The Evaluation of Applied Anaesthetic Techniques for Caesarean in Parturients with Cardiac Diseases: Retrospective Analysis

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Objective: In this study, the effects of anaesthetic technique on mother and newborn were investigated in a retrospective analysis of parturients with cardiac diseases undergoing Caesarean section between 2006-2012.

Methods: Our hospital's medical information system records were analyzed, and we found 107 parturients with cardiac disease and were undergoing Caesarean section, and their demographic data and obstetric, anaesthetic, and neonatal record forms were inspected.

Results: Fifty-three (49.5%) pregnant women received general anaesthesia, and 54 (50.5%) received regional anaesthesia (34 spinal, 19 epidural and 1 CSE) ($p=0.05$). Week of pregnancy was lower for the group of general anaesthesia ($p=0.007$). Among cardiac parturients, valvular lesion rates were higher (75.7%). The relationship between existing cardiac disease and anaesthetic management was not significant ($p=0.28$). However, we determined that parturients with higher NYHA (New York Heart Association) classifications had higher general anaesthesia rates. ($p=0.001$). A rate of 39% of 74 NYHA I patients were undergoing general anaesthesia; this rate was 64% for NYHA II and 100% for NYHA III. The patients with cardiac surgery or medical treatment history had higher general anaesthesia rates ($p=0.009$). Although the general anaesthesia group newborn weights were lower ($p=0.03$), there was no difference between groups for APGAR scores. With regard to postoperative complications and hospital stay, the groups were similar.

Conclusion: We determined that general and epidural rates in parturients with cardiac diseases were similar, general anaesthesia was preferred for parturients who had higher NYHA classifications and surgical or medical treatment history. We considered that general anaesthesia criteria should reduce the anaesthesia management of parturients with cardiac disease; epidural or CSE anaesthesia applications should increase according to the patient's physical state, haemodynamic parameters, and obstetric indications.

Key Words: Cardiac disease, pregnancy, caesarean section, anaesthetic technique, retrospective analysis

Introduction

Most pregnant women are young and healthy women. However, today, anaesthetists encounter more pregnant women with heart diseases owing to improvements in surgical techniques and drug therapies. The prevalence of heart disease during pregnancy is reported to be approximately 0.3%-3.5%, and it is a significant cause of maternal mortality. The most common heart diseases during pregnancy include rheumatic heart diseases, valvular heart diseases and congenital heart diseases (1-5).

Physiological changes, especially in the cardiovascular system, associated with pregnancy constitute an additional risk factor for women having co-morbid heart disease and increase peripartum morbidity and mortality by leading to decompensation (1-4, 6). Various parameters, such as haemodynamic state of the parturients, the type of heart disease, use of medication and urgent or elective operation, should be taken into consideration while deciding on the anaesthesia method for pregnant women with heart disease (7). Whatever the underlying heart disease is, stage III-IV patients in accordance with the NYHA (New York Heart Association) classification are under higher risk (8, 9). These patients do not have cardiovascular reserve, and pregnancy is not recommended. If pregnancy occurs, pregnancy termination can be required because of high maternal mortality (8%-35%) and morbidity (50%) rates. However, it must be known that pregnancy termination also carries risk for these patients (10).

It is difficult to manage these patients, due to rapid changes in heart rate, cardiac output, venous return and vascular resistance, especially in the case of severe mitral and aortic stenosis, and close follow-up is important. Invasive monitoring is essential in patients with NYHA stage III-IV heart failure (10).

Nowadays, owing to the successful results obtained from treatment of heart diseases, anaesthetists encounter more parturients having heart diseases, and the anaesthesia management has become more important. In this study, we aimed to investigate the anaesthetic techniques used for parturients who had been diagnosed with heart disease and had undergone caesarean section between 2006-2012 and the effects of these techniques on the mother and newborn retrospectively.

Methods

After receiving ethics committee approval for this study from the ethics committee of Ege University Faculty of Medicine (dated 17.07.2012 and numbered 12-7/11), the patient files recorded in the hospital medical information system between January 2006 and June 2012 were analysed. Obstetric, neonatal and anaesthetic records of 107 parturients who had had heart disease and undergone caesarean section were examined retrospectively. The patients' demographic information (age, weight, height), gestational week, parity, urgent or elective caesarean section, heart disease, co-morbid diseases, duration of surgery, newborn Apgar score, weight, anaesthetic technique applied, type of monitoring, postoperative complications, NYHA (New York Heart Association) classification, medical or surgical treatments administered for heart disease and total hospitalisation time in the intensive care unit and hospital were recorded.

