hypertension in negroes is worse than in caucasians.^{5,6} The disease seems to affect a younger age group and serious complications tend to occur much earlier. The response of hypertensives to anaesthesia has been thoroughly studied in caucasians by Prys-Roberts and his colleagues,^{7,8} but no study has been made of the response of negro hypertensives to anaesthesia and surgery. This study was therefore undertaken to investigate this response and to determine whether the more severe clinical course of the disease is also reflected in the response to anaesthesia and surgery. For this study it was decided to use systolic time intervals as an index of the functional efficiency of the heart. This is a non-invasive technique and causes little or no disturbance either to the patient or the operative procedure. In determining sys-

tolic time intervals, simultaneous electrocardiograms (Lead II), phonocardiograms and carotid pulse recordings are recorded (Figure 1). Total electrochemical systole (QS₂) is the interval between the beginning of Q on the electrocardiogram and the occurrence of the S₂ on the phonocardiogram. Left ventricular ejection time (LVET) is represented by the time from the beginning of the upstroke of the carotid pulse to the diastolic notch. The pre-ejection period (PEP) is the time between the onset of ventricular stimulation and the onset of ejection from the left ventricle and is represented by QS₂ minus LVET.

It has been shown that the relative duration of LVET and PEP are related to left ventricular stroke index and ejection fraction; that is, to left ventricular performance.⁹ Relative shortening of LVET and relative prolongation of PEP are associated with diminished left ventricular performance. These times are, to a certain extent, dependent on heart rate; but the ratio PEP/LVET is relatively independent of heart rate and is a good index of left ventricular performance.

FIGURE 1 Recording of the electrocardiogram, carotidogram and phonocardiogram, showing measurement of indices.

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MATERIALS AND METHODS

Nine patients admitted for various surgical procedures, with diastolic pressures of 100 mm Hg or more, were included in the study. Two of the patients had been inadequately treated with hypotensive drugs before operation. All were, therefore, uncontrolled hypertensive patients. Eight other normotensive patients admitted for various surgical conditions were used as controls. The site of operation was an important factor in the selection of patients. The site had to be in the lower part of the body so that phonocardiograms, carotidograms, and electrocardiograms could be recorded without disturbing the operative procedure.

All patients were carefully examined to determine the presence or absence of complications of hypertension. Chest X-rays were taken and preoperative electrocardiograms were done. Using the Siemen's equipment for this purpose, simultaneous recordings of the carotid pulse wave, the phonocardiogram and the lead II electrocardiogram were taken just before induction. The time and the blood pressure were also recorded. The patient was induced with a sleep dose of thiopentone (200 mg–300 mg) intravenously; 40 mg base of suxamethonium bromide (Brevidil®) was then given intravenously and the trachea was intubated. The tracheal tube was connected to the anaesthetic machine and the patient was ventilated manually until spontaneous breathing returned. Anaesthesia was then maintained with halothane 0.5–3 per cent as required. A post-induction reading of electrocardiogram, carotidogram and phonocardiogram was taken and repeated 15 and 30 minutes after the beginning of operation. Measurement of the PEP and the LVET intervals were made as shown in Figure 1. The average of three consecutive readings was taken. Only those graphs showing clear Q, dicrotic notch and S₂ were used. Post-operative electrocardiogram was done on the following day.

The ages of the nine hypertensive patients ranged from 12 years to 70 years, with a mean age of 45 years. There were four females and five males. Preoperative casual blood-pressure readings and indication for surgery are shown in Table I. The control normotensive patients included six females and two males and the ages ranged between 16 years and 45 years with a mean age of 33 years. Indications for surgery and preoperative casual blood-pressure readings are shown in Table II.

RESULTS

The pre-ejection phase for the control patients before anaesthesia ranged between 53 msec and 98 msec with a mean of 72 msec. The ratio PEP/LVET for the control patients ranged from 0.198 to 0.383 with a mean of 0.280. PEP values for hypertensive patients ranged from 78 msec to 120 msec with a mean of 99 msec and PEP/LVET ranged from 0.324 to 0.515 with a mean of 0.412. The pre-induction values for hypertensives thus show a prolongation of the PEP and an increase in PEP/LVET.

Post-induction values and values later during operation show increase in PEP/LVET for both normotensive and hypertensive patients. The ratio for normotensive patients immediately after induction was a mean of 0.397 rising later in the operation to 0.476. Mean increase of the PEP/LVET ratio was 69.6 per cent. Similarly PEP values for normotensive patients rose to a mean of 98 msec after induction and 121 msec later in surgery. PEP/LVET values for hypertensives was a mean of 0.495 after induction and 0.562 during operation. The mean increase was 36.6 per cent. Compared to the normotensives, the hypertensives showed a greater deviation from the normal under anaesthesia but the percentage increase from the pre-induction value was less. PEP values for hypertensives under anaesthesia showed a similar trend. These results are given in Table I and Table II.

