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Original Research Paper

General Medicine

A STUDY ON COMPARISON OF ANEROID, ELECTRONIC APPARATUS WITH THE CONVENTIONAL MERCURY SPHYGMOMANOMETER AND ITS CORRELATION IN HYPERTENSIVE PATIENTS WITH LEFT VENTRICULAR HYPERTROPHY

Dr. Kavi Sindhuja R. C Postgraduate, Department of General Medicine, Rajah Muthiah Medical College and Hospital, Annamalai University.

Dr. Aswinth. R Assistant Professor, Department of General Medicine, Rajah Muthiah Medical College and Hospital, Annamalai University.

Dr. Sudharsan. S Professor of Medicine, Department of General Medicine, Rajah Muthiah Medical College and Hospital, Annamalai University.

ABSTRACT

Objective To estimate and compare BP reading obtained by the Aneroid,Electronic apparatus with the Mercury sphygmomanometer and its correlation in hypertensive patients with left ventricular hypertrophy. **Methods** We conducted a hospital based observational study of 100 Hypertensive patients with LVH where BP is recorded by the above 3 mentioned devices and correlated with its long term systemic complications. **Conclusion** We found that the aneroid was the better device for replacement of mercury sphygmomanometer and better in preventing long term complications of hypertension treatment wise in comparison to readings with electronic apparatus.

KEYWORDS : LVH, Aneroid, Electronic apparatus, Mercury sphygmomanometer

INTRODUCTION

Hypertension is one of the leading causes of the global burden of disease. Elevated blood pressure affects more than one billion individuals and causes an estimated 9.4 million deaths per year[1]. Hypertension doubles the risk of cardiovascular diseases, including coronary heart disease (CHD), congestive heart failure (CHF), ischemic and hemorrhagic stroke, renal failure, and peripheral arterial disease (PAD).

It often is associated with additional cardiovascular disease risk factors, and the risk of cardiovascular disease increases with the total burden of risk factors. Although antihypertensive therapy reduces the risks of cardiovascular and renal disease, large segments of the hypertensive population are either untreated or inadequately treated.

The mercury sphygmomanometer, which has served medicine well for more than a century, is now under attack from two directions. First, mercury devices are being phased out of healthcare systems for ecological reasons.

Second, electronic blood pressure machines have become widely available and offer certain advantages not least, the opportunity to assess patterns of blood pressure behaviour by repeated measurements.

Mercury sphygmomanometer is the gold standard for measuring blood pressure as per the latest textbooks in patients with pulse irregularity, in children, and in pregnant women with hypertension.

Among all organ systems, heart disease is the most common cause of death in hypertensive patients. Multiple structural and functional adaptations lead to this hypertensive heart disease manifesting in conditions like congestive cardiac failure, coronary artery disease and arrhythmias such as atrial fibrillation.

An important index of cardiac function and its effect on mortality is left ventricular hypertrophy (LVH). LVH is associated with an increased risk of stroke, CHF and sudden cardiac death.

More importantly, adequate control of hypertension has seen to reverse or reduce LVH thereby reducing the risk of cardiovascular disease. CHF may present with either systolic or diastolic dysfunction. In hypertensive patients, diastolic dysfunction has been noted to precede systolic dysfunction with close to one third of patients presenting with isolated diastolic dysfunction. In addition, the increase in arterial stiffness and subsequent afterload caused by atherosclerotic disease augments myocardial oxygen demand and can cause myocardial ischaemia.

Furthermore, an increased myocardial mass and interstitial myocardial fibrosis is associated with a reduced coronary flow reserve. Consequently, not only is there an increased risk for myocardial ischaemia, but the tolerability is impaired[2].

Thus, intermittent myocardial ischaemia, with transient diastolic dysfunction, may lead to myocardial scarring and systolic LV dysfunction, and also promote potentially malignant arrhythmias. Importantly there is also an increased risk for atrial fibrillation, an important risk factor for congestive heart failure and thromboembolic cardiovascular complications.

This validation study comparing the next best options, the aneroid, the automated oscillometric devices works to identify that solution and hopes to make the transition of health care into a non-mercury environment a smooth one.

Inclusion Criteria

All hypertensive patients with LVH of age ≥ 14 years.

