

# Acute effects of smoking on right ventricular function<sup>1</sup>

## A tissue Doppler imaging study on healthy subjects

T. Fikret Ilgenli, Onur Akpınar

Cardiologist, Gölcük Naval Hospital, Department of Cardiology, Gölcük, Kocaeli, Turkey

### Summary

**Background:** Smoking is a risk factor for cardiovascular mortality and morbidity. Besides chronic effects, it has unfavourable effects in the acute period. Although there are plenty of data regarding its effect on left ventricle functions, the effect of cigarette smoking on right ventricular function in the acute period is unknown. The objective of this study was to investigate the effect of cigarette smoking on the right ventricular function.

**Methods:** Twenty healthy young male were evaluated by echocardiography before and after smoking one cigarette. Heart rate, blood pressure, mitral and tricuspid inflow parameters as well as annulus velocity parameters were obtained. Pulmonary artery acceleration time was measured as a surrogate marker for pulmonary artery pressure. Results at baseline and at minutes 5, 15, 30, 60; consecutively after smoking were compared.

**Results:** There was not any significant change at left ventricular diastolic function with pulsed

wave Doppler echocardiography, however right ventricular diastolic function was significantly impaired. Both right and left ventricle diastolic functions were impaired significantly with tissue Doppler echocardiography though there was no change at systolic functions. Pulmonary artery pressure increased significantly concomitant with impairment of right ventricular diastolic dysfunction. All the changes seen after smoking a cigarette almost returned to baseline levels after 30 minutes.

**Conclusions:** Cigarette smoking does not change right ventricular systolic function however impairs right ventricular diastolic function in the acute period. Its effect on diastolic function may be related to increased afterload due to increase in pulmonary artery pressure.

**Key words:** smoking; right ventricular function; tissue Doppler echocardiography

### Introduction

One billion people worldwide are still addicted to cigarettes. Every year, 3 million die from smoking related causes [1]. Smoking is a major risk factor for cardiovascular mortality and morbidity [2]. In addition to the harmful effects of chronic use, there are also harmful effects in the acute period. It has been shown to impair left ventricular diastolic function, to cause temporary rises in blood pressure and heart rate, to impair microvascular function and aortic elastic properties and to alter cerebral blood flow [3–8]. The effect of cigarette smoking on right ventricular function in the acute period is unknown.

The analysis of right ventricular functions is rather difficult due to the complex three-dimensional structure involved [9]. With the development of tissue Doppler imaging (TDI) the quantitative analysis of wall movement rates has become possible [10]. This technique is used in the analysis of right ventricular diastolic function [11, 12].

The objective of this study was to investigate the effect of cigarette smoking on the right ventricle systolic and diastolic function.

<sup>1</sup> This study has been presented in part as a poster presentation at World Congress of Cardiology which was held at 2–6 September 2006 Barcelona-Spain.

## Methods

### Patients

Twenty healthy, young volunteer male with normal echocardiography and ECG with a mean age of 21 (2) years, who had smoked cigarettes for 8 (4) years on average, were included in the study at August and September of 2005. Our patients were privately admitted and being treated in various departments of our hospital. Informed consent was obtained from all subjects. All subjects were patients who were waiting for elective surgery and had normal biochemical blood tests. The local ethical committee approved the study. The following patients were excluded: 1) those with hypertension that might affect heart functions, or who had suffered from pericarditis, 2) long-term ethanol consumers, 3) those with left branch block etc. ECG variations, 4) those with valve disease, and 5) those with diastolic function impairment at first echocardiographic examination. Patients in the study group were given 1 cigarette (the same cigarette each, containing 8 mg of tar, 0.6 mg of nicotine) after baseline measurements had been taken. Patients smoked this cigarette in a sitting position in an average of 5 minutes in a room set aside for this study. Measurements began 5 minutes after smoking. All measurements were performed by the same researcher in order to eliminate interobserver variation.

### Echocardiographic examinations

Echocardiographic examinations were performed by using ultrasonography equipment (Toshiba SSA 370 A, Powersonic 6000, Japan) with 2.5 Megahertz transducer. We recorded 4 to 7 cardiac cycle echocardiograms from all subjects. All echocardiographic measurements represent the average values of these cardiac cycle recordings.

