Clinical and echocardiographic follow-up in pregnant patients with valvular heart disease

Kalp kapak hastalığı olan gebelerin klinik ve ekokardiyografik takibi

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ABSTRACT

Objectives: Pregnancy associated cardiovascular changes may result in a significant hemodynamic burden and can lead to morbidity and even mortality in women with cardiac disease. The present study aimed to evaluate clinical and echocardiographic follow-up in pregnant patients with valvular heart disease (VHD).

Study design: The medical records of pregnant patients diagnosed with VHD from January 2004 to January 2011 were screened. Demographic characteristics including history of cardiac intervention performed during pregnancy, pulmonary edema, and maternal and fetal mortality, and cesarean section (C/S) history were collected from the hospital database and clinical records of the cardiology and obstetrics departments. The echocardiographic examination was carried out at presentation, 3rd trimester, and 1 month after delivery. The outcomes evaluated were cardiac intervention, pulmonary edema, and both fetal and maternal mortality during pregnancy and C/S.

Results: We evaluated the outcomes of 884 pregnant patients with VHD. Adverse clinical outcomes including death, pulmonary edema, and valvular interventions were frequent among patients with severe VHD, whereas no adverse clinical outcome was observed in patients with mild-moderate VHD (n=49, 5.5% *vs.* n=0, 0%, p<0.001). In patients with severe VHD, clinical outcomes were frequent among patients with valve stenosis, but lower among patients with regurgitation [death 4 (0.45%) *vs.* 0 (0%); pulmonary edema (15 (1.7%) *vs.* 13 (1.5%); valvular intervention 11 (1.2%) *vs.* 6 (0.7%); respectively).

Conclusion: Valvular heart disease is associated with fetal/maternal morbidity and mortality. Pregnant with severe VHD constitute a high-risk group in which life-threatening complications are likely to occur in the course of pregnancy.

ÖZET

Amaç: Gebelikle ilişkili kardiyovasküler değişiklikler kalp hastalığı olan kadınlarda belirgin hemodinamik yüke neden olarak ölüm ve sakatlığa yol açabilir. Bu çalışmanın amacı kalp kapak hastalığı (KKH) bulunan gebeleri klinik ve ekokardiyografik olarak takip etmektir.

Çalışma planı: Ocak 2004 ile Ocak 2011 tarihleri arasında kurumumuzda tedavi gören gebelerden KKH olanların tıpsal kayıtları geriye dönük olarak tarandı. Demografik özellikler, gebelik sırasında geçirilen kardiyak girişim hikâyesi, akciğer ödemi, anne veya çocuğa ait ölüm bilgileri, hastane bilgi işlem, kardiyoloji ve doğum kliniklerinin kayıtlarından toplandı. Ekokardiyografik inceleme başvuru anında, üçüncü trimesterde ve doğumdan bir ay sonra yapıldı. Çalışmamızda, gebelik sırasında anne veya bebek ölümü, akciğer ödemi, kardiyak girişim ve sezeryan sonlanım noktası olarak alındı.

Bulgular: Kapak hastalığı olan 884 gebe değerlendirildi. Ölüm, akciğer ödemi, kalp kapağına yönelik girişim gibi kötü klinik sonuçlar ciddi KKH olan gurupta daha sık görüldü. Hafif- orta KKH olan gurupta bu kötü klinik sonuçlar ile karşılaşılmadı (sırasıyla, n=49, %5.5 ve n=0, %0, p<0.001). Ciddi KKH olan gebelerde ölüm, akciğer ödemi ve kalp kapağına yönelik girişim gibi klinik sonuçlar kapak darlığı olanlarda kapak yetersizliği olanlara göre daha sık görüldü [sırasıyla, ölüm 4 (%0.45) ve 0 (%0); akciğer ödemi 15 (%1.7) ve 13 (%1.5); kalp kapağına yönelik girişim 11 (%1.2) ve 6 (%0.7)].