Statistical Analysis

The data were analysed using Statistical Package for the Social Sciences (SPSS, Chicago, IL, USA) Windows, version 16.0 by the Department of Biostatistics and Medical Informatics of our hospital. Mann-Whitney U test was used for evaluating the patients' anaesthetic technique and demographic data, gestational week and parity, newborn APGAR score and weight, operation duration, postoperative care unit and hospitalisation time. The relationship between previous caesarean rates, existing heart disease and NYHA classification and anaesthetic technique was evaluated through chi-square test. Fisher's exact test was employed for assessing previous heart surgery/medical treatment, co-morbid disease, urgent/elective operations, intraoperative vasopressor need, monitoring and postoperative complications.

Data were expressed as arithmetic mean±standard deviation, number and percentage. Statistical significance level was accepted to be $p < 0.05$ for all tests.

Results

It was found that 53 (49.5%) of 107 parturients having heart disease and a caesarean section had undergone general anaesthesia, and 54 (50.5%) had undergone regional anaesthesia ($p > 0.05$). Among the parturients undergoing regional anaesthesia, spinal anaesthesia had been administered in 34 women (31.8%), epidural anaesthesia was administered in 19 women (17.8%), and combined spinal epidural anaesthesia was ad-

ministered in 1 woman (0.9%). It was detected that 26.2% of the parturients ($n=28$) had been taken to urgent surgery (11 regional, 17 general anaesthesia), and 73.8% ($n=79$) had been taken to elective surgery (43 regional, 36 general anaesthesia) ($p=0.19$). In emergency cases, 10 parturients had been exposed to spinal anaesthesia, and 1 parturient had been exposed to epidural anaesthesia. On the other hand, in the cases that had undergone elective surgery, administration of 24 spinal, 18 epidural, and 1 combined-spinal-epidural (CSE) anaesthesia was determined.

It was revealed that 11 of 18 patients (16.8%) having co-morbid disease (epilepsy, diabetes, asthma, thyroid, thalassemia, hypertension) besides heart disease had been administered regional anaesthesia, and 7 had been administered general anaesthesia ($p=0.43$).

In the comparison of groups with regard to demographic data, gestational week and parity, hospitalisation time and postoperative discharge time, a statistically significant difference was found only for height and gestational week (Table 1).

Heart diseases of 107 parturients and their distribution according to NYHA classification and the anaesthetic techniques that were applied are shown in Table 2. No significant relationship was detected between existing heart disease of patients and anaesthetic technique ($p=0.28$).

When the relationship between anaesthetic technique and NYHA classification was investigated, it was seen that the ratio of general anaesthesia increased as the stage in NYHA classification increased. This result was found to be statistically significant ($p=0.001$) (Table 3).

Of the patients, 79 (73.8%) did not receive any therapy for heart disease, but 18 (16.8%) had a history of previous heart surgery. Eight patients (7.5%) were given only drug therapy; 2 patients (1.9%) both underwent heart surgery and received drug therapy. It was found that general anaesthesia was administered in 80% (16 patients) of the patients undergoing heart surgery. The number of patients receiving medical treatment was equal between general and regional anaesthesia. The patients having a surgical intervention history for heart disease and/or receiving medical treatment were compared to patients not having a surgical/medical treatment history, and a statistically significant difference was detected between them ($p=0.009$) (Table 4).

It was revealed that apart from standard monitoring, central venous catheterisation and invasive monitoring in the form of an arterial cannula were administered in 3 patients from the general anaesthesia group ($p=0.1$).

It was found that moderate hypotension had developed in 4 patients who had been exposed to regional anaesthesia in the perioperative period (3 spinal anaesthesia, 1 epidural anaesthesia), and it had been treated with vasopressor therapy ($p=0.1$).

It was determined that respiratory insufficiency that was associated with pulmonary oedema after extubation had developed in 1 patient having a diagnosis of valvular heart disease who was included in NYHA class III and undergoing general anaesthesia. The patient had been treated through non-invasive mechanical ventilation for 2 days in the intensive care unit and then discharged with full recovery. There was no statistically significant difference in terms of postoperative complications ($p=0.49$).

The hospitalisation duration of patients in the postoperative care unit was 1.07 ± 0.3 days for patients undergoing regional anaesthesia and 1.17 ± 0.1 days for patients undergoing general anaesthesia, which was statistically insignificant ($p=0.48$) (Table 1).