DISCUSSION

The non-invasive technique used in this study is relatively simple. Readings could be repeated as often as required with no harm to the patient, but the apparatus is rather cumbersome in the operating room. Previous workers have shown the technique to be reliable and reproducible. MacDonald and Hobson¹⁰ compared the relative values of non-invasive techniques in the diagnosis of cardiac disease. They found that PEP/LVET clearly distinguished patients with myocardial disease from normal control subjects, confirming the earlier observations of Weissler, Harris and Schoenfield.⁹ In their series, systolic time interval, like echo-cardiography, discriminated clearly between normal subjects and patients with myocardial disease in class I and those in classes II and III. They concluded that PEP/LVET ratio provides independent non-invasive assessment of myocardial function for both the pre-ejection and ejection phases of sys-

TABLE I
NORMOTENSIVE PATIENTS
AGE AND SEX DISTRIBUTION, INDICATION FOR SURGERY, PEP, LVET, AND PEP/LVET VALUES

Name	Age	Sex	Indications for surgery	Blood pressure (mm Hg)	Pre-induction			Post-induction			During operation		
					PEP	LVET	PEP/LVET	PEP	LVET	PEP/LVET	PEP	LVET	PEP/LVET
E.E.	42 yrs	F	4th degree uterovaginal prolapse (vag. hysterectomy)	130/80	57	250	0.248	76	287	0.265	90	305	0.295
M.M.	26 yrs	F	Uterine fibroid (myomectomy)	110/70	76	272	0.279	106	297	0.337	126	267	0.472
M.I.	16 yrs	M		110/60	55	285	0.198	83	240	0.346	85	283	0.300
C.O.	45 yrs	F	Uterovaginal prolapse (vag. hysterectomy)	120/80	98	305	0.321	107	225	0.476	98	237	0.413
E.I.	19 yrs	F	Abdominal mass (laparotomy)	110/70	84	288	0.292	112	270	0.415	135	280	0.482
E.J.	45 yrs	M	B.I.H. & hydrocoele	110/70	53	260	0.204	91	262	0.347	138	222	0.622
D.A.	30 yrs	F	Secondary infertility (laparotomy)	120/80	85	222	0.383	80	213	0.376	130	297	0.438
O.I.	42 yrs	F	Repair of 3rd degree perineal tear	110/70	71	227	0.313	130	217	0.599	167	213	0.784
Mean					72	261	0.280	98	251	0.397	121	263	0.476
S.D.					16	30	0.062	19	32	0.101	28	35	0.163

TABLE II
HYPERTENSIVE PATIENTS
AGE AND SEX DISTRIBUTION, INDICATION FOR SURGERY, PEP, LVET, AND PEP/LVET VALUES

Name	Age	Sex	Indications for surgery	Blood pressure (mm Hg)	Remarks, if any	Pre-induction			Post-induction			During operation		
						PEP	LVET	PEP/LVET	PEP	LVET	PEP/LVET	PEP	LVET	PEP/LVET
M.O.	70 yrs	F	Umbilical hernia	210/100		80	220	0.364	145	270	0.537	165	250	0.660
E.E.	31 yrs	F	Inguinal hernia	150/100	Treated with Brinerdin but not controlled	120	280	0.429	150	330	0.454	172	280	0.614
S.O.	46 yrs	M	Inguinal hernia	220/110		113	280	0.404	120	228	0.526	165	233	0.708
E.O.	70 yrs	M	Rt. hydrocoele	200/120		105	233	0.451	117	290	0.403	118	267	0.442
A.A.	55 yrs	F	2° Utero-vaginal prolapse	170/110		103	200	0.515	132	213	0.620	164	198	0.828
A.I.	12 yrs	M	Bladder stone	140/100	Non-functioning r. kidney	78	200	0.390	85	210	0.405	75	232	0.323
A.K.	52 yrs	M	Inguinal hernia	210/120		107	220	0.486	124	233	0.532	135	250	0.540
I.A.	60 yrs	F	Inguinal hernia	170/100	On aldomet 250 mg. tid but not controlled	103	295	0.349	145	243	0.597	127	232	0.547
A.M.	17 yrs	M	Hydrocoele	150/100		80	247	0.324	93	242	0.384	95	238	0.399
Mean						99	242	0.412	123	251	0.495	135	242	0.562
S.D.						16	36	0.064	23	39	0.087	24	34	0.159

tole and also provides a quantitative assessment of myocardial function. Our results show that in both normotensive and hypertensive patients under anaesthesia there is some deterioration in indices, probably indicating reduced ventricular performance. In both groups, there is prolongation of PEP and increase of the PEP/LVET ratio.