Sonuç: Kalp kapak hastalığı anne ve çocuk için ölüm ve sakat kalma ile ilişkilidir. Ciddi KKH olan gebelerin, gebelik süresince hayatı tehdit eden komplikasyonlarla karşılaşma ihtimali yüksektir.

Received: June 08, 2011 *Accepted:* September 12, 2012

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Cardiac disease in pregnancy is a major problem worldwide, especially in developing countries.[1-3] Pregnancy-associated cardiovascular changes may result in a significant hemodynamic burden and can lead to morbidity and even mortality in women with cardiac disease.[4,5] Despite the lack of clinical symptoms before pregnancy, patients with acquired heart disease, especially mitral and aortic valve stenosis, have a high risk of developing pulmonary edema, whereas asymptomatic patients with valvular insufficiency tend to tolerate volumetric overload during pregnancy.[6]

The present study aimed to evaluate the conditions related to pregnancy and labor in patients with valvular heart disease (VHD) who were hospitalized or followed by the department of cardiology or obstetrics and gynecology. In the present study, the evaluated outcomes were cardiac intervention, pulmonary edema, fetal and maternal mortality during pregnancy, and cesarean section (C/S).

PATIENTS AND METHODS

This study was approved by the Ethic Committee in accordance with the Declaration of Helsinki. The medical records of pregnant patients diagnosed with VHD from January 2004 to January 2011 were screened. Demographic characteristics and data on clinical management, history of surgery performed during pregnancy, and maternal and fetal outcomes were collected from the hospital database and clinical records of the cardiology and obstetrics departments. Disability of each patient was graded according to the New York Heart Association (NYHA) classification.[7] The echocardiographic examination was carried out at rest, in the left lateral decubitus position, using a commercially available echocardiographic device (Vivid 3, General Electric, and Milwaukee, USA) with a 3.0 MHz transducer. Postpartum assessment was done 1 month after delivery.

All patients were managed by an experienced cardiologist and obstetrician. If the antenatal period was uneventful, the mode and timing of delivery was decided together with the obstetrician at approximately 36 weeks of gestation. Vaginal delivery with epidural analgesia for pain relief was the principle mode of delivery. C/S was performed in cases of contraindication for vaginal delivery or maternal indication.

Statistical analyses

All statistical analyses were conducted using SPSS system version 10.0 (SPSS, Inc., Chicago, IL, USA). According to Kolmogorov-Smirnov test, the distribution of variables was normal. Descriptive statistics were presented as means ± standard deviation or by frequency percentages. Differences in mean values during pregnancy and after delivery were assessed using the Student's paired t-test. A two-tailed p value <0.05 was considered significant.

Abbreviations:

C/S	*Cesarean section*
MS	*Mitral stenosis*
MVA	*Mitral valve area*
MVR	*Mitral valve replacement*
NYHA	*New York Heart Association*
PMBV	*Percutaneous mitral balloon valvuloplasty*
SPAP	*Systolic pulmonary artery pressure*
VHD	*Valvular heart disease*

RESULTS

We evaluated the outcomes of 884 pregnant patients with VHD. The mean age at the time of pregnancy was a 27±8.4 year. Characteristics of the cases are summarized in Table 1. Distribution of VHD is seen in Table 2. Mitral Regurgitation was most the frequent form of VHD in the study group.

Mitral stenosis

There were 36 (4%) patients diagnosed with severe mitral stenosis (MS). Percutaneous mitral balloon valvuloplasty (PMBV) was performed in 6 patients and mitral valve replacement (MVR) in 5 patients during the 2nd TR (4 metallic, one bioprothesis). In these patients, mean mitral valve area (MVA) was <0.9 cm^2, mean systolic pulmonary artery pressure (SPAP) was 58 mmHg, and the NYHA functional class was III-IV. Wilkinson Scores were 7-8 among patients undergoing PMBV and 12-13 in the replacement group. Three patients and their babies died; of these, two had undergone PMBV (one patient having atrial fibrillation died of a cerebral embolic event 6 hours after PMBV and the other died of pulmonary edema and hypoxia) and one MVR (died of acute respiratory distress syndrome).

