An observational study of student osteopaths' measurement of arterial blood pressure by sphygmomanometry and auscultation.

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ABSTRACT

Purpose: To observe the rate of compliance that postgraduate (4^{th} and 5^{th} year) osteopathy students demonstrate when applying their undergraduate blood pressure (BP) measurement training in a clinical situation.

Procedure: Thirty-seven volunteer postgraduate participants were watched measuring blood pressure in a mock clinical situation by two observers. Both observers according to whether or not each component of blood pressure measuring was observed ticked a 20-point checklist.

Results: Overall the participants showed a 56% compliance rate according to the guidelines taught to them. Inter-class correlation coefficient showed a high level of inter-examiner reliability with a significant ICC of 0.996 found in observation of the students.

Conclusion: The results from this investigation indicated that the osteopathic students failed to comply with the blood pressure measurement guidelines taught to them. This may lead to practitioner introduced error. The importance of performing and recording certain variables should be taken into account when teaching and assessing osteopathy students in the future. Further investigation into the knowledge retention of the students is suggested before major conclusions are drawn.

Key words: Osteopathy, blood pressure, auscultation, sphygmomanometry, observation.

INTRODUCTION

Blood pressure (BP) measurement is considered by the osteopathic profession to be an established and accepted technique as part of the general health assessment of patients. When combined with history taking and examination, BP measurements help determine the correct diagnosis, treatment, referral and management decisions. The accuracy of BP measurement begins with correct measurement techniques. Current literature suggests that there is little compliance with the measurement guidelines followed by health care practitioners who perform regular BP readings.[1,2,3,4,5]

Hypertension is currently one of the leading causes of cardiovascular morbidity and mortality.[6] In 1999-2000 the Australian Diabetes, Obesity and Lifestyle Study (AusDiab) assessed the prevalence of hypertension (≥ 140/90mmHg) in the Australian population.[7] It was found that 28.6% of the Australian population suffered from hypertension, just over 15% had untreated hypertension and 13.4% had treated hypertension.

Unfortunately, health care workers' measurement of BP differs significantly from centre to centre and person to person despite published guidelines.[8] Primary health care workers who take BP in an arbitrary way could cause patients to be diagnosed incorrectly and possibly be treated for a condition which they do not have. A Canadian study performed by Joffres et al.[9] found that consistently underestimating the diastolic pressure by 5mmHg would reduce the number of patients perceived as hypertensive by 62%. Conversely, overestimating the diastolic blood pressure by 5mmHg would more than double the number of patients with hypertension in a

physician's practice (estimated from the Canadian population). Thus, accurate blood pressure measurement is of paramount importance for diagnosis and management.

Victoria University osteopathic students are taught to measure BP in the second year of their five-year training course. The students are given a one-hour lecture demonstrating the procedure and a one-hour supervised tutorial class to practice measuring in. The students are then expected to practice BP measuring in their own time with the possibility of being assessed on performing a cardiovascular examination (in which BP measuring is an essential component) at the end of the year. This is the only time in which BP measuring is taught and assessed through out the course. The expectation is for continual practice and use of the skill of blood pressure measurement within the clinical setting as part of their formal course structure.

Similarly instruction and assessment for both medical and nursing students has not always been comprehensive. Blood pressure measuring is taught to nursing students during their early education and may not be reviewed again before practising.[10] There appears to be a lack of comprehensive training at an undergraduate level,[1,2,3] which may highlight the urgent need for further education and assessment of BP measurement. Campbell et al.[11] suggested that poor results of blood pressure measurement within the allied health care practitioner setting is a direct result of the lack of ongoing training and recent literature available to professionals.

As primary health care practitioners, osteopaths can play a vital role in increasing patients' awareness of the diseases associated with hypertension and refer patients

back to general practitioners when indicated. This investigation was aimed at determining the extent of information retained by postgraduate (4^{th} and 5^{th} year) osteopathy students from the BP measuring training undertaken during their second year of training. This investigation also aimed to identify any areas in which osteopathic students may need further training or further supervised practice classes in BP measuring.

METHOD

Participants

The blood pressure measuring technique of 37 volunteer student osteopaths was observed in a structured mock-clinical situation. This represented 42% of the eligible student population. All volunteers were currently enrolled in the Masters of Health Sciences (Osteopathy) postgraduate degree program at Victoria University, Melbourne. The Victoria University Human Research Ethics Committee approved the study and all volunteers signed and provided informed consent. Participants were excluded if they had any previous formal training in BP measurement other than within their Bachelor of Science (Clinical Sciences) degree, for example a nursing background.

