Araştırma Makalesi/Research Article

Direk Radyografik Ölçümlerin Kapak Yetersizliklerinin Ciddiyetinde Belirleyici Olarak Ön Gördürücü Değeri

Predictive Value of Direct Radiographic Measurements as a Marker of Severity of Valvular Regurgitation

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ÖZET

AMAÇ: *Göğüs radyografisi (GR) kardiyak boşlukların genişlemesinin değerlendirilmesinde yaygın olarak kullanılan bir yöntemdir. Bu çalışmada GR ile belirlenen kardiyotorasik oran (KTO), kardiyak alan (KA) ve kardiyak volüm (KV) değerleri ile sol ventrikülün ekokardiyografik çapları ve kapak yetmezliklerinin ciddiyeti karşılaştırılmıştır.*

YÖNTEMLER: *Çalışma popülasyonu izole ya da kombine mitral, aort veya triküspit yetersizliği olan 220 hastadan (125 Kadın, 95 Erkek) oluşmaktadır. Hastaların tümünde sol ventrikül ejeksiyon fraksiyonu > %40 olup normale yakındır. GR ve ekokardiyografik değerlendirme tüm hastalarda aynı gün içerisinde yapılmıştır. Hastalar kapak yetersizliğinin ciddiyeti yönünden hafif orta ve ciddi olmak üzere gruplandırılmıştır.*

BULGULAR: *Basit linear pearson korelasyon testinde sol ventrikül sistol sonu çapı KV ile KA ve KTO'ya göre daha ilişkili bulunmuştur. Bununla beraber sol ventrikül diastol sonu çapı hem KA hem de KV ile koraledir. Çoklu karşılaştırma testlerinde mitral ve triküspit yetmezliği ciddiyeti ile KA ve KV'nin korelasyonu KTO'dan daha iyi bulunmuştur. Oysaki aort yetersizliği ciddiyeti yalnızca KV ile ilişkilidir.*

TARTIŞMA: *GR ekokardiyografi ile karşılaştırıldığında daha ucuz ve kolay bir yöntemdir ve rutin klinik pratikte kullanımı bu çalışmadan sonra artabilir.*

Anahtar Kelimeler: *Kapak yetersizliği, Göğüs X-Ray, ekokardiyografi*

ABSTRACT

INTRODUCTION: *The chest radiography (CR) is widely available and frequently performed as a screening test for cardiac chamber enlargement. In this study, we compared cardiothoracic ratio (CTR), cardiac area (CA) and cardiac volume (CV) on CR and echocardiographic diamaters of left ventricule and severity of valvular regurgitation.*

METHODS: *The studied population consisted of 220 patients (125 female, 95 male) with isolated or combined mitral, aortic and tricuspid regurgitation. All of the patients had near normal cardiac systolic function (Left ventriküler ejection fraction >40%). CR and echocardiographic examination were performed on the same day in every patient. The patients were grouped by the degree of valvular regurgitation as mild, moderate, or severe.*

RESULTS: *In the simple linear pearson correlations test, left ventricular endsystolic diameter correlated better with CV than with CA and CTR. However left ventricular enddiastolic diameter correlated both with CA and CV. The results of the multiple comparison test were evaluated and severity of mitral and tricuspid regurgitation correlated better with CA and CV than with CTR. Whereas severity of aortic regurgitation only correlated with CV.*

DISCUSSION: *CR is a cheaper and easier method as compared to echocardiography and potential usage in routine clinic practice may increase after the present study.*

Key words: *Valvular regurgitation, Chest X-Ray, echocardiography*

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INTRODUCTION

Valvular regurgitation is a frequently encountered disease in daily clinical practice, and follow-up of its significance is the cornerstone of management for these patients (1). Clinical examination alone is usually unreliable for differential diagnosis of valvular regurgitation, and demonstrating objective evidence of left ventricular (LV) enlargement or dysfunction are crucial to diagnosis of valvular regurgitation (2). Transthoracic echocardiography (TTE) is currently the gold standard modality for the diagnosis of valvular regurgitation, and will remain so for the foreseeable future. It provides a good general assessment of LV function (3). However, it is limited in patients with poor acoustic windows, it requires geometric assumptions in quantifying global LV systolic function, and its ability to provide specific tissue characterization is modest. However, TTE is not available in every hospital and cannot be applied by all physicians. ESC guidelines for valvular heart disease indicate that a chest X-ray (CXR) is of limited but common use in the diagnostic work-up of patients with valvular regurgitation (4). It has been concluded that LV systolic dysfunction may be present without cardiomegaly on the CXR. The cardiothoracic ratio (CTR) has been used to determine heart size in relevant reports. However, measurement of the cardiac area (CA) and cardiac volume (CV) with a plain radiograph, which is an old and little known technique, may more accurately predict the size of the heart (5,6). We aimed to demonstrate the diagnostic accuracy of radiographic measurements that are easily available in general hospitals for quantifying LV function and LV dimensions in the patients with valvular regurgitation. We compared left ventricular end-diastolic diameter (LVEDD), left ventricular end-systolic diamater (LVESD), and left ventricular ejection fraction (LVEF) derived from TTE with radiographic indices derived from posteranterior and lateral CXR in patients with valvular regurgitation.