Exclusion Criteria

Subjects with recorded history of vascular disease.

Blood pressure measurements

For this study BP was measured in left upper limb in sitting posture after 15 minutes of rest by a single examiner under standard protocols in 100 subjects with LVH by Mercury, Aneroid, Electronic apparatus and the results were compared keeping the, Mercury sphygmomanometer as standard.

RESULTS

Table -1

Age category	Frequency (n=100)	Percentage (%)
31-40	3	3
41-50	17	17
51-60	40	40
61-70	32	32
More than 70	8	8

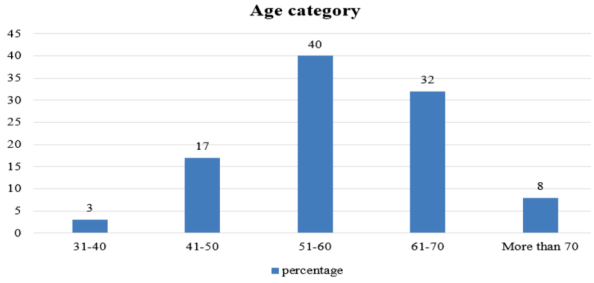
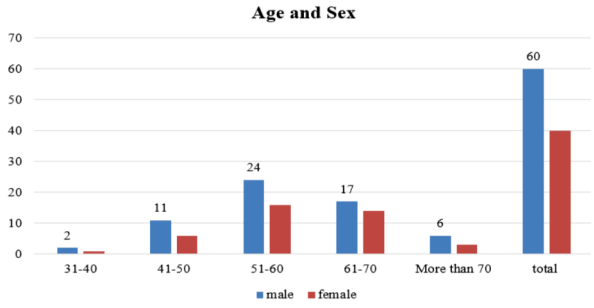
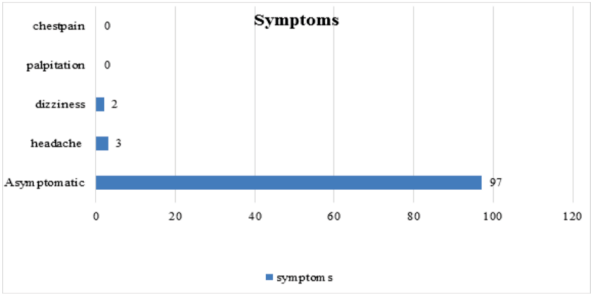


Table -2

Age category (in years)	Male		Female		Total	
	N	%	N	%	N	%
31-40	2	3.4	1	2.5	3	3
41-50	11	18.3	6	15	17	17
51-60	24	40	16	40	40	40
61-70	17	28.3	14	35	31	31
More than 70	6	10	3	7.5	9	9
Total	60	100	40	100	100	100



Bar chart showing distribution according to age and sex.



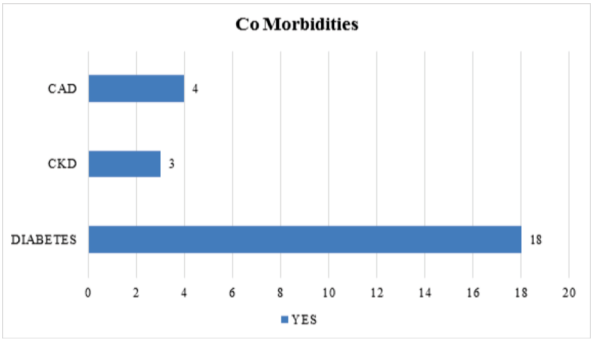


Table 3: Difference in systolic blood pressures as measured between mercury sphygmomanometer and aneroid, electronic respectively among participants with LVH

Difference in systolic pressure		Aneroid		Electronic	
		N	%	N	%
Mercury > test	>10	5	4.8	7	6.7
	6 to 10	12	11.5	21	24
	15	27	27.8	20	19.2
Equal		24	25	6	5.7
Mercury < test	-1 to -5	23	22.1	27	25.9
	-6 to -10	7	6.7	17	15.3
	>-10	2	1.9	2	1.9

Both aneroid and mercury reported equal systolic pressures, in 25% participants.

