Comparison Of Cardiac Auscultation To Echocardiography

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A. Background

The physical exam, along with the patient's history, ha's been one of the true hallmarks and mainstays of the medical profession. It has provided information about the patient and their diseases that could be not obtained in any dh er fashion. However, with the advent of new technologies, methods of obtaining information have expanded enormously and the information obtained has been made more precise and accurate. Echocardiography is one of these technologies. By using sound waves emitted by a probe that is placed on the patient's chest it enables us to look at and into the heart in ways never thought imaginable just fifty years ago and has been an invaluable tool in our quest to understand and diagnose cardiac pathology. Despite its value, echocardiography has obviously not replaced the physical exam, as no test has. It has served as a supplement to the exam - adding, clarifying, and, on occasion, enlightening.

Comparisons between echocardiography and auscultation have been made for various heart sounds. When compared to catheterization pulsed doppler echocardiography has been shown to be much more sensitive and specific than auscultation in detecting valvular pathology. In a study by Jaf f e et al patients with suspected aortic and mitral disease were evaluated using clinical findings (history, exam, radiography, EKG), doppler echocardiography, and catheterization.[1] They found echo to be significantly more accurate, sensitive, and specific than clinical evaluation in assessing valvular pathology, with improvement in clinical evaluation results when confidence of disease was high. They also found echo to be highly accurate when compared to catheterization.

Aortic insufficiency has been studied by several groups and doppler echo has been shown to be at least ninety five percent sensitive and ninety percent specific in AI.[2345] Auscultation, on the other hand, has much lower effectiveness but is at least as effective as M mode and 2-D echo. Rahko showed doppler to be much more sensitive than auscultation in detecting valvular regurgitation, with this being especially true for mild regurgitation.6 Hoffman and Burckhardt showed doppler to be effective at evaluating ill defined systolic murmurs, showing an overall diagnostic accuracy of eighty nine percent.7 In a retrospective chart review Olive and Grassman found that exam findings suggestive of mitral valve prolapse are not sensitive or specific for positive echo findings, a finding that was in agreement with other previous studies.

Contributing to this evidence of echocardiography's superiority over auscultation may bt the deterioration and inadequacy of the cardiac exam in the day of high technology. A study by Margione et al examined the proficiency of the physical exam of medical students, medical residents, and cardiology fellows.9 Using prerecorded audiotapes of the sounds of various cardiac pathologies, they found that the exams of students and residents were woefully inadequate, and those of the fellows were not much better. In addition to this they found that within training programs there is very little emphasis on teaching the skill of auscultation and suggest that more time and effort be spent teaching exam skills at the bedside so that the art of medicine is not lost.

A large trial evaluating all murmurs in a prospective manner is lacking. The above studies consist of a small sample size of patients and have several flaws including selection bias of only patients with murmurs on physical exam (therefore altering sensitivity and specificity), interpretation bias with the use of retrospective analysis, evaluation of presence or absence of one or two types of valvular pathology, and the use of artificial pre-recorded audiotapes for determining recognition of murmurs.

Our study would be the largest to date, numbering at least 150 patients obtained from consecutive admissions to the cardiology service at Columbia-Presbyterian Medical Center. It would include patients with known coronary artery disease and those being evaluated for chest pain, syncope, dyspnea, etc. The study will be conducted prospectively and double-blinded to the investigators. In

addition, all types of murmurs will be studied including mitral, aortic, tricuspid, and pulmonic regur.-itant and stenotic lesions.

Furthermore, the accuracy of auscultative findings will be determined among physicians at different levels of training with interns, residents, fellows, and attending physicians. These physicians will examine patients within twenty four hours of admission and will have the benefit of performing various maneuvers in order to increase diagnostic accuracy, an option not available to investigators in previous studies.

The results of this study will help to determine the accuracy of auscultation and the usefulness of echo in evaluating most cardiac murmurs. It may ajWo help us answer the following questions: what findings on physical exam need echocardiographic confirmation and what findings do not? How can the physical exam and echo be optimally used together and separately to complement each other? In this day and age of high cost medical care, how can we make more efficient use of echocardiography? Is it necessary to alter the training for cardiac auscultation of murmurs in order to improve physician accuracy at different levels of training?

B. Obiectives

1) To examine the correlation between physical examination and echocardiographic findings of valvular and cardiac function in a general cardiology population.
2) To evaluate the accuracy of physical examinations by physicians at different levels of training, using echo findings as the standard.

C. Methods

Recruitment in this study will be done by first approaching the primary doctor of the patient to be enrolled. Only after the primary doctor given their approval to approach the patient will the patient be approached by the investigators.

Admissions to the teaching service at CPMC are to be examined by the housestaff and cardiology attendings without the knowledge of the physical exam findings of previous examiners or each other and without the knowledge of previous echocardiogram results. They will also be instructed not to review the chart or take a history. The examiners will then be asked to submit the results of their exams in writing on a standardized form. Murmurs are to be characterized in terms of timing in cardiac cycle, location on precordium, and grade. Grading of murmurs will be done in routine fashion from l to 6. Comments are also to be made about any other extra or abnormal sounds (rubs, clicks, snaps, gallops), evidence of decreased cardiac function, and evidence of cardiac enlargement. Each exam should take no more than approximately 5 minutes.

