Influence of predicting the diagnosis from the history on the accuracy of physical examination

（病歴情報からの適切な疾患想起が身体診察の診断精度に及ぼす影響に関する検討）

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Influence of predicting the diagnosis from the history on the accuracy of physical examination

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Abstract

Background

This study aimed to clarify the influence of predicting a correct diagnosis from the history on physical examination by comparing the diagnostic accuracy of auscultation with and without clinical information.

Methods

The participants were 102 medical students from the 2013 clinical clerkship course. Auscultation was performed with a cardiology patient simulator. Participants were randomly assigned to 2 groups. Each group listened to a different simulated heart murmur and then made a diagnosis without clinical information. Next, a history suggesting a different murmur was provided to each group and they predicted the diagnosis. Finally, the students listened to a murmur corresponding to the history provided and again made a diagnosis. Correct and incorrect diagnosis rates of auscultation were compared between students with and without clinical information, between students predicting a correct or incorrect diagnosis from the history (correct and incorrect prediction groups, respectively), and between students without clinical information and those making an incorrect prediction.

Results

For auscultation with or without clinical information, the correct diagnosis rate was 62.7% (128 / 204 participants) versus 54.4% (111 / 204 participants), showing no significant difference ($p = 0.09$). After receiving clinical information, a correct

diagnosis was made by 102 /117 students (87.2%) in the correct prediction group versus 26 / 87 students (29.9%) in the incorrect prediction group, showing a significant difference ($p = 0.006$). The correct diagnosis rate was also significantly lower in the incorrect prediction group than when the students performed auscultation without clinical information (54.4% versus 29.9%, $p < 0.001$).

Conclusion

Obtaining a history alone does not improve the diagnostic accuracy of physical examination. However, accurately predicting the diagnosis from the history is associated with higher diagnostic accuracy of physical examination, while incorrect prediction is associated with lower diagnostic accuracy of examination.

Background

Performing physical examination is one of the essential skills for clinicians, and accurate examination and evaluation provide information for determining the diagnosis and treatment. However, it is not rare to miss abnormal physical findings or perform evaluation incorrectly in daily practice. Incorrect assessment of physical findings may lead to diagnostic errors, which in turn may result in an adverse outcome for the patient.[1] Depending on whether or not physical examination is performed with an underlying hypothesis, the examination itself and interpretation of the findings will differ.[2] Riegelman et al.[3] stated that physical examination represents a collection of diagnostic tests and that a method is required for incorporating each piece of information gathered into the diagnostic thinking process in consideration of the usability of the said information.

Previous studies have shown that obtaining a clinical history improves the diagnostic accuracy of auscultation,[4] visual diagnosis,[5] interpretation of radiographs, [6-11] and interpretation of electrocardiograms.[12] Of course, acquisition of the history does not guarantee that a correct diagnosis will be made in the real-world clinical setting, and incorrect diagnostic predictions may be generated. A study comparing a group of patients who had a history suggestive of the correct diagnosis and group with a misleading history concluded that obtaining the history improves the diagnostic accuracy of physical examination, provided that a correct diagnosis can be predicted from information in the history and that this prediction in turn improves the accuracy of examination. However, we have not been able to find any studies that compared

diagnostic accuracy between physical examination alone without a history and physical examination with a history that resulted in prediction of an incorrect diagnosis.

The present study aimed to clarify the influence of predicting a correct diagnosis from the history on physical examination by comparing the diagnostic accuracy of auscultation with and without clinical information. Accordingly, medical students who predicted the correct diagnosis from the history (correct prediction group) were compared with medical students who made an incorrect prediction from the history (incorrect prediction group), and medical students who performed auscultation without any clinical information were also compared with the incorrect prediction group.

Methods

Procedures

This study was approved by the Ethics Committee of Chiba University School of Medicine (Chiba, Japan). A detailed explanation of the study was given to all participants, who confirmed that they fully understood the information before voluntarily giving informed consent to participate.

Participants

One hundred and two medical students undertaking clinical clerkship at Chiba University School of Medicine in 2013 were enrolled in this study, which was part of the clinical clerkship course provided by the Department of General Medicine at Chiba University Hospital ("our department"). The students had all completed the fourth year of the medical course and had passed computer-based testing and an objective

structured clinical examination. They had also received skills training with a cardiology patient simulator, which was the same as that used in the present study.