Episodes of pulmonary edema were observed in 11 patients in the 2nd and 3rd TR. Pulmonary edema was seen in patients with mean MVA <0.9 cm^2, SPAP >55 mmHg, and maximum mitral valve gradient >20 mmHg. Eight patients had atrial fibrillation.

All patients with severe MS were hospitalized for a duration of 2-6 months during pregnancy; 9 patients

Table 1. Characteristics of pregnant women with valvular heart disease

	n	%
Age (years)		
15-20	164	18.6
21-25	338	38.2
26-30	311	35.2
31-40	57	6.4
>40	14	1.6
Total	884	100
Gravidity (G)		
G=1	512	57.9
G=2	206	23.3
G=3	43	4.9
G≥4	123	13.9
Total	884	100
Gestational age at admission		
1st trimester	216	24.4
2nd trimester	536	60.6
3rd trimester	132	15.0
Gestational age at delivery (weeks)		
<28	43	4.9
28-32	82	9.3
32-36	146	16.5
>36	613	69.3
NYHA class at presentation		
I	614	69.4
II	121	13.7
III	82	9.3
IV	67	7.6

required continuous hospitalization and 14 patients required intermittent hospitalization at the commencement of the 2nd TR of pregnancy. All patients received beta-blocker therapy (metoprolol p.o., maximally 100 mg/daily) and diuretics and 8 patients with atrial fibrillation received digoxin (0.1 mg p.o. daily) and warfarin (up to 7,5 mg daily). After delivery, there were significant decreases in SPAP (64.4±9.1 *vs*. 44.8±7.3) and mitral valve gradients (19.4±4.3 *vs*. 15.2±3.1) (Table 3).

In the mild-moderate MS group, no cardiac intervention was performed and neither maternal or fetal mortality, nor pulmonary edema was seen. In 3 patients with mild-moderate MS and 8 patients with severe MS, C/S was performed because of obstetric indications. In two pregnancies with MVA 0.9 and 1.1 cm^2, two preterm infants were born, one of which died due to respiratory distress.

Mitral regurgitation

There were 32 (3.6%) patients diagnosed with severe MR. MVR was done in 3 patients within the 2nd TR (2 metallic and 1 bioprothes). Episodes of pulmonary edema were observed in 8 patients. Among those patients mean SPAP was >50 mmHg, NYHA functional class was III-IV, and mean left ventricular end systolic dimension was 52 mm.

All patients with severe MR were hospitalized during pregnancy (for 2-5 months). Six patients required continuous hospitalization starting at the commencement of the 2nd TR of pregnancy and 12 patients' required intermittent hospitalizations. All patients received beta-blocker therapy (metoprolol p.o., maxi-

Table 2. Distribution of valvular heart diseases

Heart valve disease (n=884)	Mild n (%)	Moderate n (%)	Severe n (%)	Total n (%)
Mitral regurgitation	194 (21.9)	73 (8.3)	32 (3.6)	299 (33.8)
Mitral stenosis	76 (8.6)	33 (3.7)	36 (4)	145 (16.4)
Mixed mitral valve disease	57 (6.4)	29 (3.3)	11 (1.2)	97 (10.9)
Mitral valve prolapse with regurgitation	16 (1.8)	3 (0.3)	2 (0.2)	21 (2.3)
Aortic regurgitation	120 (13.6)	42 (4.7)	17 (1.9)	179 (20.2)
Aortic stenosis	28 (3.2)	12 (1.3)	9 (1)	49 (5.5)
Mixed aortic valve disease	39 (4.4)	19 (2.1)	8 (0.9)	66 (7.4)
Tricuspid stenosis	6 (0.7)	8 (0.9)	2 (0.2)	16 (1.8)
Pulmonary stenosis	9 (1)	1 (0.1)	2 (0.2)	12 (1.3)

mally 100 mg daily) and diuretics. After delivery, a significant decrease in LAD (5.7±0.6 *vs.* 5.2±0.5) and SPAP (48.6±8.3 *vs.* 37.4±6.9) was observed (Table 3).

