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Evaluation of Diagnostic Methods for Left Ventricular Hypertrophy at forensic Autopsy

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ÖZET

Sol ventrikül hipertrofisinin, adli otopsilerde basit ve hızlı bir biçimde ortaya konabilecek makroskopik kriterleri araştırılarak, ülkemiz koşullarında uygulamaya sokulabilecek yöntemi belirlemek amacıyla yapıldı. Otopsileri yapılmak üzere İstanbul, Adli Tıp Kurumu Başkanlığı Morg İhtisas Dairesine gönderilen ve rastlantısal olarak seçilen 100 olgu kalpte yapılan histopatolojik inceleme sonucu normal ve hipertrofik olmak üzere 2 gruba ayrıldı.

Duvar kalınlıkları ve kalp bölümlerinin biribirlerine oranları, duyarlılıklarının yüksekliği gözönüne alındığında hipertrofi tanısında yeterli gibi görünmesine rağmen, uygun koşullarda tüm tanı yöntemlerinin birlikte kullanılması daha iyi bir yaklaşım olacaktır. Bu çalışma, toplumun standart ölçümlerinin belirleneceği bir araştırma ile birlikte tanısal yöntemlerin güvenle kullanılmasında yardımcı olacaktır.

Abstract

This study is conducted for the assessment of left ventricular hypertrophy(LVH) by simple and rapid techniques and determination of macroscopical criteria which can be used for routine legal autopsy practice of our country. A hundred cases, which were sent to the Morgue Department of the Council of Forensic Medicine of Istanbul for autopsy, have been chosen randomly and given two groups have been defined as normal and hypertrophic according to the histopatological examination of hearts.

Although wall thickness and ratio of cardiac compartments can each seem sufficient separately for hypertrophy diagnosis when high sensitivity of these methods are taken into account, it would be better to use all diagnostic methods together in suitable circumstances, and comprehension of this study with a research for constructing standard measurements of the population will be helpful for these diagnostic methods to be used in confidence.

Key words: *Left ventricular, hypertrophy, diaghosis, autopsy,*

INTRODUCTION

Deciding on the mechanism of sudden death has always been a perplexing query for a forensic pathologist [1]. Sudden or unexpected death of a person with an healthy appearence should be investigated thoroughly, and it is a legal obligation to perform a postmortem examination in order to reveal the cause and mechanism of death as well as the manner for potential existence of violence and the causality.

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Cardiac disease is the most common cause of sudden death, while sudden cardiac death is mainly originated from cardiac arryhtmia, especially ventricular fibrillation [2]. Ventricular arryhtmia is related to left ventricular hypertrophy(LVH) in many studies [3,4]. Left ventricular hypertrophy with no significant coronary artery disease is a risk factor as a primary component or manifestation of cardiac disease [4].

A hundred autopsy cases have been selected consistently among the cases that had been referred to the Morgue Department of the Council of Forensic Medicine in Istanbul, of which quantitative structural properties that could have been used for diagnosing left ventricular hypertrophy had been analyzed after removal of the hearts in order to determine the most useful and easy method of postmortem diagnosis of LVH.

Materials and methods

A hundred male subjects with an age range of 15-78 that had been sent to the Morgue Department of the Council of Forensic Medicine in Istanbul for autopsy were selected correspondingly while persistence of postmortem rigidity was an essential for this study. Hearts were examined and all of the measurements were taken without fixating in order not to disturb the routine procedure of the Morgue Department although gross examination of the heart in most of the researches is commonly carried out after total fixation following the removal.

The hearts were dissected by slightly modified Schlezinger method [5], and separated into four compartments (atriums, left and right ventricules, interventricular septum) through atrioventricular groove and interventricular septum(IVS) after examining coronary arteries(Fig 1-4). Each compartment has been weighed, and recorded separately while total weight of the heart had been calculated as their sum. Thickness of left ventricular(LV) wall 1 cm far from the mitral valve and the thickness of right ventricular(RV) wall 1 cm below the pulmonary valve were measured respectively.

Each ventricular myocardium were examined grossly for possible pathological findings such as hyperemia, scars, etc., and were recorded if any. Myocardial tissue which was removed for histopathological examination was stained with Hematoxylein-Eosin after fixating in 10% formaldehyde, and then evaluated under the light microscope. These cases were evaluated either as normal or hypertrophic according to their histopathological appearence. Age, ventricular wall thickness, weights of the compartments and ratio of their weights to each were analyzed.

Results

The cases (n=100) were determined to be either hypertrophic(n=62) or normal(n=38) according to the histopathological appearance of the myocardial tissue samples which had been obtained from left ventricular lateral wall. Group differences were analyzed.

