Neck Circumference and 2:4 Digit Ratio in Patients with Acute Myocardial Infarction

Akut Miyokard İnfarktüsü Geçirmiş Hastalarda Boyun Çevresi ve 2:4 Parmak Oranı

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ABSTRACT Objective: The ratio between the length of the 2nd and 4th digits is negatively related to testosteron and prenatal levels of testosterone have been implicated in myocardial infarction (MI). Neck circumference, a simple and time-saving screening measure to identify obesity is positively correlated to increase the risk of coronary heart disease. The aim of this study is to determine the relationship between the length ratio from index to ring finger, neck circumference and the risk of acute myocardial infarction (AMI). **Material and Methods:** This study was conducted, the patients who diagnosed with AMI and, who arrived to the emergency room with other reasons at the same time, from 01.01.2006 through 31.12.2007, retrospectively. The finger ratios, neck circumference and body mass index (BMI) of 142 men and 66 women, all of whom are heterosexual and aged between 23-77, were recorded. **Results:** This study shows that the neck circumference is significantly larger in patients who underwent AMI than who did not. The neck circumferences of male patients with MI were found to be significantly larger than those of female patients. No significant relationship was observed between the neck circumference and the finger ratios of both hands of AMI patients. There was no sex difference in MI patients between finger ratios of the both hands. There were no significant relationship between the MI patients and the control group when they compared their right and the left hand's finger ratios. The male patients who had the higher right finger ratios has larger neck circumference than those of lower ratio male patients. There was no significant difference between the average BMI of MI patients and those of normal controls, although there was a positive correlation between neck circumference and BMI. **Conclusion:** According to our results, it might be advisable to use neck circumference to determine the risk of AMI, however, finger ratios is not appropriate for this purpose.

Key Words: Neck, body mass index, myocardial infarction, anthropometry

ÖZET Amaç: İkinci ve dördüncü parmakların uzunluklarının oranı testosteron ile negatif yönde ilişkilidir ve prenatal testosteron düzeyleri miyokard infarktüsü (Mİ) ile ilişkilendirilmiştir. Boyun çevresi, koroner arter hastalığı riskinin artışı ile pozitif ilişkilidir. Bu çalışmanın amacı, boyun çevresi, işaret ve yüzük parmak uzunluklarının birbirlerine oranı ve akut miyokardiyal infarktüsü (AMİ) geçirme riski arasındaki ilişkinin tanımlanmasıdır. **Gereç ve Yöntemler:** Bu çalışma, 01.01.2006 ve 31.12.2007 tarihleri arasında Acil Servis'e AMİ tanısı almış ve aynı zaman diliminde başka nedenlerle başvurmuş olan hastalarda, geriye dönük olarak yapıldı. 23-77 yaşları arasındaki 142 erkek ve 66 kadın hastanın parmak oranları, boyun çevresi ve beden kitle indeksi (BKİ) hesaplandı. **Bulgular:** Bu çalışma, boyun çevresinin, AMİ geçiren hastalarda geçirmeyenlere göre anlamlı olarak daha geniş olduğunu gösterdi. AMİ geçirmiş erkek hastaların boyun çevresi, AMİ geçirmiş kadın hastalara göre daha geniş bulundu. AMİ'li hastalarda her iki elin parmak oranları ile boyun çevresi arasında anlamlı bir ilişki olmadığı görülmüştür. AMİ'li hastalarda sağ ve sol elin parmak oranları arasında, cinsiyet açısından fark olmadığı görülmüştür. AMİ geçirmiş hastalar ve kontrol grubu arasında sağ ve sol el parmak oranları karşılaştırıldığında, anlamlı bir ilişki yoktur. Sağ el parmak oranı yüksek olan erkek hastaların boyun çevreleri, düşük oranlılara göre daha geniş bulunmuştur. AMİ geçirmiş hastalar ve kontrol grubu arasında BKİ değerleri açısından anlamlı bir fark bulunmamıştır. Tüm hastalarda boyun çevresi ve BKİ arasında pozitif yönlü ilişki bulunmuştur. **Sonuç:** Bulgularımıza göre AMİ riskinin saptanmasında boyun çevresi ölçümü kullanılabilir, ancak parmak oranlarının kullanılması uygun değildir.