Table 1. Demographic and obstetric data, hospitalisation and discharge times

	General anaesthesia (n=53)	Regional anaesthesia (n=54)	p value
Age (year)	30.7 $\pm$ 4.7	30.1 $\pm$ 5.2	0.58
Weight (kg)	71.5 $\pm$ 10	74.1 $\pm$ 12	0.47
Height (cm)	161.1 $\pm$ 5.4	163 $\pm$ 5.1	0.027*
Gestational week	38 (23-41)	39 (23-42)	0.007*
Parity	1 (0-5)	0.5 (0-2)	0.46
Previous S/C ratios (n, %)	20 (37%)	18 (34%)	0.36
Operation duration (hour)	1.25 $\pm$ 0.36	1.2 $\pm$ 0.37	0.21
Hospitalisation duration (day)	4 (1-35)	3 (3-16)	0.17
Duration in postoperative care unit (day)	1 (0-4)	1 (1-2)	0.48
Number of urgent/elective patients (n)	17/36	11/43	0.19
Number of patients with co-morbid disease (n)	7	11	0.43
Values are given as mean $\pm$ standard deviation, median (minimum-maximum) and number of patients (n). Mann-Whitney U test, t-test and chi-square test were used.* $p<0.05$.			

Table 2. Distribution of heart diseases, NYHA classification and anaesthetic techniques

Existing heart disease	Total patient number	General anaesthesia (n=53)	Regional anaesthesia (n=54)	NYHA classification		
				I	II	III
Valvular disease (n, %)	81 (75.7%)	43	38	55	20	6
Congenital heart disease (n, %)	10 (9.4%)	2	8	9	1	-
Valvular disease+congenital heart disease (n, %)	8 (7.5%)	3	5	5	3	-
Valvular disease+rheumatic heart disease (n, %)	3 (2.8%)	2	1	3	-	-
Valvular disease+pulmonary hypertension (n, %)	3 (2.8%)	2	1	1	1	1
Valvular disease+rhythm disorder (n, %)	1 (0.9%)	-	1	1	-	-
Cardiomyopathy (n, %)	1 (0.9%)	1	-	-	-	1
Values are given as number of patients (n, %). Chi-square test was used statistically. NYHA: New York Heart Association						

The newborns' weight was 3078 ± 575 g in the regional anaesthesia group and 2804 ± 710 g in the general anaesthesia group. The birth weights of the babies in the general anaesthesia group were lower, which was statistically significant ($p=0.034$). The newborns' 1-minute APGAR score was 9.8 ± 0.5 in the regional anaesthesia group and 9.4 ± 1.6 in the general anaesthesia group. It was found that a 23-week pregnant woman had experienced a stillbirth. With regard to the

Table 3. Anaesthetic technique and NYHA relationship

Anaesthetic technique	NHYA I (n=74)	NHYA II (n=25)	NHYA III (n=8)
General anaesthesia (n, %)	29 (39.2%)	16 (64%)	8 (100%)
Regional anaesthesia (n, %)	45 (60.8%)	9 (36%)	-
Values are given as number of patients (n, %). Chi-square test was used statistically. NYHA: New York Heart Association			

Table 4. The ratios of patients having previous cardiac surgery and receiving medical treatment

	General anaesthesia (n=53)	Regional anaesthesia (n=54)	Total patients (n=107)
Patients without surgical/medical treatment history (n, %)	33 (41.7%)	46 (58.2%)	79
Patients undergoing surgery (n, %)	14 (77.7%)	4 (22.3%)	18
Patients receiving medical treatment (n, %)	4	4	8
Anticoagulant therapy	1	1	2
Antiarrhythmic therapy	1	-	1
Beta-blocker therapy	-	3	3
Beta-blocker+ antiarrhythmic therapy	1	-	1
Diuretic therapy	1	-	1
Patients receiving surgical+ medical treatment (n, %)	2	-	2
Values are given as number of patients (n, %). Fisher's exact test was used statistically			

newborn APGAR scores, there was no statistically significant relationship between the regional and general anaesthesia groups (Table 5).

Discussion

All risks that parturients with heart diseases can encounter should be determined by evaluating their clinical conditions, valvular lesions and cardiac reserves. It should be specified whether these patients are suitable for pregnancy or not and, if suitable, where and how often they must be followed up (10).

While hypertrophy that is associated with increased blood volume, heart rate and cardiac volume, dilatation and increased cardiac oxygen demand in pregnancy can be tolerated by healthy women, it can cause serious morbidity and mortality in parturients (11). In the studies conducted, it has been revealed that serious increases have occurred in maternal mortality rates (6, 12, 13). Especially, parturients with cyanotic heart disease, cardiomyopathy, aortic and mitral valve stenosis, mechanic valvular diseases and pulmonary hypertension constitute the highest-risk group (6). Therefore, the anaesthetic technique is also very important for pregnant women having heart diseases.

