Factors influencing cardiac auscultation proficiency in physician trainees

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ABSTRACT

Introduction: We assessed the accuracy of physician trainees in identifying different cardiac sounds and examined the factors influencing their cardiac auscultation proficiency.

Methods: A total of 106 physicians in the Family Medicine Training Programme were asked to identify 10 cardiac sounds played sequentially on the Littmann® electronic stethoscope, which functioned as a surrogate patient. Their auscultation accuracy was scored numerically out of a maximum of 10. Demographical data of the physicians was collected prospectively.

Results: The mean (±SD) auscultation proficiency score of the study population was 4.0 ± 1.7. Physicians who graduated in 1994 or earlier fared significantly poorer than those who obtained their Bachelor of Medicine and Bachelor of Surgery degrees between 1995 and 2000 (p-value equals 0.02). Auscultation proficiency was not related to current practice, previous years of primary care, cardiology, internal medicine or paediatric medicine postings, or cumulative years of postings. Normal heart sounds were most accurately identified. Prosthetic cardiac sounds were better identified than other extra-cardiac sounds while systolic murmurs were more accurately identified than diastolic murmurs. Tachycardia had the lowest identification rate.

Conclusion: Our data suggest that cardiac auscultation skill declined with time, being significantly impaired eight years after graduation. We suggest that there is a need for retraining in the form of continuing medical education to address not only new knowledge and skills, but also basic skill competency.

Keywords: basic skill competency, cardiac auscultation, continuing medical education, physician training

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INTRODUCTION

The physician has traditionally been identified with the stethoscope. It is this bedside aptitude, of which cardiac auscultation is the hallmark, that physicians regard as one of the most valuable skills acquired during medical training[1,2]. In this era however, history- taking and physical examination are progressively being replaced by the use of advanced diagnostic techniques, with the consequence that the proficiency of physicians in such skills appears to be waning. This study assessed the accuracy rates of identifying various cardiac conditions using the electronic stethoscope, determined the subjective appreciation of recorded sounds generated by the electronic stethoscope, and investigated the factors influencing cardiac auscultation proficiency in a group of physician trainees. We also studied if the duration of a physician's clinical exposure during hospital postings, in particular internal medicine and specialised cardiology postings, affected their performance in cardiac auscultation.

METHODS

A cross-sectional study, using the electronic stethoscope as a surrogate patient, was conducted to test the hypothesis that cardiac auscultation skill of a group of physician trainees declined with time from the point of graduation from medical school. The sample included 134 physicians in the Family Medicine Training Programme of whom 106 (79.1%) were assessed in two separate sessions. Twenty-eight physicians were absent from the classes during the two testing sessions and were excluded from the analysis. Physicians intending to take the examination leading to the Graduate Diploma in Family Medicine and the Master of Medicine must complete eight quarterly modules in the programme. Any registered medical practitioner may apply for the graduate diploma programme while those admitted to the Masters programme are selected by interview.

The Littmann® electronic stethoscope (3M Health Care, St Paul, MN, USA) offers digital recording and playback of six pre-programmed individual soundtracks,

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Table I. Auscultatory scores according to year of graduation of physician trainees.

Year of graduation	Mean score out of 10 (±SD)	Range
1999-2000	4.4 (±1.8)	2-8
1997-1998	4.6 (±2.0)	1-7
1995-1996	4.4 (±1.7)	1-7
Before 1994	3.7 (±1.6)	0-7

Table II. Auscultatory scores according to number of years spent in hospital postings.

Number of years	Mean score out of 10 (±SD)	Range
0-2	3.6 (±1.4)	1-7
3-4	4.4 (±1.8)	0-8
5-6	4.1 (±1.8)	1-7
7-8	5.2 (±1.3)	4-7
>8	2.9 (±1.7)	1-6

Table III. Auscultation accuracy rates of various murmurs.