Echocardiographic images were obtained from parasternal long axis, 4 and 2-apical chamber views with the patient supine in lateral decubitus position. M-Mode measurements were performed according to the criteria of the Society of American Echocardiography [13]. Left and

right atrial diameters, ventricular end-diastolic and end-systolic diameters, volumes, thickness of the interventricular septum and posterior wall were measured. Left and right ventricular ejection fraction (LVEF, RVEF) was estimated by the method of Simpson. Left ventricular diastolic functions were determined; early (E, cm/s) and late (A, cm/s) peak velocity and their ratio, deceleration time of E wave (DT, ms) and isovolumetric relaxation time (IVRT, ms) were evaluated by using pulse wave (PW) Doppler. Right ventricular E and A velocities, their ratio and DT were measured. Pulmonary artery velocities, acceleration and ejection time were recorded and acceleration time was divided by ejection time. Mean pulmonary artery pressure (PAP) was estimated by the formula (mean pulmonary artery pressure =  $79 - 0.45 \text{ ACT}$ , mm Hg) [14].

All patients were evaluated by tissue Doppler echocardiography. We have set the filters to exclude high-frequency signals. Gain controls were minimised to obtain a clear tissue signal with minimal background noise. Peak velocities during systole ( $S_m$ , cm/s), early diastole ( $E_m$ , cm/s) and late diastole ( $A_m$ , cm/s) were taken from the apical four-chamber view with lateral side of the mitral and tricuspid annulus. The mean  $S_m$ ,  $E_m$  and  $A_m$  wave velocities and  $e/a$  ratios of the consecutive 4 cardiac cycles of each subject were calculated.

### Statistical analysis

The SPSS for Windows 11.0 program (SPSS Inc, Chicago, Illinois) was used for statistical analysis. Data are expressed as mean values (standard deviation). Data obtained at minutes 5, 15, 30 and 60, were compared with baseline values. A p value of 0.05 or less was considered statistically significant. Means and confidence intervals (95%) for each measurement at minutes 0, 5, 15, 30 and 60 were calculated. Means were shown with a red line and confidence intervals as red points at figures.

## Results

Baseline clinical characteristics of study group are shown table 1. Our study group consisted of young subjects with a mean age of 21 (2) years. Duration of smoking was 8 (4) years and mean number of cigarettes smoked per day was 19 (5). Baseline M-mode and two dimensional echocardiographic data are shown in table 2. Left ventricle (LV) and right ventricle (RV) ejection fractions

were within normal limits. Heart rates and blood pressures were increased immediately and returned to baseline values at minute 30. All the changes seen after smoking a cigarette almost returned to baseline levels after 30 minutes.

### Pulsed wave and tissue Doppler results

Table 3 shows all data obtained throughout the study. Although there was a tendency towards abnormal relaxation there was no significant change at LV E/A ratio at baseline and follow-up. Left and right ventricular DT and LV E/A ratios and LV IVRT were similar throughout the study. Only RV E/A ratio decreased significantly at minutes 5 and 15.

There was no change at LV and RV  $S_m$  wave which shows systolic function of ventricles (fig. 1). However, both right and left ventricle  $E_m/A_m$  ratios were decreased significantly (fig. 2). Although our group consisted of young subjects, the RV  $E_m/A_m$  ratio decreased below one in half of these subjects at the 5 minute measurement. Although

**Table 1**  
Baseline characteristics of study group (n = 20).

Parameters	Mean (SD)
Age (years)	21 (2)
Sex (Male/female)	20 / 0
Systolic Blood Pressure (mm Hg)	112 (11)
Diastolic Blood Pressure (mm Hg)	73 (9)
Heart rate (beats/min)	76 (8)
Duration of smoking (years)	8 (4)
Number of cigarettes smoked per day	19 (5)
Height (cm)	170 (18)
Weight (kg)	68 (8)
Body Surface Area (m <sup>2</sup> )	1.8 (0.2)

**Table 2**  
Baseline echocardiographic data.

Parameters	Mean (SD)
Interventricular septum (mm)	8.1 (0.7)
Posterior wall (mm)	7.7 (0.6)
Left atrium (mm)	32 (3)
Left ventricular diastolic diameter (mm)	44 (3)
Left ventricular end-diastolic volume (mL)	81 (19)
Left ventricular end-systolic volume (mL)	26 (6)
Left ventricle ejection fraction (%)	67 (5)
Right atrium (mm)	28 (2)
Right ventricular diastolic diameter (mm)	32 (4)
Right ventricular end-diastolic volume (mL)	29 (8)
Right ventricular end-systolic volume (mL)	10 (3)
Right ventricle ejection fraction (%)	68 (4)

LV  $E_m/A_m$  ratio decreased at all patients, it did not decrease below one. Left ventricular  $E/E_m$  ratio did not change significantly, whereas RV  $E/E_m$  increased significantly (fig. 3).