Anahtar Kelimeler: Boyun, beden kitle indeksi, miyokard infarktüsü, antropometri

The second to fourth digits ratio of the hand (the 2D:4D ratio) is negatively correlated with prenatal testosteron levels.[1-4] The 2D:4D ratio in men is lower than women.[1,5,6] This discrepancy appears as early as the 14th week of fetal life and remains stable throughout puberty.[5,7] The 2D:4D ratio has previously been identified as a predictor of MI and breast cancer.[4]

Prenatal testosteron has an organizing effect on the vascular system.[6] In the literature, some studies found that there was a negative correlation between the testosteron levels and AMI, while others demonstrated that male sex factor and obesity are among the risk factors that lead to AMI.[8,9]

Neck circumference (NC) is a simple and time-saving screening measure to identify obesity and it is positively correlated to increase the risk of coronary heart disease. Fink et al found that the positive correlation between NC and 2D:4D ratio in men.[10]

The studies which show that there is a relation between 2D:4D ratio and AMI are not many, though. The aim of the present study is to investigate the relationship between 2D:4D ratio, NC and the risk of AMI, in males and females.

MATERIAL AND METHODS

This study was conducted in the emergency unit of Dokuz Eylül University Faculty of Medicine from 01.01.2006 through 31.12.2007 with patients who were diagnosed with AMI (with ECG, laboratory and angiography) according to the 121-122 International Statistical Classification of Diseases (ICD) code. Ethical Approval was provided from the Ethic Comitte of Dokuz Eylül University Faculty of Medicine. The patients were contacted from February 2008 through May 2008 and informed about their participation in the study. The control group were chosen similarly by using randomization number table among those patients who came to the emergency unit of the same hospital between the same time period and were diagnosed with a disease other than AMI according to the ICD10. The AMI and control patients who volunteered to participate in the study were given appointments by phone calls. The patients who were far away from study place, those who refused to parti-

cipate, those who died during this period of time, those with finger deformities, those who were in the control group, but who suffered from AMI in the past were excluded from the study.

The participants gave their signed informed consent before the study. Demographic data and comorbid diseases of the patients were recorded and their height, weight, NC and the length of the index and ring fingers were measured while the patients were anatomic pozitions. The BMI's (based on World Health Organization data) were calculated based on their weight and height. The values 18.5 and below were evaluated as underweight, between 18.5-24.9 as normal, between 25.0-29.9 as overweight, and 30.0 and above as obese. The NC (cm) was measured with a plastic measuring tape within 1 mm on the level of laryngeal prominence. The lengths from the basal crease of the digit to the tip of the digit of the 2nd and 4th digits were measured by using a digital caliper (Mitutoyo) accurate to 0.01 mm, on the palmar surface. All measurements were taken by one person (F. Aksu). The digit ratio was calculated by dividing the length of the second digit by that of the fourth. The finger ratio 2D:4D <1 was considered low, and ≥1 as high. The analysis of the data collected in the study was done by using SPSS 11.0 software program. In the analysis of the categorical data chi-square was used, numeric data were analyzed with student t-test and Mann-Whitney U test, and correlations were analyzed with Pearson Correlation Analysis.

RESULTS

This study was conducted on 208 adults. Table 1 and Table 2 show all demographical data, the mean values and the statistical analyses of the NC, BMI and 2D:4D ratio of the right and the left hands.

THE RELATIONSHIP BETWEEN AMI AND 2D:4D RATIO

The relationship between AMI and 2D:4D ratio for both hands and statistical difference between AMI and control groups were shown in Table 3.