Cesarean delivery was performed due to obstetric indications in 11 patients. Two preterm newborns died due to respiratory distress. In these cases, the mothers had 3-4 degree MR and SPAP >50 mmHg. No adverse clinical outcome occurred among patients with mild to moderate MR.

Mitral stenosis with mitral regurgitation

Seventy-six patients with MVA >1.5 cm^2 and grade I-II MR and one patient with MVA of 0.8 cm^2 and grade 4+ MR were allocated to this group. A patient with 0.8 cm^2 MVA and grade 4+ MR was underwent MVR in the 2nd TR (with metallic valve). Episodes of pulmonary edema were observed in 1 patient in the 3rd TR (MVA 1.3 cm^2 and 3+ MR and had atrial fibrillation). In three patients, C/S delivery was required due to obstetric indications.

Mitral valve prolapse (MVP)

MVP and grade III MR were seen in 2 patients. Treatment with diuretics and a beta-blocker was applied. No adverse clinical outcome occurred. Three patients required cesarean delivery due to obstetric indications.

Table 3. Patients with mitral stenosis, mitral regurgitation, aortic stenosis, and aortic regurgitation

	Mild-Moderate MS (n=109)					Severe MS (n=36)		
	Presentation	3rd TR	p*	Postpartum	p**	Presentation	Postpartum	p***
Mitral stenosis	Mean±SD	Mean±SD		Mean±SD		Mean±SD	Mean±SD	
MGA mitral valve	6.2±3.1	6.5±3.5	NS	6.3±2.9	NS	19.4±4.3	15.2±3.1	**<0.001**
MVA (cm)	1.9±0.3	1.8±0.4	NS	1.8±0.3	NS	0.94±0.22	0.93±0.3	NS
LAD (cm)	3.9±0.4	4.2±0.3	**<0.01**	4.0±0.4	0.05	5.2±0.7	4.9±1.3	**0.05**
LVEF (%)	62.4±7.0	64.6±5.7	NS	61.1±8.4	NS	60.9±8.5	62.3±6.7	NS
SPAP (mmHg)	22.6±4.7	28.8±5.6	**<0.001**	21.9±6.1	**<0.001**	64.4± 9.1	44.8±7.3	**<0.001**
Mitral regurgitation	Mild-Moderate MR (n=267)					Severe MR (n=32)		
LAD (cm)	3.1±0.6	3.3±0.5	NS	3.2±0.7	**0.05**	5.7±0.6	5.2±0.5	**0.05**
LVESD (cm)	2.8±0.5	2.8±0.7	NS	2.8±0.6	NS	3.9±1.1	3.7±0.9	NS
LVEF (%)	64.7±5.5	63.1± 6.8	NS	63.8±6.2	NS	63.9±7.4	65.1±5.8	NS
SPAP (mmHg)	20.4±8.5	23.7±6.6	NS	20.9±7.4	NS	48.6± 8.3	37.4±6.9	**0.05**
Aortic stenosis	Mild-Moderate AS (n=28)					Moderate-Severe AS (n=21)		
AVA (cm)	2.03±0.34	1.99±0.41	NS	2.01±0.38	NS	1.21 ±0.32	1.20±0.26	NS
MGA aortic valve (mmHg)	24.7±6.8	29.9±5.3	**0.01**	23.6±7.1	**0.05**	49.4±9.4	59.1±8.5	**0.001**
LAD (cm)	3.5±0.2	3.9±0.5	**0.05**	3.6±0.3	**0.05**	3.9±0.94	4.4±0.7	**0.05**
LVESD (cm)	3.4±0.5	3.8±0.5	**0.05**	3.51±0.60	**0.05**	3.43±0.87	3.81±0.66	**0.05**
LVEDD (cm)	5.5±0.4	5.8±0.4	NS	5.58±0.32	**0.05**	5.47±0.62	5.83±0.51	**0.05**
LVEF (%)	68.2±7.3	65.7±6.6	**0.05**	66.4±8.1	NS	64.3±6.3	62.7±7.3	NS
SPAP (mmHg)	26.4±6.3	38.2±8.8	**0.05**	29.1±7.9	**0.05**	62.1±8.7	41.6±10.7	**0.05**
Aortic regurgitation	Mild-Moderate AR (n=162)					Severe AR (n=21)		
LAD (cm)	3.0±0.7	3.6±0.4	**0.01**	3.3±0.3	**0.01**	4.4±0.3	4.5±0.6	NS
LVESD (cm)	3.7±0.4	3.8±0.5	**0.01**	3.51±0.6	**0.01**	3.9±0.9	3.8±0.5	NS
LVEDD (cm)	5.2± 0.3	5.6±0.4	**0.01**	5.4±0.5	**0.01**	5.8±0.5	5.6±0.5	**0.05**
LVEF (%)	65.8±6.9	63.1±8.3	NS	65.4±7.2	NS	65.3±4.3	64.1±8.3	NS
SPAP (mmHg)	21.1±5.2	24.8±6.9	NS	23.9±8.1	NS	33.6±6.5	38.2±7.2	**0.05**

