Anesthetic Management of A Patient with Wolff-Parkinson-White Syndrome Undergoing Laparoscopic Nephrectomy: Case Report

Laparoskopik Nefrektomi Yapılan Wolff-Parkinson-White Sendromlu Hastada Anestezik Yaklaşımımız

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ABSTRACT Laparoscopic surgery represents a significant advance in surgical technique, but a number of physiologic sequelae result from positioning and insufflation. These physiologic changes may be more significant in patients with Wolff-Parkinson-White syndrome (WPW). WPW syndrome is a condition associated with ventricular pre-excitation and episodes of supraventricular tachycardia (SVT) or atrial fibrillation (AF). One major problem associated with the anesthetic management of patients with WPW syndrome is the risk of tachyarrhythmias as a result of the presence of the accessory pathway. Therefore it has been suggested that the aim of anaesthetic management should be the avoidance of tachyarrhythmia and sympathetic stimulation. Laparoscopic surgery, though being a minimally invasive procedure, markedly changes both the respiratory mechanics and hemodynamics of the patient. Retroperitoneal insufflation of carbon dioxide used for urological procedures may potentially cause CO_2 accumulation. At the cellular level hypercarbia is a direct depressor of myocardial contractility and a direct stimulant of myocardial irritability and arrhythmicity. We present the anesthetic management of a patient with WPW who successfully underwent laparoscopic nefrectomy. Under a well-managed anesthesia preventing hypercarbia and stress responses due to pneumoperitoneum, laparoscopic surgery would be safe enough for patients with Wolff-Parkinson-White syndrome.

Key Words: Anesthesia, general; Wolff-Parkinson-White Syndrome; retropneumoperitoneum

ÖZET Laparoskopik cerrahi, cerrahi teknik olarak çok az travmatik olsa bile pozisyon ve insuflasyona bağlı istenmeyen etkiler ortaya çıkabilmektedir. Bu durum Wolff-Parkinson-White (WPW) sendromlu hastalar için önem arzeder. WPW sendromu bir ventriküler preeksitasyon sendromudur, supraventriküler taşikardi ve atrial fibrilasyona kadar varan taşiartmi episodları ile seyreder. WPW sendromlu hastada anestezi yönetimindeki en önemli problem aksesuar yolaktan kaynaklı taşiaritmilerin ortaya çıkması olasılığıdır ve bu nedenle bunlara sebep olabilecek sempatik aktivasyonu önlemek amaçlanır. Laparoskopik cerrahi hastanın solunum mekaniklerini ve hemodinamiğini etkileyen değişikliklere sebep olabilir. Ürolojik operasyonlarda uygulanan retroperitoneal insuflasyonun intraperitoneal yaklaşıma oranla daha çok karbondioksit birikimine yol açtığı gösterilmiştir. Hücre düzeyinde de hiperkarbinin miyokardial irritabilite ve aritmisite yönünde direk bir stimulan olduğu da bilinmektedir. Bu olguda; Wolff-Parkinson-White sendromlu hastada pneumoperitoneum sonucunda ortaya çıkabilecek stres cevap ve hiperkarbiyi önleyebilen iyi yönetilmiş bir anesteziyle, laparoskopik cerrahinin sorun olmayacağını düşünmekteyiz

Anahtar Kelimeler: Genel anestezi; Wolff-Parkinson-White sendromu; retropnömoperitonium

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Laparoscopic surgery represents a significant advance in surgical technique, but a number of physiologic sequelae result from positioning and insufflation. These physiologic changes may be more significant in patients with Wolff-Parkinson-White syndrome (WPW). In 1930, Wolff,

Parkinson, and White[1] described a group of patients who had "bundle branch block" with short PR intervals associated with paroxysmal tachycardia (PSVT). The physiologic basis for the syndrome is the activation or "preexcitation" of the ventricles at a site other than the normal atrioventricular conduction system.

WPW syndrome is a condition associated with ventricular pre-excitation and episodes of supraventricular tachycardia (SVT) or atrial fibrillation (AF).[2] In sinus rhythm, the presence of WPW pattern is recognized on the electrocardiogram (ECG) by a short PR interval and a wide QRS complex with a delta wave corresponding to ventricular preexcitation.