When 2D:4D ratios of the the right and left hands of the male and female patients with AMI

TABLE 1: Comparision of the means of the demographic features, NC, BMI and 2D:4D ratio between the control and AMI groups.

	Total (n= 208)	AMI (n= 110)	Control (n= 98)	p**
Age	56.81 ± 11.83 (range 23-77)	59.75 ± 9.93	53.51 ± 12.82	-
Male/female (n)	142/66	90/20	52/46	-
NC (cm)	36.95 ± 3.59	37.68 ± 3.68	36.12 ± 3.32	0.002
BMI	29.3	29.3	29.2	0.882
2D:4D ratio right hand	0.97 ± 3.84	0.96 ± 3.93	0.97 ± 3.72	0.164
2D:4D ratio left hand	0.97 ± 3.72	0.96 ± 3.35	0.97 ± 4.06	0.066

NC: Neck circumference, BMI: Body mass index, AMI: Acute myocardial infarction.
** Student t-test.

TABLE 2: The distrubitions of the 2D:4D ratios, NC and BMI according to gender on AMI patients.

	Male	Female	p***
NC (cm)	38.53 ± 3.05	33.87 ± 3.96	<0.001
BMI	29.3	29.2	0.882
2D:4D ratio right hand	0.96 ± 3.85	0.97 ± 4.34	0.476
2D:4D ratio left hand	0.96 ± 3.37	0.97 ± 3.27	0.475

NC: Neck circumference, BMI: Body mass index, AMI: Acute myocardial infarction.
*** Mann Whithney-U test.

TABLE 3: The relationship between AMI and 2D:4D ratio for both hands and statistical difference between AMI and control groups.

	AMI (n= 110)	Control (n= 98)	p*
(right hand)			
2D:4D ratio <1	90	69	
2D:4D ratio ≥ 1	20	29	0.071
(left hand)			
2D:4D ratio <1	81	63	
2D:4D ratio ≥ 1	29	35	0.176

AMI: Acute myocardial infarction.
* Chi-square.

were compared, no significant difference was found (Table 4).

The low levels of 2D:4D ratio of the both hands of the AMI patients and control group according to gender are shown in Table 5.

THE RELATIONSHIP BETWEEN AMI, NC AND BMI

The average of NC of AMI patients was found to be significantly larger than that of the control group. However, there was no significant relationship between the BMI averages of the AMI patients and the control group (Table 1).

The NC of the male AMI patients was found to be significantly larger then the NC of the women. There was no such difference in BMI's of males and females, though (Table 2).

A positive correlation was found between the NC and BMI. (Pearson correlation, R:1, p<0.001).

DISCUSSION

Coronary disease of artery, frequently seen after age 40, is four times more frequent in man than in women. The estrogen found in women is protective. This is why AMI in women is more frequently seen in menopause when this hormone decreases. A majority of our AMI patients were males above age 40.

A number of previous studies maintain that there is a correlation between the length of index finger and the levels of estrogen in women and the length of ring finger and the levels of testosterone in men.[5] Apart from that, a negative correlation between the levels of testosterone and AMI was found.[11] Some researchers, however, suggest that this is not certain and that more prospective studies are necessary.[12]

Previous study reported that there is a correlation between 2D:4D ratio of the fingers in the right hand and AMI.[13] Although there is a great body of evidence from previous studies that there is a relation between low 2D:4D ratio and male gender and the levels of serum testosterone, no significant correlation between AMI and 2D:4D ratio of the right or left hand fingers was observed in our study.

Vehmas et al studied radiographic 2D:4D index in females and found no relation between anthropometric, behavioral, nutritional, health-related, occupational or fertility variables. In their study, there was no relation between 2D:4D index

TABLE 4: Comparison of 2D:4D ratios of right and left hands in all participants and patients with AMI according to gender.