MS: Mitral stenosis; MR: Mitral regurgitation; AS: Aortic stenosis; AR: Aortic regurgitation; TR: Trimester; MGA: Mean gradient across; MVA: Mitral valve area; LAD: Left atrial diameter; LVEF: Left ventricular ejection fraction; SPAP: Systolic pulmonary artery pressure; LVESD: Left ventricular end systolic diameter; LVEDD: Left ventricular end diastolic diameter.
p* value presentation *vs.* 3rd TR; p** value postpartum *vs.* 3rd TR; p*** value presentation *vs.* postpartum; NS: Not significant.

Aortic stenosis

There were 9 (1%) patients diagnosed with severe AS. Episodes of pulmonary edema were observed in three of those patients in the 3rd TR. Pulmonary edema was seen in patients with mean aortic valve area (AVA) <0.9 cm^2, aortic valve gradient 64 mmHg, and SPAP 52 mmHg. One patient and her baby died during delivery due to cardiopulmonary arrest. In this patient, diagnosis of severe AS was determined at autopsy.

Cesarean delivery under generalized anesthesia was performed in 9 patients with severe AS for obstetric indication. LVEDD, LVESD, LAD and SPAP (62.1±8.7 *vs.* 41.6±10.7) were significantly decreased after delivery (Table 3). No adverse clinical outcomes occurred in the mild-moderate AS group.

Aortic regurgitation

Episodes of pulmonary edema were seen in five patients. These patients had enlarged left ventricles (LVEDD >6 cm, LVESD >4 cm) and depressed cardiac function (EF <50%). Aortic valve replacement was completed in two patients with enlarged left ventricles and who were symptomatic despite diuretic and digoxin therapy. Cesarean delivery with generalized anesthesia was performed in three patients due to obstetrical indications. One neonatal death occurred after C/S due to respiratory distress. LVEDD, LVESD, and LAD (3.0±0.7 *vs.* 3.6±0.4) increased significantly during the 3rd TR compared to the initial presentation (Table 3).

Pregnancies complicated with maternal mortality, pulmonary edema, or interventions were characterized by severe VHD, markedly elevated PASP, and NYHA class III-IV (Table 4).