Design

This study employed a cardiology patient simulator (Ichiro®; Kyoto Kagaku Co., Kyoto, Japan), which is currently used at approximately 120 educational institutions in Japan. This device provides training in the auscultation of 26 different heart sounds, palpation of arteries at 8 sites, observation of the jugular veins, and palpation of cardiac impulses, and it also displays electrocardiographic waveforms.[13]

Four valvular abnormalities (mitral stenosis [Q1], aortic stenosis [Q2], aortic regurgitation [Q3], and mitral regurgitation [Q4]) were selected from among the cardiac conditions that the students had studied in their cardiovascular medicine course as the diagnoses to be made by physical examination.

The participants were randomly assigned to 2 groups (Group A and Group B). First, Group A performed auscultation for Q1 and Q2, while Group B performed auscultation for Q3 and Q4. The participants were then asked to make a diagnosis based on their findings at auscultation (diagnosis without clinical information, n = 204 examinations [51 students × 2 questions × 2 groups]). Next, a clinical history suggestive of Q3 and Q4 or a history suggestive of Q1 and Q2 was provided to Group A and Group B, respectively, and the students were asked to make the most appropriate diagnosis based on the data in the history. Subsequently, the students listened to simulated heart murmurs corresponding to the history that they had been given and were again asked to make the most appropriate diagnosis (diagnosis with clinical information, n = 204 examinations [51 students × 2 questions × 2 groups]) (Figure 1). The histories provided

to the students were based on questions from prior national examinations for medical practitioners, and their appropriateness was assessed by an expert panel from our department before use. The same history was given to the participants for each question. When a pilot study of students undergoing the clinical clerkship rotation at our department was conducted last year, all students made their diagnostic predictions within 10 minutes after being provided with a history and within 3 minutes after performing auscultation. Therefore, the time limits for this study were set according to those findings.

In order to avoid leakage of the questions, the participants were told that this study had nothing to do with their grades and were asked not to discuss the questions with other persons.

Main Measures

The diagnostic accuracy of auscultation was compared between students who received clinical information and those without clinical information, between the correct prediction group and the incorrect prediction group, and between students without clinical information and the incorrect prediction group.

Subsidiary Measure

The relationship between the number of correct diagnoses made without clinical information and the number of correct diagnoses predicted with clinical information was examined by the cross tabulation.

Statistical analysis

Statistical analyses were performed by using SPSS Statistics for Windows 20.2 (IBM Corp. Armonk, NY), with the level of significance being set at $P < 0.05$. The diagnostic accuracy of auscultation was compared between the groups by using the chi-square test. The relationship between the number of correct diagnoses made without clinical information and the number of correct diagnoses predicted with clinical information was examined by using the chi-square test or Fisher's exact test.

Based on the results of the pilot study mentioned above, the diagnostic accuracy of auscultation was predicted to be 60% when students received clinical information and 40% when they had no clinical information. Assuming an α error of 0.05, β error of 0.2, and power of detection of 0.8, a sample size of at least 97 participants was required for each of the correct and incorrect prediction groups to allow comparison of the diagnostic accuracy of auscultation.

Results

Comparison between the medical students performing auscultation with or without clinical information showed that a correct diagnosis was made in 128 / 204 examinations (62.7%) when they received clinical information versus 111 / 204 examinations (54.4%) when they had no clinical information. There was no significant difference in the diagnostic accuracy of auscultation between medical students with and without clinical information ($p = 0.09$) (Table 1). Comparison between the correct and incorrect prediction groups showed that the correct prediction group made a correct diagnosis after auscultation in 102 / 117 examinations (87.2%), while a correct diagnosis was only made in 26 / 87 examinations (29.9%) by the incorrect prediction group. The diagnostic accuracy of auscultation was significantly higher in the correct

prediction group ($p = 0.006$) (Table 2). When the students without clinical information and the incorrect prediction group were compared, performing auscultation without clinical information led to a correct diagnosis in 111 / 204 examinations (54.4%), while a correct diagnosis was made only in 26 / 87 examinations (29.9%) in the incorrect prediction group, and the diagnostic accuracy of auscultation was significantly lower in the incorrect prediction group ($p < 0.001$) (Table 3). There was no relationship between the number of correct diagnoses made by auscultation without clinical information and the number of correct predictions made with clinical information ($p = 0.446$) (Table 4).

Discussion

This study showed that simply being provided with clinical information from the history did not affect the diagnostic accuracy of auscultation by medical students. However, the diagnostic accuracy of auscultation increased when the correct diagnosis was predicted from the history, while it decreased when an incorrect diagnosis was predicted. Accordingly, the diagnostic accuracy of auscultation was influenced by whether or not the medical students made a correct diagnostic prediction from the history.