Pulmonary artery pressures were increased immediately and returned to baseline values at minute 30. They were increased significantly concomitant with impairment of RV diastolic function (fig. 4). The correlation between pulmonary artery pressure with right ventricular PW Doppler E/A and right ventricular tissue Doppler  $E_m/A_m$  respectively shown at figure 5. One of our patient's tissue Doppler echocardiographic changes from baseline to 60 minutes of cigarette smoking is shown in figure 6.

## Discussion

Cigarette smoking has been shown to impair left ventricular diastolic function in the acute period [3-5]. However the effect of cigarette smoking on right ventricular function in the acute period is unknown. Our study revealed that cigarette smoking impairs acutely right ventricular diastolic

function. Right ventricular diastolic function is impaired beginning from minute 5 and returns to normal at minute 30. Examination of the data obtained suggests that this impairment may be related to a sudden rise in pulmonary artery pressure; in other words to afterload increase.

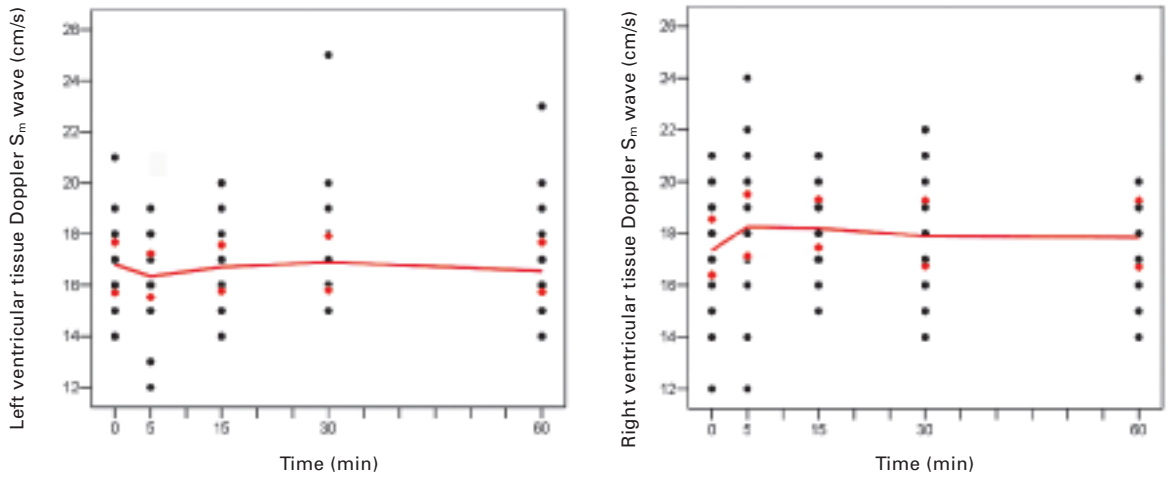
**Table 3**  
Echocardiographic data obtained throughout study. Results were given as mean (SD).