Both electronic and mercury reported equal systolic BP for 5.7% participants. On comparing the readings, electronic apparatus underestimates the systolic blood pressure in comparison with mercury which in turn leads to long term systemic complications of hypertension.

Table 2: Difference in diastolic blood pressures as measured between mercury sphygmomanometer and aneroid, electronic, respectively among participants with LVH

Difference in diastolic pressure		Aneroid		Electronic	
		N	%	N	%
Mercury > test	>10	4	3.8	10	13.4
	6 to 10	13	12.5	13	12.5
	15	23	25.9	15	14.4
Equal		32	30.7	24	22.8
Mercury < test	-1 to -5	17	16.3	19	18.3
	-6 to -10	10	9.6	17	16.3
	>-10	1	0.09	2	1.9

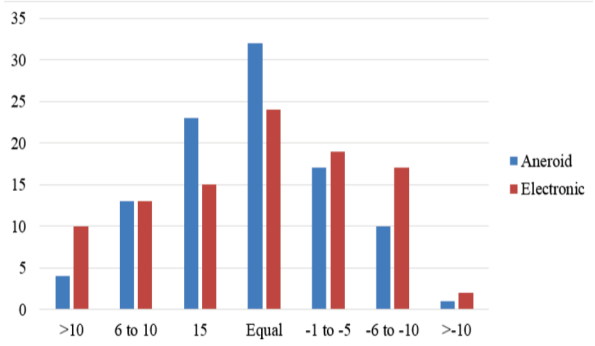


Figure 1: Bar chart showing distribution according to difference in diastolic blood pressure among participants with LVH

- Both aneroid and mercury reported equal diastolic pressures, in 30.7% participants.
- Both electronic and mercury reported equal diastolic BP for 22.8% participants.

DISCUSSION

In this study we compared the blood pressure readings of Aneroid and Electronicwith Mercury as standard. In this study population, from the clinical view point, the strength of agreement measured by the kappa and P values, the prevalence of hypertension was underestimated by the electronic devices.

With the above results and correlating with the long term complications of hypertension, patients are either under treated or over treated with medications leading to systemic complication when the accuracy of the devices are grossly damaged and are mostly under-treated.

From our results, taking sensitivity and specificity ,on comparing the Aneroid and electronic with Mercury, Aneroid shows significant relation, having the systolic blood pressure readings sensitivity (95.48%), specificity (95.68%) with Mercury apparatus.

The diagnostic accuracy of aneroid sphygmomanometer was 95.6%. Both electronic and mercury reported equal systolic BP for 5.7% participants. Both electronic and mercury reported equal diastolic BP for 22.8% participants.

CONCLUSION

The mercury sphygmomanometer, which has served medicine well for more than a century, is now under attack from two directions. First, mercury devices are being phased out of healthcare systems for ecological reasons. Second, electronic blood pressure machines have become widely available and offer certain advantages not least, the opportunity to assess patterns of blood pressure behaviour by repeated measurements. Mercury sphygmomanometer is the gold standard for measuring blood pressure as per the latest textbooks in patients with pulse irregularity, in children, and in pregnant women with hypertension. In those patients, it was recommended that blood pressure readings by automated and aneroid devices should be verified by a mercury sphygmomanometer.

All the blood pressure measuring devices are measured by non-skilled persons nowadays with improvement in technology and to enable every person to record their BP on their own at home. This results in variations in accuracy leading to inter and intra observer errors.

These findings suggests that for screening and follow up of hypertension, the frequency of variability is more with the Automated oscillometer device, although not statistically significant.

Hence automatic device may be used for screening purposes in a diagnosed hypertensive patients on a large scale and in epidemiological surveys even by a non-skilled person when needed but the aneroid device is a better option owing to its accuracy though not as accurate as Mercury sphygmo manometer.

Hence, in this study we found that the aneroid sphygmomanometer was the better device for replacement of mercury sphygmomanometer in health care, but with caution due to its inter-manufacture formulae variation and other pitfalls.

Further it is recommended that the Blood pressure readings are to be recorded by doctor, nurse, trained persons or any other skilled health care professionals in order to sustain accuracy for managing the systemic complications of the hypertension in long term.

Irrespective of the replacement, device, periodic validation and calibration is important for proper functioning of these devices to maintain accuracy.

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