DISCUSSION

We evaluated the outcomes of 884 cases of pregnancies with VHD. Mitral valve disease is the most common form of VHD, mainly occurring as regurgitation of the valve in this study group. Adverse clinical outcomes including death, pulmonary edema and valvular interventions were frequent among patients with severe VHD, whereas no adverse clinical outcome was observed in patients with mild-moderate VHD. In patients with severe VHD, clinical outcomes were frequent with valve stenosis, but lower in patients with regurgitation [death 4 (0.45%) *vs.* 0 (0%), pulmonary edema 15 (1.7%) *vs.* 13 (1.5%), valvular intervention 11 (1.2%) *vs.* 6 (0.7%), respectively].

Regurgitations without left ventricular dysfunction are usually well tolerated during pregnancy, however the pressure gradient across the narrowed valves increases during pregnancy secondary to the physiological rise in heart rate and stroke volume, leading to the development or worsening of symptoms.[8] In our study group, adverse outcomes (maternal and fetal mortality, pulmonary edema) were significantly more frequent in mitral and aortic stenosis ($p<0.001$, except C/S).

In the assessment of a pregnant patient with VHD, it should be remembered that the evaluation may be complicated by normal functional and anatomical changes of the cardiovascular system during pregnancy, resulting in signs and symptoms mimicking cardiac disease.[4] Timing and mode of delivery should be discussed and decided with the consultation of a cardiologist, an obstetrician, and an obstetric anesthesiologist. Generally, vaginal delivery with appropriate anesthesia and shortening of the 2nd stage of labor is safe and can be performed in the majority of patients

Table 4. Characteristics of patients with cardiac intervention, pulmonary edema and maternal mortality

Grade of valvular disease	MS (Severe mean MVA 0.9 cm^2)	MR (3-4 degree)	MS+MR (4 degree MR and mean MVA 1 cm^2)	MVP (3 degree MR)	AS (Severe mean AVA 0.9 cm^2)	AR (3-4 degree)
Functional capacity at presentation (NYHA)	IV	III	IV	III	IV	III
Mean systolic PAP (mmHg)	58	52	54	43	57	52
Left atrial diameter (cm)	5.3±0.4	5.6±0.6	4.8±0.4	4.5±0.3	3.8±0.7	4.6±0.4
EF (%)	61	64	58	62	56	51

MS: Mitral stenosis; MR: Mitral regurgitation; MVP: Mitral valve prolapses; AS: Aortic stenosis; AR: Aortic regurgitation; NYHA: New York Heart Association; PAP: Pulmonary artery pressure; EF: Ejection fraction.

with VHD.[9,10] C/S is potentially associated with a higher rate of complications[11,12] and should only be performed for obstetric indications and in the occasional patient with cardiac instability. In our study, C/S was performed in 32 (3.6%) patients due to obstetric indications, with no maternal mortality.

Increased venous return in the early puerperium may result in a marked increase in left atrial and SPAP and can lead to the development of pulmonary edema.[9,10] For this reason, these patients should be followed carefully after delivery for acute pulmonary edema. In this study, pulmonary edema was seen in 28 (3.2%) patients. These patients had severe valvular stenosis or regurgitation (11 severe MS, 8 severe MR, 1 severe MS and MR, 5 severe AR) and increased SPAP (>55 mmHg) and NYHA of III or IV. After delivery, pulmonary edema was seen in 14 (1.6%) patients (7 severe MS, 2 severe AS, 3 severe AR and 2 severe MR).

Mitral stenosis: Isolated cases of maternal death have been described in other reports in women with critical MS who were in NYHA functional class III and IV.[7] However, no mortality was reported in 124 pregnancies in women with MS at two tertiary-care facilities with high-risk obstetric/ cardiology clinics in North America, or among 71 cases treated in India.[8-10] In the present study, three patients having severe MS and their babies died, of whom two had undergone PMBV and one MVR.

Pulmonary hypertension is a progressive and fatal disease characterized by elevation of pulmonary vascular resistance and right heart failure.[13] In patients with pulmonary hypertension, pregnancy can be associated with a high risk of maternal death.[14] In our study group, 3 patients with severe MS and pulmonary hypertension (SPAP >50 mmHg) died.