Age range of all cases in our research was 15-78, while the mean age was 31.66±10.73, and 45.24±14.43 for normal and hypertrophic groups, respectively, and

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found highly significant ($p < 0.001$).

The difference for the mean value of two groups left ventricular wall and interventricular septum thicknesses was found significant (respectively $p<0.001$ and $p<0.05$), while right ventricular wall thickness had no significant difference(Table 1).

Left ventricule, IVS, Left ventricule+IVS, right ventricule, left ventricule+IVS+right ventricule, atriums and total heart weight differed significantly for each group, and higher values were obtained for combined weight of atriums and total weight (Table 2).

Evaluation of compartmental weight ratios revealed that all of the ratios differed

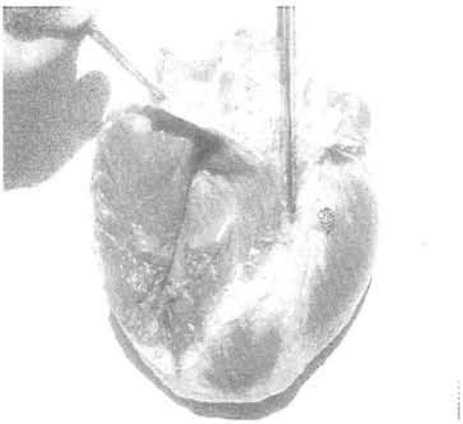

Figure 1

Figure 2

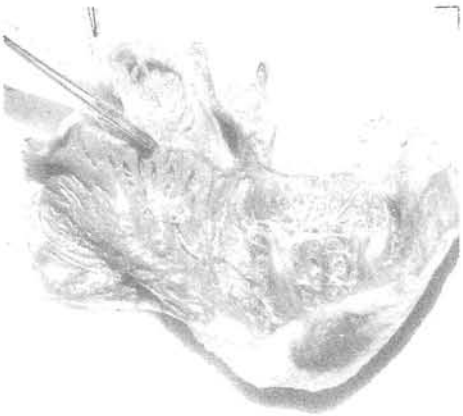

Figure 3

Figure 4

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significantly but only LV+IVS/RV ratio (Table 3).

Discussion and conclusion

The criteria of left ventricular hypertrophy for gross examination had been discussed intensively in various studies[6-9], however judgements have been stated to be insufficient to reveal whether ventricular wall thickness and total weight of heart which had been used for more than a century were adequate for diagnosis of left ventricular hypertrophy[9]. Various approaches have been asserted for a more accurate way of diagnosis[7,9]. Total weight together with weights of each compartment have been suggested to be more precise than ventricular wall thickness that undergo changes due to postmortem status of myocardium [7,8,10].

Normal (n=38) and hypertrophic (n=62) groups that had been classified by histopathological examination were compared in respect with the parameters mentioned above.

The prevalance of LVH is reported to increase in consistence with age dramatically, with an increasement of 15% for each decade among males, and 67% for females($p<0.001$) while LVH is diagnosed in 33% of men at the age of 70 or more, and 49% of women at the same age [11-14]. Age range of all cases in our research was 15-78, while the mean age was 31.66±10.73, and 45.24±14.43 for normal and hypertrophic groups, respectively, and found highly significant ($p<0.001$).

The mean left ventricular wall thickness was measured 13.11±1.89 mm for normal group while it was 15.3±2.57 mm in hypertrophic group and this difference was found significant ($p<0.001$)(Table 1). This result points out the wall thickness as an appropriate evidence for diagnosis of LVH if it is measured more than 15mm whereas utmost caution has to be paid for measurements with less than 15mm in order not to ignore the possibility of hypertrophy.

Table 1

THE MEAN VALUES OF WALL THİCKNESS İN NORMAL(N=38) AND HYPERTROPHİC GROUP(N=62)

Wall thickness (mm)		Mean	SD	Range	't'value
Left ventricular	*N*	13.11	±1.89	9-17	4.01**
	H	15.03	±2.57	11-24	
Right ventricular	*N*	3.72	±0.82	2-5	1.45
	H	3.99	±0.94	2-7	
Interventricular septum	*N*	12.33	±1.97	9-16	2.12*
	H	13.71	±2.99	9-23	

*p<0.05 **p<0.001 N= Normal H= Hypertrophy

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Total weight of the heart is still accepted as an adequate criterion for evaluation of the heart in most of the centers. The mean weight of the heart had been found to be 371 g in a study that measurements were taken after washing the compartments [10], and without dissecting epicardial fatty tissue and without any methods of fixation, while Zeek [15] reported that mean weight of the heart without being fixated was 316 g and 322 g for age groups of 20 and 30. In different studies that were carried out among adult males, these values had been found to be 296.7±48.5 g [16] and 371±53 g [17]. Hence, these values may vary with the characteristics of the population accordingly. As for our cases, mean total weight was found to be 311.67±51.10 g for normal group and 372.97±83.40 g for hypertrophic group ($p<0.001$)(Table 2). Diagnostic value of total weight for LVH is limited for this apparently high standard deviation though the difference is statistically significant.