Type of murmur	Accuracy rate (%)
Pan-systolic murmur	79.2
Ejection systolic murmur	67
Early diastolic murmur	28.3
Mid-diastolic murmur	23.6

Table IV. Auscultation accuracy rates of normal and extra heart sounds.

Type of heart sound	Accuracy rate (%)
Normal	74.5
Prosthetic	56.6
S3	27.4
S4	23.6
Mid-systolic click	17.9
Tachycardia	6.6

with data transmission via infrared signal to another model or a personal computer. We have previously demonstrated that the electronic stethoscope is a valid and reproducible tool in teaching and learning cardiac auscultation[3]. A set of 10 different cardiac sounds was used: normal heart sound, third heart sound, fourth heart sound, mid-systolic click, ejection systolic murmur, pan-systolic murmur, early diastolic murmur, mid-diastolic murmur, prosthetic valve and tachycardia. Where applicable, the cardiac sound was recorded from the most representative area of the praecordium. For instance, the "pan-systolic murmur" was recorded from the mitral area. The auscultatory sounds used were compiled from the library of sounds from real patients that had previously been validated and from the 3M Heart Sound Plug-in Module HSM1 (3M Health Care, St Paul, MN, USA) using the Wolff Heart Sound System (Wolff Industries San Marino CA, USA).

Prior to the assessment, the physicians were trained to use the electronic stethoscope. During the assessment, they were allowed 30 seconds to recognise each of the 10 cardiac sounds played once sequentially on the electronic stethoscope. For each cardiac sound, the physicians were asked to select the correct answer out of the 10 options provided in the answer sheet for each auscultation. One mark was awarded for each correct cardiac sound identified. No marks were deducted for wrong identification, thus yielding a minimum total score of 0 and a maximum of 10. After the assessment, they were asked to provide subjective feedback on the quality of the recorded sounds using a scoring sheet with Likert scales of 1 to 5.

The data was analysed using the Statistical Package for Social Sciences for Windows version 10.0 (SPSS, Chicago, IL, USA). The results were reported in mean ± standard deviation (SD). Comparison of data was performed using the analysis of variance and t-test as appropriate. Multivariate analyses were done using the linear regression test.

RESULTS

The population comprised 48 (45%) physicians working in general practice, 35 (33%) in polyclinics and 15 (14%) in hospitals; 57 (54%) physicians graduated more than eight years prior to the study and 76 (72%) physicians graduated from the National University of Singapore. The mean (±SD) total auscultatory accuracy score of the 106 physicians was 4.0 ± 1.7 (range 0 to 8). Physicians who graduated in 1994 or earlier fared significantly poorer than those who graduated between 1995 and 2000 (3.7 ± 1.6 vs. 4.5 ± 1.8, p=0.02) (Table I). The number of years spent in hospital postings also predicted the ability of physicians in diagnosing accurately the cardiac sounds. In general, physicians who had more than eight years of hospital postings fared poorer than those with 8 or fewer years of hospital postings (p=0.04) (Table II).

There was a significant difference in the mean scores of physicians who graduated from Singapore and those from overseas institutions (p=0.045). The mean (±SD) score for each of the groups were: Singapore 4.3 ± 1.8, United Kingdom 3.8 ± 1.8,

Table V. Subjective appreciation of the electronic sthethoscope by physician trainees.

Different aspects of appreciation	Opinion (% of participants)				
	Very bad	Bad	Neutral	Good	Very good
S1 and S2	1.9	9.4	25.5	57.5	5.7
S3, S4 and diastolic rumble	4.7	24.5	42.5	25.5	1.9
Murmurs and opening click	0.9	13.2	36.8	45.3	1.9
Crispness of sound	1.9	16	46.2	33	1.9
Freedom from background noise	14.2	31.1	33	20.8	0.9
Freedom from manipulation artifacts	6.6	20.8	50.9	17.9	0.9
Comfort	1.9	5.7	39.6	47.2	5.7
Overall appreciation	1.9	10.4	47.2	39.6	0.9

Australia/New Zealand 3.1 ± 3.1, and others 3.2 ± 0.98. The place of current practice, the duration of practice in primary care, internal medicine, paediatric medicine and cardiology as a medical officer did not differ between physicians who performed well and those who did not.