Parameters	Baseline	5	15	30	60
SBP (mm Hg)	112 (11)	124 (10)	118 (10)	114 (8)	111(8)
DBP (mm Hg)	73 (9)	79 (7)	75 (8)	72 (8)	70 (7)
HR (beats/min)	76 (8)	85 (9)	83 (9)	78 (8)	74 (6)
LV E (cm/s)	92 (14)	88 (12)	87 (11)	89 (13)	91 (13)
LV A (cm/s)	52 (7)	54 (9)	49 (7)	50 (8)	49 (8)
LV E/A	1.8 (0.2)	1.7 (0.3)	1.8 (0.3)	1.8 (0.3)	1.9 (0.3)
LV DT (ms)	110 (18)	108 (21)	104 (16)	105 (15)	116 (18)
LV IVRT (ms)	76 (7)	74 (6)	76 (7)	74 (5)	75 (6)
RV E (cm/s)	53 (10)	48 (9)	48 (10)	47 (8)	51 (9)
RV A (cm/s)	30 (7)	34 (9)	31 (6)	29 (6)	32 (6)
RV E/A	1.8 (0.3)	1.5 (0.2)	1.6 (0.2)	1.6 (0.2)	1.6 (0.2)
RV DT (ms)	118 (17)	119 (18)	117 (15)	112 (16)	117 (30)
LV $S_m$ (cm/s)	17 (2)	16 (2)	17 (2)	17 (2)	17 (2)
LV $E_m$ (cm/s)	25 (3)	24 (3)	24 (3)	25 (3)	24 (2)
LV $A_m$ (cm/s)	12 (1)	14 (2)	13 (3)	12 (2)	12 (1)
LV $E_m/A_m$	2.2 (0.3)	1.8 (0.3)	1.9 (0.3)	2.1 (0.3)	2.1 (0.3)
LV $E/E_m$	3.7 (0.5)	3.7 (0.5)	3.7 (0.5)	3.6 (0.5)	3.8 (0.5)
RV $S_m$ (cm/s)	17 (2)	18 (3)	18 (2)	18 (2)	18 (2)
RV $E_m$ (cm/s)	20 (3)	17 (3)	19 (3)	19 (3)	20 (3)
RV $A_m$ (cm/s)	15 (3)	18 (3)	17 (2)	14 (2)	14 (2)
RV $E_m/A_m$	1.4 (0.3)	1.0 (0.2)	1.2 (0.3)	1.4 (0.3)	1.4 (0.3)
RV $E/E_m$	2.6 (0.4)	3.0 (0.8)	2.6 (0.6)	2.5 (0.5)	2.6 (0.5)
PV AT/ET	0.5 (0.0)	0.4 (0.0)	0.4 (0.0)	0.4 (0.0)	0.4 (0.0)
PAP	21(5)	30 (5)	27 (5)	22 (6)	22 (5)

LV = Left ventricular; RV = right ventricular; E = peak transmitral filling velocity during early diastole; A = peak transmitral atrial filling velocity during late diastole; DT = deceleration time; IVRT = isovolumic relaxation time;  $E_m$  = peak myocardial early diastolic wave velocity;  $A_m$  = peak myocardial late diastolic wave velocity;  $S_m$  = peak myocardial systolic wave velocity, SBP; Systolic blood pressure, DBP; Diastolic blood pressure, HR; Heart rate, PAP; Pulmonary artery pressure, PV AT/ET = Pulmonary artery acceleration time / ejection time.

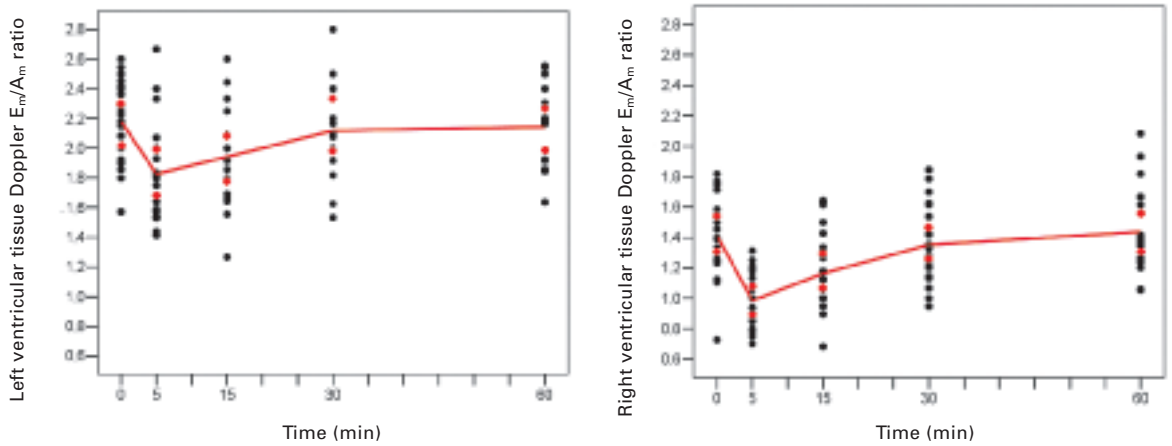
**Figure 1**

Changes of left and right ventricular  $S_m$  wave with time.