The decision to perform PMBV before conception in patients with MS should be made on the basis of their MVA, symptoms, and exercise tolerance. Careful judgment is required in a patient with MS who is not a suitable candidate for PMBV.[9,15,16] In our MS group, PMBV was completed in 6 patients in the 2nd TR; two of these patients died because of cerebral embolic events and pulmonary edema after intervention.

The available data clearly shows that vaginal delivery can be permitted in most cases of MS, including severe MS, and cesarean is applied mostly for obstetric indications. The 2nd stage of labor should be shortened by the use of outlet forceps or vacuum extractor.[17] Epidural anesthesia is recommended for pain relief[17] and has been shown to minimize intrapartum fluctuations in cardiac output.[18] In our severe MS group, assisted delivery in the 2nd stage of labor was performed for 25 (2.8%) patients and cesarean section was performed for 8 (0.9%) patients for obstetrical reasons.

Mitral regurgitation: Because of the significant fall in systemic vascular resistance during pregnancy and reduced left ventricular after load,[19] MR is well tolerated during pregnancy. Asymptomatic patients do not require therapy during pregnancy, and the treatment of patients with left ventricular dysfunction who develop hemodynamic abnormalities and symptoms of heart failure consists of diuretics and digoxin. For the patient with MR who is contemplating pregnancy, but is not considered a candidate for surgical MVR or repair on the basis of the usual clinical indications,[19] prophylactic surgery should not be done. Because of the high incidence of fetal loss,[18] surgery for MVR or valve replacement should be avoided during pregnancy if possible and considered only in patients with severe symptoms not controlled by medical therapy. In our MR group, MVR was done in 3 patients in the 2nd TR because of NYHA class IV. Maternal or fetal loss was not observed.

Aortic stenosis: Patients with mild/moderate AS have a favorable outcome in pregnancy,[9] however the presence of severe AS may result in hemodynamic and symptomatic deterioration with the development of heart failure, leading to hospitalizations and premature delivery. Episodes of pulmonary edema were observed in three patients in the 3rd TR. Fetal and maternal loss was seen in one pregnancy. In this case, the diagnosis of severe AS was determined at autopsy.

The medical treatment of symptomatic patients with AS during gestation is limited. Patients who develop severe symptoms during pregnancy may require early termination of pregnancy[20] or repair of the valve.[21] Surgery may increase complaints related to pregnancy and confer additional risk to the fetus. In our study group, no patient with AS had undergone aortic valve surgery.

Aortic regurgitation: Aortic regurgitation without left ventricular dysfunction is usually well tolerated during pregnancy, probably because of a decrease in systemic vascular resistance and a physiological in-

crease in heart rate that may shorten diastolic time and thus reduce the degree of regurgitation.[8] Asymptomatic patients with severe AR but normal left ventricular function who contemplate pregnancy are not considered candidates for valve replacement on the basis of the established indications.[19] When aortic valve surgery is indicated, it should be delayed if possible until delivery to avoid the high risk of fetal loss.[22] In this study, AVR was done in 2 patients with severe AR in the 2nd TR with no adverse outcomes.

In conclusion, VHD is associated with fetal and maternal morbidity and mortality. Pregnancies with severe valve stenosis (mitral or aorta) constitute a high-risk group in which life-threatening complications are likely to occur in the course of pregnancy. The optimal management of pregnancy in cases of valvular heart disease requires the active collaboration of an obstetrician, a cardiologist, and a cardiothoracic surgeon.

Acknowledgments

The authors would like to thank Siddik Keskin for assisting in the statistical analysis.

Conflict-of-interest issues regarding the authorship or article: None declared

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Key words: Echocardiography; heart valve diseases; pregnancy; pregnancy complications, cardiovascular.

Anahtar sözcükler: Ekokardiyografi; kalp kapak hastalıkları; gebelik; gebelik komplikasyonu, kardiyovasküler.