One major problem associated with the anesthetic management of patients with WPW syndrome is the risk of tachyarrhythmia as a result of the presence of the accessory pathway.

Therefore it has been suggested that the aim of anesthetic management should be the avoidance of tachyarrhythmia and sympathetic stimulation.[3,4] Laparoscopic surgery, though being a minimally invasive procedure, markedly changes both the respiratory mechanics and heamodynamics of the patient. We present here, with informed consent of the patient, the anesthetic management of a patient with WPW who successfully underwent laparoscopic nefrectomy.

CASE REPORT

A 51-year-old, 60kg and 152cm high woman, with WPW syndrome was scheduled for operation of laparoscopic nephrectomy for nonfunctional left kidney with nephrolithiasis. Her physical examination revealed no significant abnormalities with the exception of ECG findings. The ECG revealed a shortened PR interval followed by a wide aberrant looking QRS with a slurred initial deflection, delta wave, which is characteristic of the early depolarization (Figure 1). Cardiology evaluation was done. Her preoperative echocardiogram demonstrated left ventricular hypertrophy, reduced left ventricular relaxation, mild mitral regurgitation and ejection fraction was 60%. The patient was informed

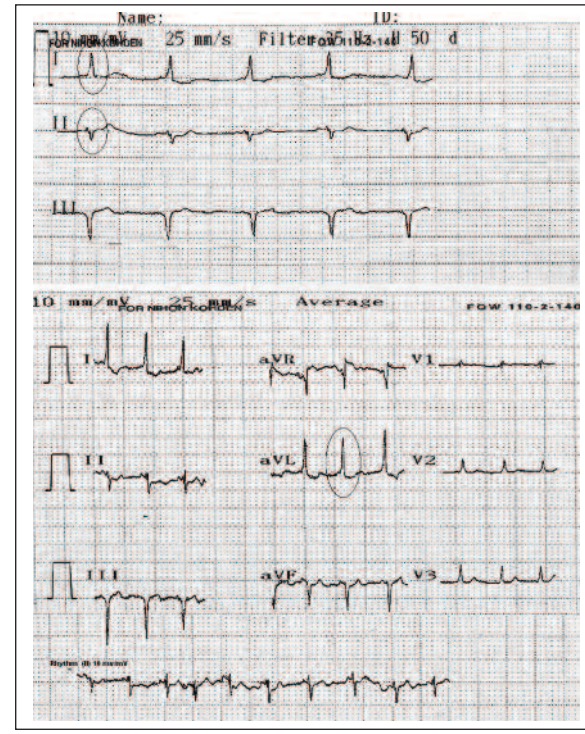

FIGURE 1: Preoperative ECG showing a sinusal rhythm with a heart rate of 75.min-1, shortened P-R interval, delta wave and inverted T wave.

about the operation and anesthetic procedure during the routine preanesthetic evaluation the day before surgery and her informed consent was achieved.

The patient was pre-medicated with midazolam 5 mg intramuscularly 30 minutes before the procedure. In the operative room, routine monitoring (in the form of heart rate (HR), noninvasive blood pressure (NIBP), peripheral oxygen saturation (SpO_2) and urinary catheterization) was instituted. Baseline blood pressure 145/78 mmHg and a heart rate of 90 beats/min in normal sinus rhythm were noted. Following left radial artery catheterization for sampling of blood gas analysis (ABG); first sampling was obtained on room air and it exposed to: pH 7.43, P_aCO_2 32 mmHg, P_aO_2 98 mmHg, bicarbonate 21 $mmol \cdot L^{-1}$. An uneventful induction of general anesthesia was achieved with the administration of lidocaine 60 mg i.v., propofol 140 mg, fentanyl 125 μg and vecuronium 7 mg. After anesthesia induction, the NIBP and HR remained stable, and the end-tidal CO_2 was 33 mmHg. Anesthesia was maintained with 4-8

$mg.kg^{-1}.h^{-1}$ of propofol and 0.1-0.5 $mcg.kg^{-1}.min^{-1}$ of remifentanil.