Our finding that obtaining the history alone did not affect the diagnostic accuracy of auscultation is not consistent with the report of Sibbald et al.,[4] who concluded that obtaining the history improved the diagnostic accuracy of physical examination. However, Sibbald et al. provided a history that allowed easy diagnosis, and the accuracy of diagnostic prediction based on the history alone was 86.0%, which was higher than in our study (57.4%). We provided the participants in the present study with more difficult histories, and fewer participants could make a correct diagnostic prediction compared with Sibbald's study, which could explain why the availability or lack of clinical information did not influence the diagnostic accuracy of auscultation in our study.

Our finding that predicting the correct diagnosis from the history led to improved diagnostic accuracy of auscultation is consistent with the report by Leblanc et al.,[5] who stated that making a correct diagnostic hypothesis based on the history improved the accuracy of visual diagnosis. Leblanc et al. considered that evaluation focused on the predicted diagnosis led to collection of key information and influenced the interpretation of data to improve the diagnostic accuracy. In the present study, these factors may have contributed to the higher diagnostic accuracy of auscultation in the correct prediction group.

Conversely, making an incorrect diagnostic prediction from the history was associated with lower diagnostic accuracy of auscultation in the present study. This finding is consistent with the report that an incorrect history decreases the diagnostic accuracy of cardiac physical examination, [14]as well as reducing the accuracy of visual diagnosis[15] and interpretation of the electrocardiogram .[12] A new finding of the present study was that the diagnostic accuracy of examination was lower when an incorrect diagnostic prediction was made from the history than when examination was performed with no history. This indicates that predicting the correct diagnosis from the history is critical for reducing errors when performing physical examination. Although it is possible that medical students who interpret the history inaccurately may also be less proficient at auscultation, there was no relationship between the number of correct diagnoses made without clinical information and the number of correct predictions made from the history.

Heuristic bias could explain why the diagnostic accuracy of auscultation was lower in the incorrect prediction group than when auscultation was performed without any clinical information. Potential heuristic biases include availability bias (making decisions based on information that comes to mind easily), anchoring bias (the tendency to place too much trust in the initial diagnosis), confirmation bias (the tendency to look for information that supports one's hypothesis and ignore information that contradicts it), and premature closure (termination of the clinical reasoning process before reaching a correct diagnosis or considering alternative diagnoses) .[16] In this study, confirmation bias and premature closure may have been involved in reducing the diagnostic accuracy of auscultation in the incorrect prediction group. After an incorrect diagnostic hypothesis was made from the history, the medical students may have based their final

diagnosis on this prediction even though data obtained by auscultation were inconsistent with the predicted diagnosis.

In this study, approximately 30% of the students made an incorrect diagnostic prediction based on the history, but subsequently made a correct diagnosis after performing auscultation (Table 2). The above-mentioned electrocardiogram study showed that experts were less likely than beginners to make errors of interpretation even if they predicted an incorrect diagnosis from the history.[12] In our study, the students who made an incorrect diagnostic prediction from the history but obtained the correct diagnosis after auscultation may have been more skillful at performing auscultation and capable of detecting disease-specific findings, and thus made a correct diagnosis based on their findings without being derailed by confirmation bias and premature closure.

This study had several limitations. First, the subjects were medical students with limited clinical experience, so the present findings may not be applicable to physicians with greater skill in performing physical examination. Second, the level of confidence that subjects had in the preliminary diagnosis made from the history was not evaluated. If the level of confidence is low, confirmation bias and premature closure will have little effect even if an incorrect diagnostic prediction is made, and a decrease in the diagnostic accuracy of physical examination may not occur.

Conclusions

Obtaining a history does not improve the diagnostic accuracy of physical examination. However, accurately predicting the diagnosis from the history is important, because it is associated with a higher diagnostic accuracy of physical examination, while incorrect prediction decreases the diagnostic accuracy of examination.