Procedure

The project took place over two days at the Victoria University Teaching Clinic, Melbourne. Two researchers, well known to the students, carried out observation of the students' techniques. The procedure followed a similar format to that previously described by Torrance and Serginson,[1] with many of the major components recommended by the American Heart Association. In one of the treatment rooms, a table, chairs, paper, pen, clock, treatment table, mercury sphygmomanometer, stethoscope (with a bell and diaphragm) and alcohol wipes were set out.

It was made clear to the participants that this did not form or influence any component of formal course assessment. It was also stated that the results would remain completely confidential. The volunteer student was invited into the room, shown the equipment and asked to take the BP as if they were measuring that person's BP for the first time in an initial consultation scenario. It was emphasised that they were free to set up and conduct the session any way they wished. Once the participant took the BP measurements they were required to stay in the room and become the mock patient for the following participant. A checklist with 20 points was developed from the instruction protocol described by Bickley[12] which is used as the standard teaching method prescribed in the second year of the osteopathic course (appendix 1). Points were ticked as 'observed' or 'not observed' depending on whether or not the student performed that component of BP measurement. The students did not have access to the checklist before, during or after the investigation. The two researchers did not converse between the observations. Two researchers were used in this investigation to increase the reliability of the observations.

The students were observed for compliance to follow the guidelines taught to them during their undergraduate training, as described in Bickley.[12] Blood pressure measurement by mercury sphygmomanometry (rather than aneroid sphygmomanometry) was chosen for the investigation as this was used in the undergraduate training. A number of key criteria were explored in this investigation as they are known to impact of BP results. Extraneous variables such as whether the patient consumed alcohol, caffeine or exercised recently are known to influence BP.[13,14] Certain medications are also known to affect BP and it was expected that the students should ask about and/or record these variables demonstrating knowledge that

they influence BP. To reduce false high readings, the patient should be allowed to rest in the room for at least five minutes.[4,11] As Bickley[12] states, the elbow should be flexed and the arm (brachial artery) supported at the level of the heart, again to reduce false high readings due to the possibility of the patient's own effort supporting the artificially arm raising BP.

The patient's heart rate should be taken and the centre of the deflated bladder (of sphygmomanometer) placed over the brachial artery. The cuff should be 2.5cm above the antecubital line and snug and secure. The systolic pressure should then be estimated via radial artery palpation. This assists in preventing patient discomfort caused by over-inflating the cuff and, more importantly, may avoid occasional error caused by auscultatory gap (a silent interval between the systolic and diastolic pressures) which may cause false low readings.[12] A 15-30 second gap should be allowed for arterial recovery time before the true systolic BP reading is taken. In this investigation, either the diaphragm or the bell of the stethoscope was allowed to be used when auscultating. The deflation rate should be no more than 2-3mmHg per second and the examiner should not inflate the cuff while deflating it. The cuff should be completely deflated at the end.

When using mercury sphygmomanometers the reading of the diastolic and systolic pressures should be read at eye level to the meniscus. It should be read to the nearest 2mmHg and not rounded off to the nearest 5mmHg. It is important on the first consultation that BP be taken in both arms[12,14] as there may be pressure differences of more than 10mmHg between each arm in hypertensive patients.[14,15]

Data analysis

The observed and not observed data from each of the two researchers' 20-point checklists (appendix 1) was analysed. The observations from researcher one and researcher two were summed to give the total observed. This was then converted to an observed percentage for each component and then for the overall percentage for the total investigation. An inter-class correlation over the 20 categories was used to determine inter-examiner reliability and to show concordance between the two researchers. Kappa was not used even though the data was categorical, due to having to analyse 20 components, which may result in considerable alpha slip.

RESULTS

All data is tabulated and reported in Table 1, which shows an overall compliance rate of 56% with the guidelines taught to the students. Only six of the 37 participants asked the patients about extraneous variables, such as whether they had consumed caffeine, alcohol, exercised recently or if they were currently taking any medications. Only one participant allowed the patient to rest for five minutes before measuring BP. All participants took the BP when the patient was seated or lying supine. No volunteers took the BP when the participant was standing. Two participants took BP both seated and supine. Arm positioning was generally well done with 91% observed flexing the arm at the elbow and 88% supporting the arm either on the table or bed.