Multivariate linear regression analysis identified two variables that were significantly associated with performance in cardiac auscultatory assessment, namely: year of graduation from the medical school and place of graduation. The number of years spent in hospital postings did not affect the total score. Tables III and IV show the auscultation accuracy of the various murmurs and extra-cardiac sounds, respectively. Normal heart sounds were most accurately identified. Prosthetic cardiac sounds were better identified than other extra-cardiac sounds. Systolic murmurs were identified more accurately than diastolic murmurs. However, of all cardiac sounds, sinus tachycardia was identified least accurately. Table V shows the subjective feedback on the electronic stethoscope. Overall, the feedback was positive, with physicians scoring the quality of sounds of the electronic stethoscope as neutral to good.

DISCUSSION

Although our study population is a self-selected group of trainees in the Family Medicine Training Programme, there is a fair distribution of physicians from various practices. The mean score of 4.0 was less than 50% of the total possible score of 10.0. This is similar to recent cardiac auscultation studies that revealed accuracy rates ranging from 0% to 58% in physician trainees[4-6]. While the scores cannot be compared due to differing methodologies designed to simulate actual auscultatory situations, they suggest that the level of auscultation proficiency of physicians is not satisfactory. These results warrant our attention regarding the competency of physicians in cardiac auscultation[7,8].

St Clair et al have documented that internal medicine trainees had difficulty establishing a correct diagnosis based on cardiovascular examination alone[9]. They suggest that the difficulty was due to the lack of emphasis on making a diagnosis by auscultation. Mangione et al also showed that there is no structured teaching of cardiac auscultation in 75% of internal medical programmes and two-thirds of cardiology programmes in the United States[4]. In one study, as little as 16% of time spent on ward rounds was undertaken at the bedside, with the majority of time being spent in conference rooms and corridors[10]. With diminished bedside exposure, physician trainees express little confidence in their own auscultatory ability[5].

Physicians who graduated eight or less years ago do better than those who graduated more than eight years ago, with the difference being statistically significant. In contrast, statistical tests were insignificant for cut-offs at two, four and six years. Butterworth and Reppert observed that physicians in general practice with up to nine years of experience had a mean accuracy close to that of medical students and interns, but accuracy fell beyond nine years of practice[11]. This suggests that the decline in auscultatory ability may be due to a lower level of exposure to abnormal heart sounds in general practice. Our study, however, did not show a relation between physician performance and the duration in primary care. This could be due to our small numbers and the lack of details of the study population of Butterworth and Ruppert for comparison.

Interestingly, recent proficiency studies also revealed that the auscultatory accuracy of trainee physicians was not statistically better than that of medical students[4-6]. Cardiac auscultation skills are

only taught and assessed in undergraduate training. Such evidence emphasises the importance of building a strong foundation in cardiac auscultation in medical school. Hence, there is a need for continuing medical education, which should address not only new knowledge and skills, but also retraining in basic skill competency such as auscultation.

The trainees who obtained their Bachelor of Medicine and Bachelor of Surgery degrees from Singapore seemed to perform better than those who graduated from overseas. This finding persisted even after correcting for confounding factors. However, this finding cannot be taken to imply a difference in the quality of graduates from different countries since the characteristics of physicians who were not enrolled in the programme were not examined. The reason behind varying performance in the different cardiac sounds may be due to the deficiencies in certain areas of auscultation teaching, or to intrinsic factors related to the sounds or physicians. Further studies may be undertaken to elucidate other factors which may affect auscultatory proficiency in physicians, including the addition of more cardiac sounds to improve discrimination between the high and low scores.

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