The mean pre-induction PEP is significantly greater in hypertensive patients ($P < 0.01$). This probably indicates some deterioration in left ventricular function although none of these patients was in cardiac failure. This prolongation is in keeping with other observations on patients in Benin.¹¹ PEP/LVET values after anaesthesia in the hypertensives are significantly higher than in the normotensives and indeed 66 per cent show values over 0.5 which we usually find in cases of cardiac failure. Twenty-five per cent of normotensives show values above 0.5.

As would be expected, laryngoscopy and tracheal intubation would produce sympathetic stimulation with a tendency to a raised blood pressure. Halothane would also alter the preload and after load, with definite effects on the ventricular performance. It is assumed that the two factors would operate in both the normotensive and hypertensive patients and that the difference in response would be due mainly to the pre-existing pathological state. The results must be seen against this background. It would be desirable to see the changes in the values in treated well controlled hypertensives under anaesthesia.

The deterioration in indices in patients with hypertension indicates the need for control of hypertension before operation. This would seem to confirm the findings of Prys Roberts, *et al.*⁷ who showed a reduced incidence of postoperative complications (electrocardiographic ischaemic changes) if patients were normotensive before surgery. Ischaemic changes do not seem to be a common complication of hypertensive heart disease in Nigerians. Although preoperative and postoperative electrocardiograms were studied in our patients there was no evidence of ischaemic changes and this is in keeping with low incidence of coronary heart disease in the population.¹² In a three-year clinical study of 210 hypertensive patients Akinkugbe¹³ did 186 electrocardiograms and could not find evidence of cardiac ischaemia or infarction. Abrahams, Alele and Barnard¹⁴ reviewed over 2,000 electrocardiograms in African patients at Ibadan, Nigeria, and did not encounter a single tracing suggestive of cardiac infarction. Although more recently we are beginning to see a few cases of ischaemic

changes, the absence of cardiac ischaemic complications in our small series may not be significant. On the other hand the wide deviation from the normal for hypertensive patients under anaesthesia may call for caution in dealing with Nigerian hypertensives. It is probably safer to control the blood pressure adequately before anaesthesia and surgery.

SUMMARY

This study was undertaken to determine the cardiac response of Nigerian hypertensives to anaesthesia and surgery, using systolic time intervals as an indication of ventricular function. Nine hypertensive and eight normotensive patients who were admitted for various operations had carotidogram, phonocardiogram and electrocardiogram recorded simultaneously before induction of anaesthesia, after induction and during operation. The pre-ejection phase (PEP) and the left ventricular ejection time (LVET) were measured from the tracings and the ratio PEP/LVET was calculated.

The results showed that for both normotensive patients and hypertensive patients there was a mean increase of the PEP/LVET ratio under anaesthesia and surgery, indicating deterioration of ventricular function. Hypertensive patients showed a much greater deviation from normal, approaching heart failure values. It is concluded that hypertensive patients seemed to be at greater risk during anaesthesia and surgery. The implication is that hypertensive patients should be adequately treated before operation.

RÉSUMÉ

L'hypertension a tendance à être plus sévère chez le noir et à présenter ses complications à un plus jeune âge. Ce travail a étudié la réponse à l'anesthésie et à la chirurgie chez des Nigériens hypertendus, et ceci à l'aide des intervalles systoliques comme reflet de la fonction myocardique. On a donc enregistré de façon simultanée l'électrocardiogramme, le carotidogramme et le phonocardiogramme chez neuf opérés hypertendus et chez huit autres normotendus; ces enregistrements ont été effectués avant et après l'induction ainsi que durant la chirurgie. On a pu ainsi mesurer la période de pré-éjection (PEP), la phase d'éjection du ventricule gauche (LVET) et établir le rapport PEP/LVET. Une prolongation de la phase de pré-éjection ou une augmentation du rapport PEP/LVET étaient considérées

comme un signe de perturbation de la fonction myocardique. Nous avons trouvé qu'il y avait perturbation de ces indices durant l'anesthésie et la chirurgie, et cela chez le normotendu comme chez l'hypertendu. Les perturbations étaient plus graves chez l'hypertendu, les résultats correspondant parfois à une défaillance cardiaque. L'on conclut que les hypertendus présentent un risque opératoire plus élevé et il est suggéré de les traiter adéquatement avant la chirurgie.

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