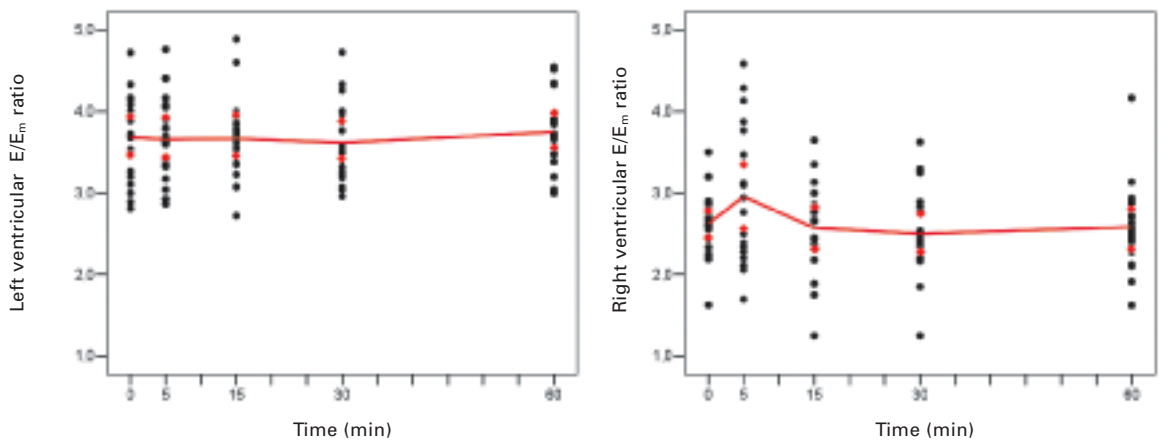
**Figure 2**

Changes of left and right ventricular  $E_m/A_m$  ratios with time.



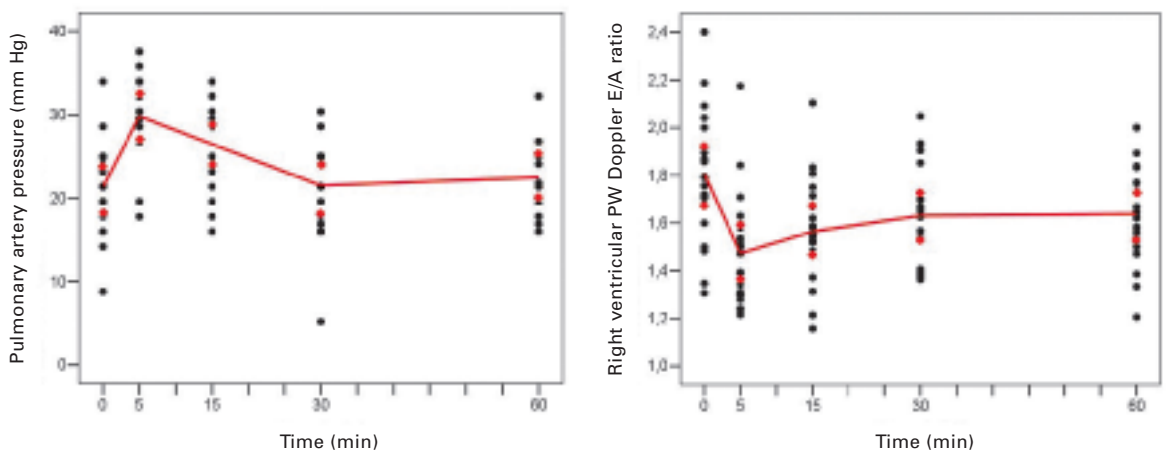
**Figure 3**

Changes of left and right ventricular  $E/E_m$  ratios with time.