MATERIAL AND METHODS

3.1. Patients

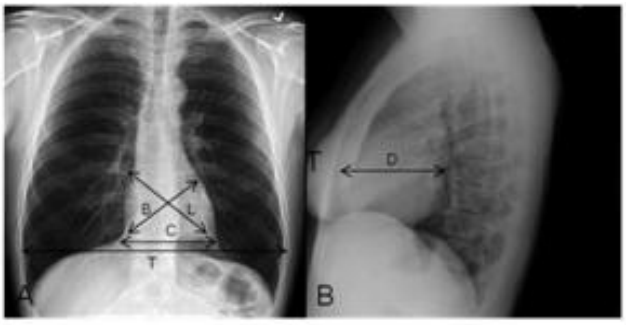
This retrospective study group consisted of 220 (125 female, 95 male) untreated patients who attended the outpatient clinic of the Department of Cardiology at the Turkiye Yuksek Ihtisas Education and Research Hospital for the differential diagnosis of dyspnea. Each patient's ECG, CXR, and TTE recordings were analyzed, and recordings were reviewed for physical examination findings, initial clinical presentation, family history, past medical history, smoking status, and New York Heart Association (NYHA) functional class. Severity of valvular regurgitation was detected by TTE. The patients with moderate or severe systolic dysfunction (LVEF< %40) were excluded. Echocardiographic images and plain radiographs were evaluated by two independent observers. All radiographic images were checked by a radiologist who was blinded to the clinical characteristics and echocardiographic data of the patients.

The protocol was approved by the Ethical Committee of the Turkiye Yuksek Ihtisas Education and Research Hospital. Written consent was not obtained because of the retrospective design of the study.

3.2. Radiographic assessment

The radiographic assessment was performed by a direct radiography (DR) system (Axiom Aristos, Siemens Medical Solutions, USA) in the radiology unit. The measurements were made blind to the results of the other investigations. CTR was evaluated solely via PA erect radiograph (Figure 1). No AP, supine, or seated films were accepted. CV was measured by using the method described by Keats and Enge (5) (Figure 1):

$CV=L \times B \times D \times K$



The length diameter (L) is measured from the junction of the superior vena cava to the cardiac apex. The broad diameter (B) is taken from the junction of the right atrium and the diaphragm and the junction of the pulmonary artery. D represents the greatest horizontal diameter of the heart in lateral film. Thus, the calculation of CV requires both a PA and lateral film. K is a constant (0.63), and the value of K varies with different focal-film distances. In our study, the focal-film distance was 150 cm for a K value of 0.39.

CA was calculated as described by Ungerleider and Gubner (6):

$CA=B \times L \times (\pi/4)$

3.3. Echocardiographic Study

A skilled echocardiographer blind to the clinical features of the patients performed the echocardiographic study using a Vivid 7 (GE Healthcare, Horten, Norway) ultrasound system. Basic measurements included LV diameters and LA diameters by 2D echocardiography with settings per recommendations by the American Society of Echocardiography (7). Left ventricular volumes, LVEF and the degree of valvular regurgitation were determined as recommended by the American Society of Echocardiography (8).

3.4.Statistical Analysis

Statistical analysis was performed with the SPSS/PC software package (version 15.0 for Windows; IBM SPSS, USA). Categorical data are reported as proportions, and continuous variables are expressed as mean±standard deviation. Frequency comparisons were made using thet-test, Kruskal-Wallis test, Mann-Whitney U test, and chi-square test as appropriate. Analyses of continuous variables were performed using the Student's t-test or analysis of variance (AVONA) for comparison of normally distributed data. Statistical significance was set at a $p<0.05$. All reported probability values were two-sided.

RESULTS

In the simple linear pearson correlations test, LVESD correlated better with CV than with CA and CTR (Table 1). However LVEDD correlated both with CA and CV.