The arm (brachial artery) was observed in 14 (38%) students to be below the level of the heart. The cuff was generally snug and secure, however only 14 out of the 37 participants placed the centre of the deflated bladder (of the sphygmomanometer) over the brachial artery. In 57% of the participants, the lower edge of the cuff was placed 2.5cm above the antecubital crease with the remaining participants observed having the lower edge touching the antecubital crease. Two participants took blood pressure in both arms and most participants used the diaphragm (92%).

Sixteen percent of the participants took the heart rate prior to the BP reading and 19% did not estimate the systolic BP via radial artery palpation. Of those participants who did estimate the systolic pressure, less than half (46%) allowed a 15-30 second gap before measuring BP. The deflation rate was generally at 2-3mmHg (66%) or faster. The majority of students completely deflated the cuff (86%) and did not inflate the

cuff while deflating it (92%). All students recorded both a systolic and diastolic reading. An average of 4% of the students read the meniscus at eye level, with the remaining reading it from well above the meniscus. Twenty-three participants recorded the systolic and diastolic pressures to the nearest 2mmHg. Inter-class correlation coefficient showed a high level of inter-examiner reliability with an ICC of 0.996 found.

Table 1: Number and percentage observed of each BP measurement component

	Sample Size = 37	Researcher 1	Researcher 2	Total observed	Total percentage observed
	CHECKLIST	**Observed**	**Observed**		
1	Patient asked if they have consumed caffeine, alcohol, exercised recently and if they are on any medications	6	6	12	16%
2	Patient allowed to rest for 5minutes	1	1	2	3%
3	Arm flexed at elbow	33	34	67	91%
4	Arm (brachial artery) at level of heart	23	23	46	62%
5	Arm supported on table/bed/onto chest if standing	31	34	65	88%
6	Patients heart rate taken prior to BP reading	6	6	12	16%
7	Centre of deflated bladder (of sphygmomanometer) placed over brachial artery	14	14	28	38%
8	Lower edge of cuff placed 2.5cm above the antecubital crease	22	20	42	57%
9	Cuff snug and secure	33	35	68	92%
10	Estimate of systolic pressure via radial artery palpation	29	31	60	81%
11	15-30 second gap between systolic estimation and BP measurement	17	17	34	46%
12	Bell of stethoscope used	3	3	6	8%
13	Deflation rate at 2-3mmHg per second	27	22	49	66%
14	Examiner not inflating the cuff while deflating	35	33	68	92%
15	Systolic BP recorded	37	37	74	100%
16	Diastolic BP recorded	37	37	74	100%
17	Reading read at eye level to the meniscus	2	1	3	4%
18	Cuff completely deflated	33	31	64	86%
19	Both diastolic and systolic pressure read to the nearest 2mmHg	23	23	46	62%
20	Blood pressure taken in both arms	2	2	4	5%
TOTALS				824	56%

DISCUSSION

The results from this investigation appear to indicate that the osteopathic students that completed this study failed to comply with the measurement guidelines taught to them. This may limit practitioner competence and introduce possible errors in the accuracy of BP measuring. There was an overall compliance rate of 56% with the guideline taught from Bickley,[12] which is comparable to current literature. [1,3,5,8,10,16]

Previous literature reports very similar findings both in student and professional populations.[1,3,5,8,10,16] In a similar format to this current investigation Torrance and Serginson[1] observed 50 nursing students from Victoria University for their compliance with guidelines taught from the British Hypertension Society (BHS) and the American Heart Association (AHA). The schedule assessed preparation of the subject, positioning of the arm and cuff, palpation for systolic pressure, technique of auscultation and recording of the readings. The results indicated little compliance with published guidelines taught. Of the 80 junior hospital doctors observed by Feher et al.[3] over one third of the study group had poor clinical technique such as not supporting the arm (33%) or taking one single measurement (31%). McKay et al.[16] found that out of 48 graduate doctors involved in an observational BP measurement study, only 42% followed the AHA recommendations. The graduate doctors were observed performing six of the major BP measuring components, all of which were present in this investigation. Some of these included: time resting the patient, determining the systolic pressure by palpation, supporting the arm, the position of the antecubital crease and the rate of deflation. The Bickley[12] procedures followed in this study are based on the AHA guidelines with approximately 90% agreement.