Disclorure

The authors report no conflicts of interest in this work

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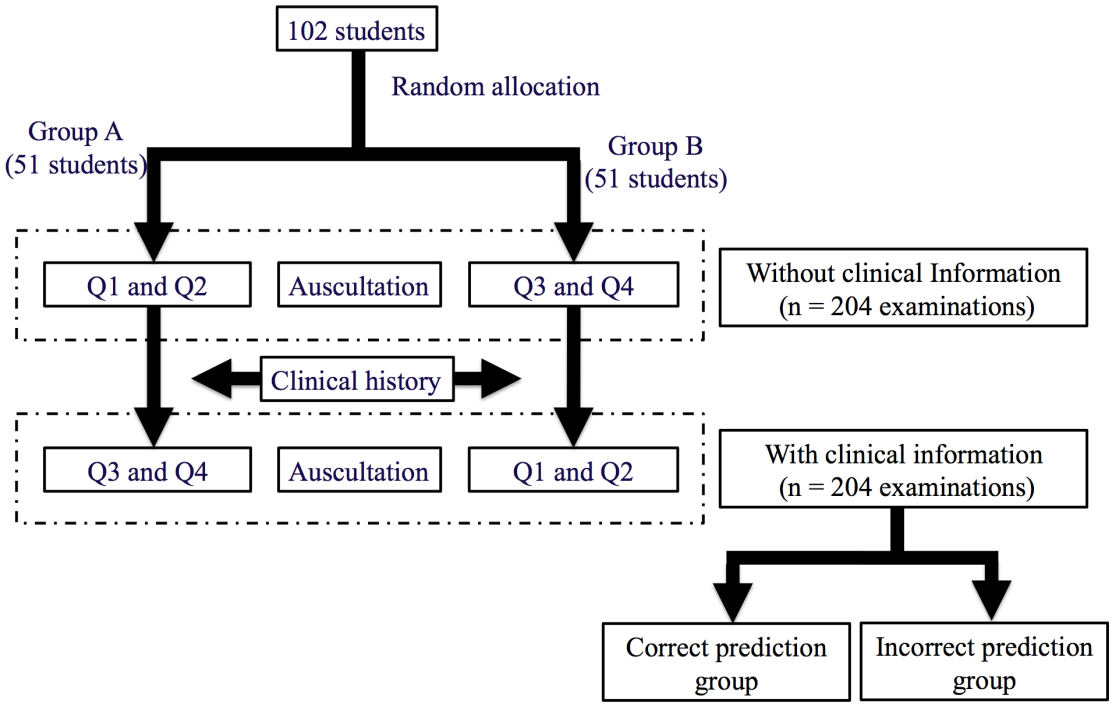
Figure 1 Outline of the study.



Notes: One hundred and two students were randomized to Group A (51 students) that started with Q1 and Q2 or Group B (51 students) that started with Q3 and Q4. The students initially performed auscultation without clinical information (n=204 examinations, 51 students ×2 questions ×2 groups), and then performed auscultation again after being given a history (n=204 examinations, 51 students ×2 questions ×2 groups). The students were then classified into correct or incorrect prediction groups, depending on whether correct or incorrect diagnoses were predicted from the clinical information, respectively.

Abbreviation: Q, question.

Table 1 Diagnostic accuracy of auscultation without clinical in- formation and with clinical information

	Without clinical information (n = 204)	With clinical information (n = 204)
Correct diagnosis, n(%)	111 (54.4)	128 (62.7)
Incorrect diagnosis, n(%)	93 (45.6)	76 (37.3)

Note: No significant differences were noted between the students without clinical information and with clinical information (*P*=0.09).

Table 2 Diagnostic accuracy of auscultation in the correct prediction group and incorrect prediction group

	Correct prediction group (n = 117)	Incorrect prediction group (n = 87)
Correct diagnosis, n(%)	102 (87.2)	26 (29.9)
Incorrect diagnosis, n(%)	15 (12.8)	61 (70.1)

Note: The correct diagnosis rate of auscultation was significantly higher in the correct prediction group than in the incorrect prediction group (P=0.006).

Table 3 Diagnostic accuracy of auscultation without clinical information and in the incorrect prediction group

	Without clinical information (n = 204)	Incorrect prediction group (n = 87)
Correct diagnosis, n(%)	111 (54.4)	26 (29.9)
Incorrect diagnosis, n(%)	93 (45.6)	61 (70.1)

Note: The correct diagnosis rate of auscultation was significantly higher without clinical information than in the incorrect prediction group (*P*,0.001).

Table 4 Relation of correct diagnoses made after auscultation without clinical information to correct diagnoses predicted with clinical information

		With clinical information Number of correct predictions		
		0	1	2
Without clinical information Number of correct diagnose	0	6(28.6%)	11(52.4%)	4(19.0%)
	1	9(17.6%)	24(47.1%)	18(35.3%)
	2	5(16.7%)	12(40.0%)	13(43.3%)
	total	20(20.6%)	47(50.0%)	35(29.4%)

Note: There was no relation between the number of correct diagnoses made by auscultation without clinical information and the number of correct diagnoses predicted from the history (Fisher's exact test, P=0.446).