Table 1: The simple lineer correlation between radiographic and echocardiographic parameters

	LVEF	LVEDD	LVESD	LA	CTR	CA	CV
LVEF	1	-0.610**	-0.805**	-0.455**	-0.205*	-0.105	0.005
LVEDD	-0.610**	1	0.925**	0.475**	0.010	0.220**	0.465**
LVESD	-0.805**	0.925**	1	0.565**	0.090	0.110	0.210**
LA	-0.455**	0.475**	0.565**	1	0.485**	0.505**	0.710**
CTR	-0.205*	0.010	0.090	0.485**	1	0.245**	0.220**
CA	-0.105	0.220**	0.110	0.505**	0.245**	1	0.850**
CV	0.005	0.465**	0.210**	0.710**	0.220**	0.850**	1

CA, cardiac area; CTR, cardiothoracic ratio; CV, cardiac volume; LA, Left atrial diamater; LVEDD, left ventricular enddiastolic diamater; LVEF, left ventricular ejection fraction; LVESD, left ventricular endsystolic diamater
** P<0.05, ** P<0.01*

The results of the multiple comparison test were evaluated and severity of mitral and tricuspid regurgitation correlated better with CA and CV than with CTR (Table 2). Whereas severity of aortic regurgitation only correlated with CV.

Table 2 The results of multiple comparisons test

Dependent Variable			Mean Difference (I-J)	Std. Error	Significance
	(I) AR	(J) AR			
CTR	Severe	Mild	0.11	0.05	0.19
	Severe	Moderate	0.09	0.05	0.15
CA	Severe	Mild	14.15	5.25	0.622
	Severe	Moderate	9.25	3.55	0.551
CV	Severe	Mild	995.15*	404.30	0.025
	Severe	Moderate	225.25	95.15	0.126
	(I) MR	(J) MR			
CTR	Severe	Mild	0.03	0.02	0.592
	Severe	Moderate	0.008	0.005	0.810
CA	Severe	Mild	22.45*	7.35	0.010
	Severe	Moderate	18.70*	6.25	0.029
CV	Severe	Mild	1550**	295	0.0005
	Severe	Moderate	555*	254	0.04
	(I) TR	(J) TR			
CTR	Severe	Mild	0.12	0.05	0.55
	Severe	Moderate	0.09	0.04	0.52
CA	Severe	Mild	45**	9	0.0005
	Severe	Moderate	28**	8.5	0.006
CV	Severe	Mild	1750**	355	0.0004
	Severe	Moderate	425*	224	0.02

AR, aortic regurgition; CA, cardiac area; CTR, cardiathoracic ratio; CV, cardiac volume; MR, mitral regurgitation; TR, tricuspid regurgitation
**p<0.05, P<0.01*

DISCUSSION

Valvular regurgitation is a commonly seen problem in patients presenting to the cardiology clinics. Correct diagnosis, especially in situations that require rapid intervention, can be life saving. Although history and physical examination play an important role in the differential diagnosis of cardiovascular causes from the other etiologies, the symptoms are usually similar, and the gold standard for diagnosis is TTE. However, echocardiography devices and a physician who can evaluate the results of echocardiography are not available in many centers.

In contrast, direct radiographic study is available at almost all hospitals and does not require expertise in cardiology for the interpretation of the findings. Radiographic study is also cheaper and can be applied quickly. Several studies in adults have compared radiographic and angiographic data and have generally found a good correlation between radiographic CV's and various angiographic left heart measurements (9-11).

There are contradictory results in the literature concerning the comparison of echocardiographic and radiological cardiac dimensions. Davidson et al. (12) demonstrated that although there was a significant correlation between the radiographic total CV and echocardiographic ventricular

volumes, especially in left-sided pathologies, CTR and CA did not correlate well with echocardiographic measurements. However, Levis (13) found a high degree of correlation between CA and LVEDV in patients with pure aortic valve insufficiency. In addition, Glove et al. (14) demonstrated that CV gives the greatest diagnostic accuracy for measurement of the left ventricular dimensions (79%) when compared with CTR.

In our study, we found a strong relationship between echocardiographic dimensions and CA and CV in patients with valvular regurgitation. Therefore, we believe that physicians may use CA and CV measurements in the follow-up of patients with valvular regurgitation, which is a cheaper and more rapidly available diagnostic tool. However, it is well known that serial chest X-ray may be harmful way for follow-up of these patients, due to total radiation dose. A single chest x-ray exposes the patient to about 0.1 mSv, which is about the radiation dose people are exposed to naturally over the course of about 10 days.

In conclusion, chest radiographies are commonly used as an initial test for the diagnosis of cardiac enlargement and heart failure. It is cheaper and easier method as compared to echocardiography. We use serial echocardiogram and chest radiography examination to evaluate size and function of the heart in the follow-up aortic, mitral and tricuspid regurgitation in our daily practice. In our knowledge this is the first study which compare CTR, CA and CV with echocardiographic parameters in the patients with valvular regurgitation.

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