It is difficult to manage these patients, because heart rate, cardiac output, venous return and vascular resistance change rapidly, especially in the case of severe mitral and aortic stenosis, and therefore, close follow-up is important. Regional anaesthesia is contraindicated in patients with severe valvular stenosis and using anticoagulants. Moreover, prophylactic fluid therapy administered to prevent hypotension that develops in association with regional anaesthesia and medications, such as vasopressors and atropine, used for hypotension and bradycardia treatment can pose problems for patients with limited cardiac reserve. On the other hand, general anaesthesia administration includes various risks, such as cardiovascular instability secondary to rapid induction and positive pressure ventilation, difficult or wrong intubation and stomach content aspiration (14).

Hidano et al. (5) analysed the anaesthetic techniques of 67 parturients with congenital heart disease retrospectively and found that 51 of them underwent regional anaesthesia and 16 underwent general anaesthesia. Although they found the rates of maternal and neonatal complications to be higher in the general anaesthesia group than in the regional anaesthesia group, they stated that this result might have been affected by the clinical conditions of the parturients. In our study, the ratios of regional and general anaesthesia were similar in the parturients with heart disease. However, among our patients, there were also pregnant women having severe valvular disease, as well as congenital heart diseases, and those included in the NYHA III group. Hidano et al. (5) involved parturients with congenital heart disease in their study and reported that none of them was included in NYHA class III-IV. On

Table 5. Newborn weight and APGAR score in regional and general anaesthesia

	General anaesthesia (n=53)	Regional anaesthesia (n=54)	p value
Newborn weight (g)	2950 (500-4100)	3155 (1020-4100)	0.034*
Newborn height (cm)	49.08±3.3	49.2±2.3	0.8
APGAR score 1. min	10 (0-10)	10 (7-10)	0.069
5. min	10 (0-10)	10 (9-10)	0.052
Values are given as mean±standard deviation, mean median (minimum-maximum). *Mann-Whitney U test was used			

the other hand, Goldszmidt et al. (6) noted that they mostly administered regional anaesthesia for caesarean section in parturients with heart diseases. In their study, it was stated that only 17 of 192 pregnant women were included in NYHA class III-IV, the ratios of epidural and general anaesthesia were similar in patients in NYHA class I-II (66%, 70%) and these ratios for the ones in NYHA class III-IV were 16% and 24%, respectively. They also noted that they administered epidural anaesthesia during the caesarean section process in 70% of NYHA III-IV patients and during normal delivery in 84% of the patients. The authors emphasised that spinal anaesthesia was not used for patients included in NYHA class III-IV, but instead, epidural anaesthesia was preferred due to the easily adjustable block level. In some heart diseases, epidural anaesthesia is preferred, because cardiovascular stability is protected better (14). Boyle et al. (1) administered epidural anaesthesia for 7 of 12 patients in NYHA class III-IV, epidural anaesthesia combined with general anaesthesia for 1 patient, spinal anaesthesia for 1 patient and general anaesthesia for 3 patients. In our study, the ratios of general anaesthesia were found to be significantly high in patients with higher NYHA scores and in parturients receiving medical treatment for heart disease or having undergone surgical intervention. Goldszmidt et al. (6) suggested gestational age and urgency of birth as factors that increase the possibility of general anaesthesia. In our study, it was seen that 17 of 28 emergency cases had undergone general anaesthesia. The rate of general anaesthesia was significantly higher in patients with lower gestational week but with high NYHA scores. Nowadays, the indications for general anaesthesia have been narrowed to haemodynamic instability, treatment-resistant heart failure or patients who can not tolerate the supine position (6). In our study, it was detected that 8 patients included in NYHA class III had been operated on under general anaesthesia; 4 of them had been taken into urgent operation, 1 patient had undergone aortic valve replacement, 1 patient had had cardiomyopathy, and 1 patient had had severe mitral stenosis. Furthermore, we thought that the significantly lower newborn weights in the general anaesthesia group might have resulted from the fact that most of the parturients were taken into urgent operation due to early disruption of haemodynamics that resulted from intolerance to the pregnancy. However, in the investigation

carried out as a result of general anaesthesia administration for most of the pregnant women having valvular disease and being included in NYHA classes I and II, it was found that a great majority of these patients had either multiple valvular diseases or third-stage valve insufficiency and over.

Dob and Yentis (15) noted that if there was enough time, they preferred regional anaesthesia in cases requiring urgent caesarean section, and otherwise, they administered general anaesthesia. Furthermore, they stated that the way of administering anaesthesia was more important than the technique that was chosen.