Table 2

THE WEIGHT OF CARDIAC COMPARTMENTS AND TOTAL CARDIAC WEIGHT IN NORMAL AND HYPERTROPHIC GROUP

Cardiac compartments weights (g)		Mean	SD	Range	't'value
	N	152.29	±30.06	100-213	
Left ventricular					2.91*
	H	177.99	±49.10	102-379	
	N	29.74	±4.78	22-43	
Interventricular septum(IVS)					2.85*
	H	33.90	±8.20	18-57	
	N	182.03	±33.20	122-256	
Left ventricular +IVS					3.04*
	H	211.90	±54.69	120-426	
	N	72.33	±12.05	51-101	
Right ventricular					3.26*
	H	83.40	±18.65	47-122	
	N	254.55	±42.75	173-338	
Left ventricular +IVS + Right ventricular					3.40**
	H	295.29	±66.29	172-537	
	N	57.32	±11.23	36-80	
Atriums					5.65**
	H	77.67	±20.34	36-154	
	N	311.67	±51.10	209-418	
Total heart weight					4.08**
	H	372.97	±83.40	225-661	

*p<0.05 **p<0.001 *N*=Normal *H*=Hypertrophy

Total weight of the heart and the wall thickness have been claimed to be inadequate criteria of hypertrophy and it has been emphasized that the weight of the com-

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partments are supposed to be more significant [7]. Left ventricular weight has been measured 73 to 195 g in a study held among normal people, although this can be varied in accordance with body surface area,sex and physical activity [18]. Henceforth, some authors suggest that hypertrophy can be seen in cases with a weight of LV less than 190 g and not necessarily detected with a weight over 225g for body weight is an important component to be regarded [7].

Weights of all compartments were elevated in hypertrophic group, and difference between the mean values of two groups was statistically significant in this study. Left ventricule with the septum weighed 122 to 256 g in normal group and the mean value was 182.03 g whereas the range varied from 120 to 426 g and the mean value was found to be 211.90 g for the group with hypertrophy (Table 2). Weights obtained in this study have been similar to the results that had been reported in other studies. Expectation of LVH will be higher with a weight more than a limit value of 182 g which was the mean weight of normal group, because the difference between the weights of LV that were more or less than the limit of 182 g has been significant ($p<0.05$).

Ratio of compartmental weights is also suggested for determination of LVH [19,20]. Ratio of atriums to ventricules together with septum has been found 0.24 while both atriums to LV with septum was reported 0.34 in a study [9]. Miscellaneous studies since 1883 displayed similar data independent of the dissection of epicardial fatty tissue. The probability of hypertrophy apparently increased in consistent with the increase in the ratio of total heart weight to both ventricules, ratio of combined weight of atriums to total, ratio of both atriums to both ventricules with septum, and ratio of both atriums to the left ventricule with septum [21].

Table 3. Ratio of Compartment Weights

Weight Ratios of Heart Compartments		*Mean*	*SD*	*range*	*'t'value*
Total heart weight	N	1.39	± 0.048		
Right ventricular+left ventricular	H	1.43	±0.055	1.30-1.55	3.57**
Atriums	N	0.18	±0024		
Total heart weight					
	H	0.20	±0.027	0.14-0.25	4.65
Artimus					
Left ventriculer+IVS+Right venricular	N	0.22	±0.035	0.17-0.39	4.52**
Artimus					
Left venticular+IVS	N	0.31	±0.057	0.22-0.64	3.92**
	H	0.37	±0.071		
Left ventricular+IVS	N	2.52	±0.29		
Right ventricular	H	2.59	±0.56	1.55-4.44	0.75

**p>0.001 N=Normal H=Hypertophy

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It can be stated that if the ratio of total heart weight to both ventricules is more than 1.39, the ratio of combined weight of atriums to total is more than 0.18, the ratio of atriums to both ventricules with septum is more than 0.22, and the ratio of both atriums to left ventricule with septum is more than 0.31(Table 3), the probabilitiy of being in normal limits for the heart will be less than 1% as far as this data of our study is concerned ($p<0.01$).

Diagnosis of LVH which is an important risk factor for sudden cardiac death is instructive in forensic medicine. However there is no single method of diagnostic value as for the limitations of postmortem examination such as postmortem changes. Although left ventricular wall thickness appears to be a significant evidence for diagnosis, it would be more appropriate to use weights of the compartments together with the ratios to each other, especially for the cases which undergo postmortem autolytic changes.

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