Therefore this allows the results to be compared to previous studies that have similarly followed the AHA recommendations.

Poor compliance in following guidelines is not only limited to students or recent graduates. In 2003, Veiga et al.[5] measured the level of concordance between the recommended BP measuring procedure and the one that was actually performed. The procedure involved observing 14 components of BP measurement, 10 of which were also used in this current investigation. Of the 105 health care workers who took part in the investigation, 40% of nurses and nurse's aides abided by the recommended procedures and 70% of the other professionals (teachers, physicians, residents and nursing students) investigated abided by the procedures. Veiga et al.[5] McKay et al.[16] and Feher et al.[3] all concluded that permanent educational activities, such as further assessment and training should be aimed at standardising the way practitioners take blood pressure measurements.

Villegas et al.[8] investigated 63 general practitioners and 59 nurses in a two-part observational and questionnaire study. In the observational component only three and two percent respectively obtained reliable results. The results were disturbing especially as nurses are normally in charge of BP measurements and hospital doctors usually rely on nurses for the purpose of BP follow-ups.

In a study by Armstrong,[10] 78 clinical nurses were involved in a descriptive observational study in a metropolitan teaching hospital in Queensland. The identification of both systolic and diastolic blood pressures, the interpretation of blood pressure sounds and the deflation rates were all of a passable level above 50%. The

knowledge of arm position for seated measurement, the determination of inflation pressure and the incidence of terminal digital preference was inadequate and below 50%. The overall findings were similar to this current study, indicating that the knowledge of participants was inadequate to perform blood pressure measurement in a standardised manner and prevent introduced error.

In this investigation the volunteer students were told that being a participant would in no way contribute to any of their formal class assessment and that they were allowed to take as much time as they needed in the room. In spite of this, many of them were nervous, lacking in confidence and almost rushing the procedure. Torrance & Serginson[1] recorded a similar observation. This is likely to have been a contributing factor to only one student being observed resting the patient for at least 5 minutes. Previous investigations have showed variable results. Only 6% of the students rested the patient for at least 5 minutes in Torrance & Serginsons'[1] investigation and McKay et al.[17] observed only 10% of 114 primary care physicians giving the patient the appropriate rest. Veiga et al.[5] in 2003 observed 66.7% of 105 practitioners resting the patient for at least 3-5minutes prior to BP measurement. In a 12 point BP measurement observational study by Drevenhorn et al.,[4] 12 out of the 21 (70%) nursing staff allowed the patient to rest for at least five minutes.

The majority of participants seemed unaware of asking about and recording extraneous variables as only six students verbally asked the patients. None of the 50 nursing students in the practical component to Torrance & Serginson's[1] study asked about extraneous variables. It is very important that these are recorded as they may have a large impact on the true BP reading. Even recent ingestion of alcohol (<1hr)

may cause an increase in both systolic and diastolic pressures to 5mmHg and 7mmHg respectively.[18]

A study by Smith et al.[19] supported previous research that showed a significant drop in BP (3/2mmHg) within 1hr after a meal in older adults (>65). The same study showed that four hours after the meal there was a subsequent increase in BP by approximately 3/3mmHg from 0 hours.

Failure to place the patients arm in the correct position may alter BP readings. An unsupported arm may increase both the systolic and diastolic pressures by 2mmHg. Where as having the arm 10cm above or below the level of the heart may in fact increase (or decrease) both the systolic and diastolic pressures by 8mmHg.[13] The arm was shown to be supported well in 88% of the observations and was correctly flexed at the elbow. Thirty eight percent of the students kept the arm below the level of the heart. Torrance and Serginson[1] observed 56% of the nursing students had the antecubital fossa at the level of the heart. However variably McKay et al.[17] found that almost all of the physicians supported the patients arm correctly at the level of the heart. Similarly when observing the 21 public health care nurses Drevenhorn et al.,[4] reported that all of the nurses supported the arm at the level of the heart, while the Feher et al.[3] study, of junior hospital doctors observed 33% not supporting the arm.