Ioscovich et al. (16) reported that they preferred to insert an effective epidural catheter at the proper time to avoid using general anaesthesia with rapid intubation in emergency cases of high-risk obstetric patients and that they preferred epidural analgesia for haemodynamically unstable patients for whom postoperative analgesia was an important component.

In our study, it was found that hospitalisation time for parturients operated on under general anaesthesia went up to 35 days. This was interpreted as close prenatal monitoring of patients in hospitals. Boyle et al. (1) noted in their retrospective study involving 5 years that heart disease in pregnancy extended the time for hospitalisation apparently, but this was not related to maternal age, parity and the type of heart disease. In their study, hospitalisation time was found to be significantly longer in NYHA III-IV patients compared to other patients.

In our study, we observed that birth weights of babies of parturients undergoing general anaesthesia were significantly lower. The rate of general anaesthesia also increased with increased NYHA classification, and these patients were taken into caesarean operations early, because they probably can not tolerate pregnancy. As a result of this, newborns had lower birth weights. However, no significant difference was found between APGAR scores.

EKG, arterial blood pressure, pulmonary occlusion pressure and cardiac output must be certainly followed up in patients having NYHA stage III-IV heart failure (10). Cardiovascular changes secondary to pregnancy and sudden and serious changes in maternal haemodynamics associated with existing heart disease can be observed. Invasive monitoring techniques are primarily preferred for patients who are expected to have more haemodynamic changes. Dob et al. (15) stated that they built a scale for invasive monitoring, varying according to the severity of symptoms and the condition of heart disease; they performed routine invasive arterial monitoring for patients being included in the high-risk heart disease group and having serious symptoms, they did not use a CVP catheter very often and they rarely used a pulmonary arterial catheter. Goldszmidt et al. (6) reported that the ratio was 32% for arterial monitoring, 10% for CVP catheter insertion and 2% for pulmonary artery catheter insertion; the ratios of CVP

and pulmonary artery catheter insertion before the year 2000 were 8% and 4%, respectively, and after 2000, these ratios decreased to 5% and 0.4%. In our study, the ratio of invasive artery and CVP catheter insertion was 2.8%, and we found that no different implementation for invasive monitoring was carried out in other centres that we examined.

Vasopressor choice and practices are very important for patients with heart disease, because they are more sensitive to increased heart rate (7). In our study, it was detected that moderate hypotension had developed in 4 patients (after 3 spinal and 1 after epidural anaesthesia) during the intraoperative period, and a vasopressor had been used.

We determined that one patient had had respiratory insufficiency associated with pulmonary oedema after general anaesthesia and had been exposed to non-invasive mechanical ventilation for 2 days in the anaesthesia intensive care unit. Goldszmidt et al. (6) revealed that 17 patients included in NYHA class III-IV underwent a caesarean section, and the hospitalisation rate in the postoperative intensive care unit was 13%. In our records, there was no patient included in NYHA class IV, and there were only 8 patients included in NYHA class III. In the studies, it was observed that no matter how serious the heart disease was, the women were given a chance to become pregnant; however, they were closely followed up during the antepartum, peripartum and postpartum periods.

Conclusion

For parturients with heart disease who have undergone caesarean section on urgent or elective operation, anaesthesia and analgesia can be given through epidural or low-dose CSE technique without disrupting haemodynamics. A controllable level of epidural anaesthesia is one of the most important advantages. General anaesthesia can cause a rapid intubation requirement, high aspiration risk and tachycardia and hypertension associated with laryngoscopy and intubation. However, it can be preferred for patients for whom regional techniques can not be administered and who can display excessive blood loss and haemodynamic instability.

In our research, the ratios of regional and general anaesthesia applied during caesarean were similar in parturients having heart disease, but it was observed that general anaesthesia had been preferred mostly because of some reasons, such as being included in a high NYHA class, being taken into an urgent operation, having a history of previous heart surgery and/or receiving drug therapy and having stage 3 and over or multiple valvular disease. However, it has been seen in recent studies that regional anaesthesia techniques are preferred much more, even for parturients with heart disease included in a high NYHA class. It has been concluded that the advantages of epidural or low-dose CSE anaesthesia should be taken into consideration to avoid overload of fluid, provide haemodynamic stability, provide better postoperative analgesia

and keep haemodynamic parameters more stable. Moreover, general anaesthesia criteria can be reduced for selecting the anaesthesia technique in parturients with heart disease, and epidural or CSE anaesthesia implementation can be increased according to the patient's clinical condition, haemodynamic parameters and obstetric emergency.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Ege University Faculty of Medicine.

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