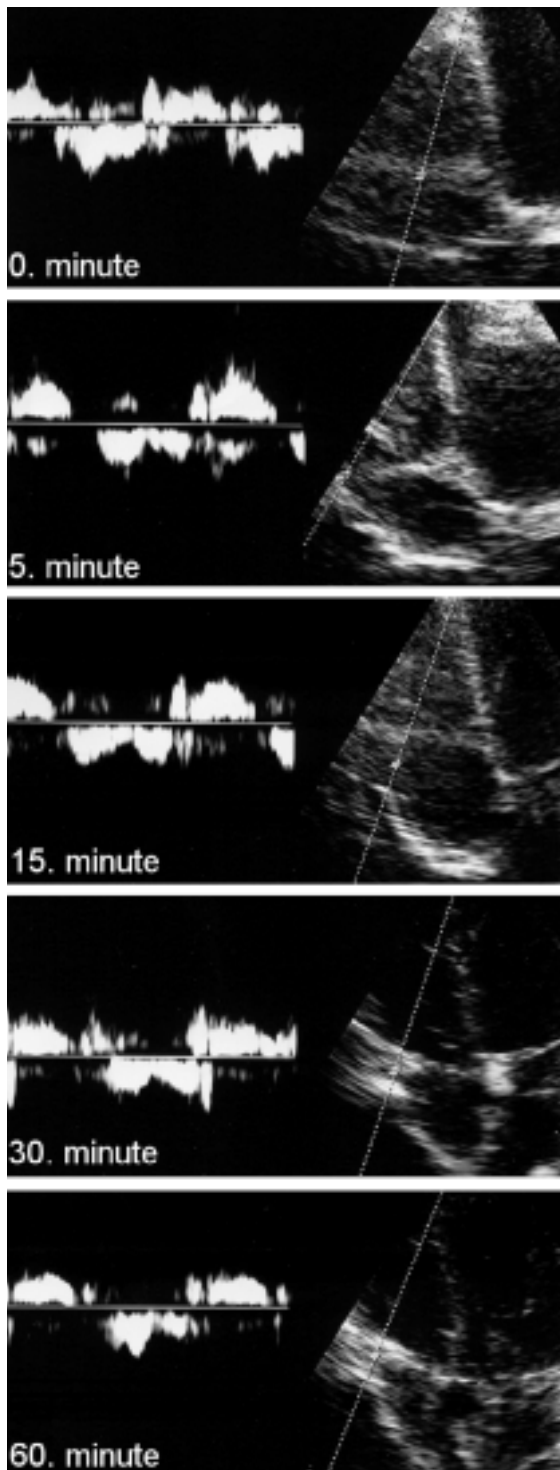
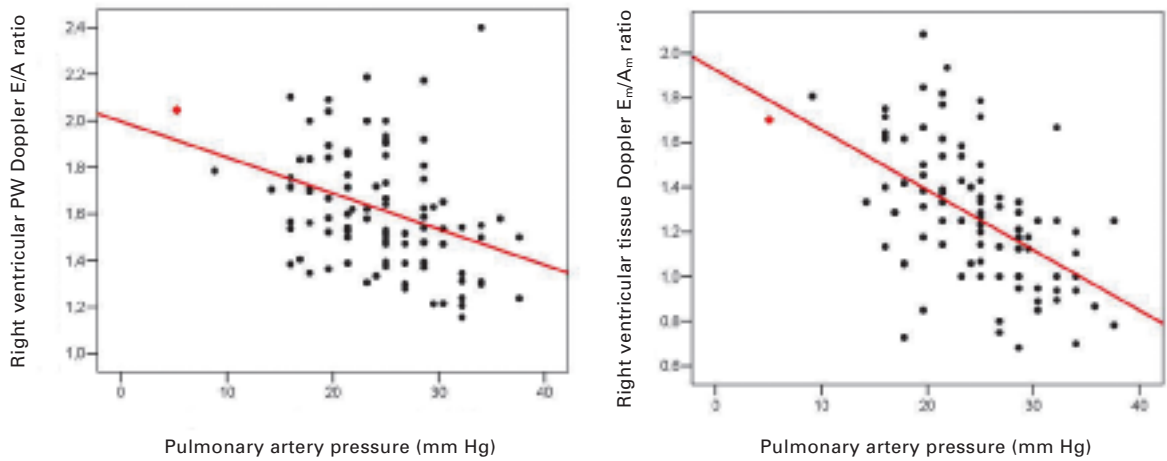
**Figure 4**

Changes of pulmonary artery pressure and right ventricular pulsed wave Doppler E/A ratio with time.



**Figure 5**

Correlation between pulmonary artery pressure with right ventricular PW Doppler E/A and right ventricular tissue Doppler  $E_m/A_m$ . The point marked in red is unusual. The correlation between pulmonary artery pressure and right ventricular PW Doppler E/A is 0.30 and 0.28 with and without this point respectively. The correlation between pulmonary artery pressure and right ventricular tissue Doppler  $E_m/A_m$  is 0.14 and 0.12 with and without this point respectively.



**Figure 6**

One of our patient's tissue Doppler echocardiographic changes from baseline to 60 minutes of cigarette smoking.