The cuff and stethoscope placement results were variable. The cuff was generally snug and secure, however 14 students did not place the centre of the bladder (of the sphygmomanometer) over the brachial artery even though there was a placement arrow marked on the bladder. In 43% of students the lower edge of the bladder was

placed directly on the antecubital crease making it difficult to place the stethoscope correctly at the brachial artery site. Villegas et al.[8] reported that the arm and cuff positions in their investigation were inadequate in 73%. This is in contrast to Torrance and Serginson[1] who observed central placement of the bladder in 48 out of the 50 students. They also recorded that in 49 cases the cuff was correctly above the antecubital crease by 2-3cm. In this present study six students took the patients heart rate and three students used the bell of the stethoscope and the remaining used the diaphragm.

Estimation of systolic pressure, via radial artery palpation, prior to measuring the BP is a major component of BP measurement which must be performed. If it is not estimated then the practitioner may under-estimate the systolic pressure and over-estimate the diastolic pressure.[12] Auscultatory gap is the important 'silent' interval which may be present in some individuals between the systolic and the diastolic BP readings. On average the observed percentage of students who estimated the systolic pressure prior to the BP measurements was acceptable at 81%. This result was in contrast to previous investigations, which showed results well below a passable 50%. Previous observational studies have shown that many practitioners forget this important component.[1,4,16,17] Torrance and Serginson[1] only observed 12% of the students estimating the systolic pressure before the BP reading. Drevenhorn et al.[4] had a similar finding where under 10% of nurses estimated the systolic pressure via radial artery palpation. In McKay et al's[16] study approximately 40% estimated the systolic pressure.

Only four percent of the students were observed reading the meniscus at eye level. The majority of the students read it from well above eye level. When reading the column, in Torrance and Serginson's[1] investigation, 20% of the nursing students read it at eye level.

Terminal digit preference can play a large role in either overestimating or underestimating BP. Thirty eight percent of the students did not read both the diastolic or systolic pressures to the nearest 2mmHg. Instead they rounded to the nearest 5mmHg or zero. Drevenhorn et al.[4] observed only 38% registered the BP to the nearest 2mmHg. In this present study, after finishing the procedure some students appeared flustered and nervous when asked to write the final reading down. Considering that the mercury column is set out in increments of 2mmHg (0,2,4,6,8), it is surprising to note how many previous investigations have observed participants rounding final figures. [1,4,5,16]

Only two students were observed to take BP in both arms. Feher et al.[3] found that 31% of the junior hospital doctors took BP in both arms without being prompted. As stated earlier this is very important as there may be a pressure difference of 10mmHg between each arm.[15]

Contrasting results appear to be evident in different studies with some components observed at a passable level and others not. However, from the conclusion of the majority of the investigations, it still appears that not all health care workers are following set BP measurement guidelines. This is the first study of its kind in the osteopathic field. So before any major conclusions are drawn it would be valuable to

have an understanding of knowledge retention by the student body, perhaps as a second part to this investigation in the form of a questionnaire. The importance of performing and recording certain variables should be taken into account when teaching and assessing osteopathy students in the future. Because hypertension is one of the leading causes of cardiovascular morbidity and mortality, the simple and accurate measurement of blood pressure can be life saving. Osteopaths can play a vital role in increasing patients' awareness of the diseases associated with hypertension and refer patients back to general practitioners when indicated.

Appendix 1

	Checklist of procedures to follow	Observed	Not observed
1	Patient asked if they have consumed caffeine, alcohol, exercised recently and if they are on any medications		
2	Patient allowed to rest for 5 minutes		
3	Arm flexed at elbow		
4	Arm (brachial artery) at level of heart		
5	Arm supported on table/bed/onto chest if standing		
6	Patients heart rate taken prior to BP measurement		
7	Centre of deflated bladder (of sphygmomanometer) placed over brachial artery		
8	Lower edge of cuff 2.5cm above the antecubital crease		
9	Cuff snug and secure (correct cuff size)		
10	Estimate of systolic pressure via radial artery palpation		
11	15-30 second gap between systolic estimation and BP measurement		
12	Bell of stethoscope used		
13	Deflation rate at 2-3mmHg per second		
14	Examiner not inflating the cuff while deflating		
15	Systolic BP recorded		
16	Diastolic BP recorded		
17	Reading read at eye level to the meniscus		
18	Cuff completely deflated		
19	Both diastolic and systolic levels read to nearest 2mmHg		
20	Blood pressure taken in both arms		

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