The patients will undergo two-dimensional and pulsed doppler echocardiography within 24-36 hours of examination, and these will be reviewed and interpreted by an echocardiographer using the standards of the CPMC echo lab. Valvular regurgitation and stenosis will be based on the standards of Jaffe et al. as follows:

Regurgitation:	Mild Moderate Severe	regurgitant flow < 10% regurgitant flow 10 29% regurgitant flow >30%
Stenosis: mitral and tricuspid	absent insignificant significant	valve area > 2.2 cm2 valve area 1.5 2.2 cM2 valve area < 1.5 cM2
aortic	absent insignificant significant	valve area > 2.2 cM2 valve area 1.1 - 2.2 cM2 valve area < 1.1 cM2
pulmonic	present	if valve area < 1.0 cm2

The echocardlographer will be blinded to the results of clinical findings.

Using the echo as the standard sensitivities, specificities, positive and negative predictive values for auscultation among the various levels of expertise will be determined in the usual manner (see attached). In order to evaluate performance in potentially *confounding situations,* Bayes' theorem will be applied when multiple valvular lesions are present (see attached) . Interrater agreement will be assessed using an overall proportion of agreement (see attached) . Finally, a test of proportions using a chi-square will be done to compare findings between the different classes of examiners (see attached).

After the *examinations and* echocardiogram no further tests will be performed and additional active participation by the subjects will not be required. It is anticipated that the total duration of the study will be several months.

D. Study Drugs

No drugs will be used in the course of the study.

E. Medical Devices

Other than a stethoscope and an echocardiography machine no devices will be used in the study.

F. Questionnaires

No questionnaires will be given to the patient. A data entry form of suspected diagnoses will be given to each examiner (Attached).

G. Cost and Compensation

There will be no additional cost to the patients if they choose to participate in this study. The patient will not, receive any monetary compensation for participation.

H. Location

The study will be carried out using in-patients at Presbyterian Hospital.

I. Confidentiality

All information obtained during the study will remain confidential. Patient information will be coded without use of names, social security numbers, or medical record numbers. Each patient will be identified by a unique numerical code known only to the investigators and the information obtained will remain in a secure location.

J. Risks and Benefits

The patient will be at no additional risk as a result of participation in this study. The patient may or may not benefit from this study. It is possible that the studies performed may reveal findings that may be helpful in their care. The benefits to society will probably be more profound and may include:

1) more judicious and improved use of echocardiography.
2) stimulus to improve physical examinations with time and teaching.
3) improved patient care.

K. References

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Physical Examination and Echocardiography Study Checklist

Date:

Patient: Location: Unit Number:

Exam Findings:

Examiner: Intern Resident Fellow Attending

Murmurs: Y N (if Y, fill in below information)

Murmur #1
Systolic Diastolic
Early Mid Late Holo
Grade: 1 2 3 4 5 6
Location: Apex Axilla LLSB RLSB LUSB RUSB

Murmur #2
Systolic Diastolic
Early Mid Late Holo
Grade: 1 2 3 4 5 6
Location: Apex Axilla LLSB RLSB LUSB RUSB

Murmur #3
Systolic Diastolic
Early Mid Late Holo
Grade: 1 2 3 4 5 6
Location: Apex Axilla LLSB RLSB LUSB RUSB

JVP: Normal Elevated

Click: Y N

Rub: Y N

Opening snap: Y N

S_4: Y N

S_3: Y N

PMI: Normal Abnormal
If abnormal, in what way?

PLEASE INDICATE MOST APPROPRIATE DIAGNOSIS(ES)

	Mild	Moderate	Severe
AS			
AI			
MR			
MS			
MVP			
TR			
TS			
PS			
PI			
VSD			
SEM			
PDA			
IHSS			
Other specify:			

Abbreviations
LLSB = Left lower sternal border
RLSB = Right lower sternal border
LUSB = Left upper sternal border
RUSB = Right upper sternal border
AS = Aortic stenosis
AI = Aortic insufficiency
MR = Mitral regurgitation
MS = Mitral stenosis
MVP = Mitral valve prolapse
TR = Tricuspid regurgitation
TS = Tricuspid stenosis
PI = Pulmonic insufficiency
PS = Pulmonic stenosis
VSD = Ventricular septal defect
SEM = Systolic ejection murmur
PDA = Patent ductus arteriosus
IHSS = Idiopathic hypertrophic subaortic stenosis
JVP = Jugular venous pressure
PMI = Point of maximal impulse

1. Sensitivity, Specifity, Postive and Negative Predictive Value

		Echo +	Echo -	
Exam	+	A	B	A+B
	-	C	D	C+D
		A+C	B+D	

Sensitivity= $\frac{A}{A+C}$ = $\frac{\text{True Postive (TP)}}{\text{True Postive+False Negative (FP)}}$

Specificity= $\frac{D}{B+D}$ = $\frac{\text{True Negative (TP)}}{\text{True Negative+False Positive (FN)}}$

Positive Predictive Value= $\frac{A}{A+B}$ = $\frac{TP}{TP+FP}$

Negative Predictive Value= $\frac{D}{C+D}$ = $\frac{TP}{TP+FP}$

2. Bayes Theorm

A and B are two separate events

$$P(A/B) = \frac{p(B/A)p(A)}{P(B/A)p(A) + p(B/\bar{A})p(\bar{A})}$$ = Probablity of A given B

$\bar{A}$ = not A or events other than A

3. Interrater Agreement

		Intern: Lesion x	Intern: Other
Attending	Lesion X	A	B
	Other	C	D

P_0 = overall proportion of agreement = A + D

4. Test of the proportion

All Echos + for Lesion x

		Intern +	Intern -	
Attending	+	A	B	A+B
	-	C	D	C+D
		A+C	B+D	

Conduct x^2 with 1 degree of freedom and α of 0.05 (=3.84)

$$x^2 = \frac{(|B-C|-1)^2}{B+C}$$

Reject null hypothesis if $x^2 > 3.84$