**The relationship between cigarettes and pulmonary artery pressure**

Acute changes in RV afterload can be achieved by many interventions and manoeuvres, such as leg rising, sitting down, running, isometric exercise, etc. Right ventricular function is continuously modulated by changes in heart rate, pre- and afterload, contractility and intrapleural pressure changes. These are normal variations in the determinants of RV diastolic function. Cigarette smoking has been shown to have acute physiological effects [15]. It increases tracheal pressure, PAP, systemic blood pressure and left atrium pressure. It has been shown that serum angiotensin converting enzyme activity increases immediately after cigarette smoking and returns to the control value after 20 minutes [15]. The pathogenesis of cigarette related pulmonary hypertension was investigated in an animal model by Wright JL et al. [16, 17]. Pulmonary vascular structure responds very quickly to cigarettes. It enhances acutely gene expression of vasoactive mediators endothelin, vascular endothelial growth factor (VEGF) and VEGF flk-1 receptor in the pulmonary artery and intraparenchymal vessels. The rise in pulmonary blood pressure in cigarette smokers may be related to the direct effect of cigarette smoke on the pulmonary vascular bed [17]. In our group after smoking a cigarette PAP increased immediately and returned to baseline levels at minute 30. We have found that there was a strong correlation between PAP and RV PWE/A and RV tissue Doppler  $E_m/A_m$  respectively. It has been shown that acute pulmonary hypertension impairs right ventricular contractile function and that when pulmonary constriction is normalised right ventricular systolic and diastolic function return to normal [18]. In a recent study by using TDI, the effect of pulmonary hypertension on right ventricular diastolic function in rats was also investigated [11].

**Effect of smoking on ventricle function**

Pulsed wave tissue Doppler imaging is a method that allows the analysis of preload-independent left ventricular diastolic and systolic functions. It has been demonstrated that TDI provides



additional information, detecting even minor diastolic changes in different diseases [19, 20]. Effect of smoking on LV function was studied before. Kim et al. studied immediate effects of smoking on LV diastolic function between healthy volunteers and type 2 diabetic patients [5]. Our findings regarding left ventricular function are compatible with previous studies [3–5]. This can be ascribed to heart rate and blood pressure variations. It has been suggested that an increase in plasma free fatty acids may play a role [5, 21]. Our study showed that in the same way that cigarettes impair left ventricular diastolic function, more profoundly it acutely impairs right ventricular diastolic function.

### Study limitations

The small sample size may be regarded as a limitation. In addition, our study group consisted of young males and it is possible that acute changes at RV diastolic function due to smoking could be more severe in those who are older and have high blood pressure. Furthermore, measurement of PAP via right heart catheterisation may be suggested for a better estimation of PAP. However since it is an invasive procedure, it is impractical to use for research purposes such as our study. Non-

invasive measurement of PAP is a feasible method and used at echocardiography laboratories in daily practice. One of the methods is estimation from acceleration time from pulmonary flow analysis. This method was affected from heart rate, but a good correlation between corrected acceleration time and either systolic or mean pulmonary artery pressure was reported [22].

### Conclusions

Cigarette smoking does not change right ventricular systolic function. However it impairs right ventricular diastolic function in the acute period. Its effect on diastolic function may be related to increased afterload due to an increase in pulmonary artery pressure.

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#### Correspondence:

T. Fikret Ilgenli

Gölcük Deniz Hastanesi

Kardiyoloji Kliniği

TR-41650 Gölcük-Kocaeli

Turkey

E-Mail: fikretilgenli@yahoo.com

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### References

- 1 Fowler GH. Tobacco and cardiovascular disease: achieving smoking cessation. In Yusuf S, Caimis AJ, Fallen EL, Gersch BJ (Eds). Evidence-Based Cardiology. Second Edition. BMJ Books. 2003;114–20.
- 2 Rosengren A, Wallentin L, Simoons M, Gitt AK, Behar S, Battler A, et al. Cardiovascular risk factors and clinical presentation in acute coronary syndromes. *Heart*. 2005;91:1141–7.
- 3 Alam M, Samad BA, Wardell J, Andersson E, Högglund C, Norlander R. Acute effects of smoking on diastolic function in healthy participants: studies by conventional Doppler echocardiography and Doppler tissue imaging. *J Am Soc Echocardiogr*. 2002; 15:1232–7.
- 4 Stork T, Danne O, Müller R, Mockel M, Hochrein H. Effect of smoking on relaxation and filling behavior of the left ventricle in healthy probands. An echocardiography study *Med Klein. (Munich)* 1991;15;86:173–9.
- 5 Kim HK, Bae JW, Chung JW, Cho YM, Kim YJ, Sohn DW, et al. Differences in immediate effects of smoking on left ventricular diastolic function between healthy volunteers and patients with Type 2 Diabetes Mellitus. *J Am Soc Echocardiogr*. 2005; 18:320–5.
- 6 Ijzerman RG, Serne EH, van Weissenbruch MM, de Jongh RT, Stehouwer CD. Cigarette smoking is associated with an acute impairment of microvascular function in humans. *Clin Sci. (Colch)* 2003;104:247–52.
- 7 Stefanadis C, Tsiamis E, Vlachopoulos C, Stratos C, Toutouzias K, Pitsavos C, et al. Unfavorable effect of smoking on the elastic properties of the human aorta. *Circulation*. 1997;95:31–8.
- 8 Yamamoto Y, Nishiyama Y, Monden T, Satoh K, Ohkawa M. A study of the acute effect of smoking on cerebral blood flow using 99mTc-ECD SPET. *Eur J Nucl Med Mol Imaging*. 2003;30: 612–4.
- 9 DeI'Alita L. The right ventricle: Anatomy, physiology, and clinical importance. *Curr Probl Cardiol*. 1987;10:653–720.
- 10 Yu WC, Lee WS, Huang WP, Wu CC, Lin YP, Chen CH. Evaluation of cardiac function by tissue Doppler echocardiography: hemodynamic determinants and clinical application. *Ultrasound Med Biol*. 2005;31:23–30.
- 11 Boissiere J, Gautier M, Machet MC, Hanton G, Bonnet P, Eder V. Interest of Doppler Tissue Imaging for modification of pulmonary hypertension-induced right ventricle dysfunction. *Am J Physiol Heart Circ Physiol*. 2005 Jul 29.
- 12 Arinc H, Gunduz H, Tamer A, Ozhan H, Akdemir R, Saglam H, et al. Use of tissue Doppler to assess right ventricle function in hemodialysis patients. *Am J Nephrol*. 2005;25:256–61.
- 13 Gardin JM, Adams DB, Douglas PS, Feigenbaum H, Forst DH, Fraser AG, et al. American Society of Echocardiography. Recommendations for a standardized report for adult transthoracic echocardiography: a report from the American Society of Echocardiography's Nomenclature and Standards Committee and Task Force for a Standardized Echocardiography Report. *J Am Soc Echocardiogr*. 2002;15:275–90.
- 14 Kitabatake A, Inoue M, Asao M, Masuyama T, Tanouchi J, Morita T, et al. Noninvasive evaluation of pulmonary hypertension by a pulsed Doppler technique. *Circulation*. 1983;68: 302–9.
- 15 Kitamura S. Effects of cigarette smoking on metabolic events in the lung. *Environ Health Perspect* 1987;72:283–96.
- 16 Wright JL, Tai H, Dai J, Churg A. Cigarette smoke induces rapid changes in gene expression in pulmonary arteries. *Lab Invest*. 2002;82:1391–8.
- 17 Wright JL, Tai H, Churg A. Cigarette smoke induces persisting increases of vasoactive mediators in pulmonary arteries. *Am J Respir Cell Mol Biol*. 2004;31:501–9.
- 18 Greyson C, Xu Y, Cohen J, Schwartz GG. Right ventricular dysfunction persists following brief right ventricular pressure overload. *Cardiovasc Res*. 1997;34:281–8.
- 19 Nagueh SF, Middleton KJ, Kopelen HA, Zoghbi WA, Quinones MA. Doppler tissue imaging: a noninvasive technique for evaluation of left ventricular relaxation and estimation of filling pressures. *J Am Coll Cardiol*. 1997;30:1527–3.
- 20 Yalcin F, Kaftan A, Muderrisoglu H, Korkmaz ME, Flachskampf F, Garcia M, et al. Doppler tissue velocity during early left ventricular filling preload independent? *Heart*. 2002;87:336–9.
- 21 Mjos OD. Lipid effects of smoking. *Am Heart J*. 1988;115: 272–5.
- 22 Chan KL, Currie PJ, Seward JB, Hagler DJ, Mair DD, Tajik AJ. Comparison of three Doppler ultrasound methods in the prediction of pulmonary artery pressure. *J Am Coll Cardiol*. 1987;9: 549–4.

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