	Total (n= 208)			AMI (n= 110)		
	Female n (%)	Male n (%)	P*	Female n (%)	Male n (%)	P*
Right hand						
2D:4D ratio <1	47 (71%)	112 (79%)		16 (80%)	74 (82%)	
			0.226			0.758
2D:4D ratio ≥ 1	19 (29%)	30 (21%)		4 (20%)	16 (18%)	
Left hand						
2D:4D ratio <1	44 (67%)	100 (70%)		15 (75%)	66 (73%)	
			0.630			1.000
2D:4D ratio ≥ 1	22 (33%)	42 (30%)		5 (25%)	24 (27%)	

AMI: Acute myocardial infarction.

* Fisher's exact test.

and presence of cardiovascular disease as observed in our study.[14]

NC is an indication of body fat. As has been made clear in the previous studies, NC is a simple way to diagnose obese and overweight patients. Adıgüzel et al found that positive correlation between BMI and NC in men and in women in their study.[15]

Depending on the sex steroid hormones in men and women, body fat ratios are distributed variably and their effects on cardiovascular and metabolic diseases are well-known.[10] Ben-Noun et al found a significant association betweeen NC and BMI in their study and emphasized that NC correlated positively with the factors of metabolic syndrome and increased risk of coronary heart disease.[16,17] It was found in the previous study that NC below 37 cm in men and NC below 34 cm in women correlated with the low level BMI.[16] Similarly, BMI and NC significantly correlated in our study. Also, the results of our study were consistent with the previous study in that the NC values in men and women with AMI were higher than the values mentioned above.

Fink et al found that the positive correlation between NC and 2D:4D ratio in men (n= 127) but did not in women (n= 117). In their opinion, this could lead to a predisposition to coronary artery disease in men and this may be due to the sexual dimorphic pattern of body fat distribution in men

TABLE 5: The low levels of 2D:4D ratio of the both hands of the AMI patients and control group according to gender.

	2D:4D ratio	AMI	Control	p*
Male	Right hand <1	74 (%82)	38 (%73)	0.208
	Left hand <1	66 (%73)	38 (%73)	0.383
Female	Right hand <1	16 (%80)	31 (%67)	0.383
	Left hand <1	15 (%75)	29 (%63)	0.405

AMI: Acute myocardial infarction.

* Fisher's exact test.

and women, which is known to be closely linked to sex-steroid hormones, and thus causes cardiovascular diseases.[10] We also found a positive association between low 2D:4D ratios in both of hands and AMI in both sex, but this was not statistically significant. Therefore, we could not corroborate the results of Fink et al.[10] We only found a significant correlation between NC and AMI. The large NC values of men can account for the male dominance in AMI in our study (p< 0.001). When male and female AMI patients were compared, mean values of NC were found to be higher in men. However, it is more plausible to say that the high values of NC are directly linked to the AMI, but not to the sex differences since mean values of NC in the whole population are significantly high in men.

The intrauterine hormonal environment is associated with the aetiology of a number of adult–onset diseases such as AMI. A previous study demonstrated that high 2D:4D ratios may be asso-

ciated with the prognosis after MI and premature MI. The authors emphasized that the determination of 2D:4D ratios at birth may help early diagnosis of MI and its prognosis as well as raising awareness in life standards of MI patients.[6] Unlike this view, we hold that there is no relation between 2D:4D ratio diagnosed in adulthood and AMI.

CONCLUSION

According to our study, there is no significant correlation between 2D:4D ratio and AMI. We maintain that there is a significant positive correlation between NC and AMI and that it is not advisable to use finger ratios in determining the risk of AMI.

DISCLOSURES

Since our study is a retrospective one, the measurements of the patients were not performed concurrently with AMI. The testosterone levels of the patients were not detected. We believe further research will shed light on this issue.

FIGURE 1: The news in the press on this issue.

FIGURE 2: Basında çıkan haberlerThe news in the press on this issue.

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