Neuromuscular block was maintained with intermittent i.v. boluses of vecuronium guided by train-of-four (TOF) monitoring. After induction of anesthesia, patient was turned to the left lateral lombotomy position for the laparoscopic approach retroperitoneally with an insufflation pressure of 12 mmHg.

The patient was ventilated with 40% oxygen in air using a Bain's circuit. Mechanical ventilation was provided with a tidal volume of 500 mL and respiratory rate of 10 bpm (minute ventilation of 5.2 $L.min^{-1}$), which produced a peak inspiratory pressure of 16 cmH_2O. At 10^{th} min of carbondioxide insufflation, the end-tidal CO_2 pressure increased to 45 mmHg, the tidal volume was then increased to 600 mL and the ventilatory rate to 12 bpm (minute ventilation of 7.2 $L.min^{-1}$) which resulted in a peak inspiratory pressure of 23 cmH_2O. After this manipulation of ventilatory parameters analysis of arterial blood gases revealed a pH of 7.31, P_aCO_2 of 42 mmHg, P_aO_2 of 125 mmHg, and bicarbonate of 20 $mmol \cdot L^{-1}$. During surgery, the intra-abdominal pressure was kept below 14 mm Hg and minute ventilation was adjusted to prevent hypercarbia targeting the end-tidal CO_2 between 33-38 mmHg. The highest end-tidal CO_2 observed was 56 mmHg at the 90^{th} min of operation which didn't last for long as we manipulated the respiratory rate until 18-19 bpm without changing tidal volume. There was minimal blood loss, almost negligible. Total urinary output was 250ml which was more than 1 ml. $kg^{-1}.h^{-1}$.

The vital signs remained stable throughout the operation and paroxysmal tachycardia or any other arrhythmias was not seen on the ECG monitoring. At the end of the procedure which lasted for about 140 minutes, we ventilated the patient till the neuromuscular blockade wore off which was confirmed on TOF monitorization and extubated thereafter without decurarization with neostigmin. One hour after extubation in the post anesthetic care unit, her blood gas analysis was within normal limits (pH: 7.38 P_aCO_2: 40 mmHg P_aO_2: 90 mmHg HCO_3: 20 $mmol \cdot L^{-1}$). Her postoperative course was uncomplicated. Her urinary discharge and laboratory findings including kidney function tests were all within normal limits throughout her course in the wards. There was no episode of arryhtmia in her postoperative course and she was discharged home on the third postoperative day.

DISCUSSION

We present our case with the diagnosis of Wolff-Parkinson-White syndrome who was laparoscopically operated for her nonfunctional left kidney and managed successfully under total intravenous anesthesia (TIVA) with propofol and remifentanil infusion. Applying the optimal monitorization and absolute principles of anesthesia for laparoscopy we have instituted an uneventful peri and postoperative period for the patient.

Laparoscopy induces particular pathophysiological changes in response to pneumoperitoneum. Stress responses to laparoscopic surgery are well-known. The pneumoperitoneum necessarily rises intraabdominal pressure (IAP), which can have significant cardiovascular, respiratory, and neurological effects. Tachyarrhythmia can occur because of increased concentrations of carbon dioxide and catecholamines. Paroxysmal tachycardia and hypertension, followed by ventricular fibrillation, have been reported during laparoscopic adrenalectomy.[5]

The extent of the cardiovascular changes associated with creation of pneumoperitoneum will depend on the IAP attained, volume of carbon dioxide absorbed, patient's intravascular volume, ventilatory technique, surgical conditions, and anesthetic agents used. However, the critical determinants of cardiovascular function during laparoscopy are the IAP and patient position. The cardiovascular system changes occurring during CO_2 pneumoperitoneum result from two main factors: hypercarbia (and the subsequent acidosis) and increased intra-abdominal pressure. Hypercarbia and acidosis can cause heamodynamic changes by direct action on the cardiovascu-

lar system and by an indirect action through sympathoadrenal stimulation. At the cellular level hypercarbia is a direct depressor of myocardial contractility and a direct stimulant of myocardial irritability and arrhythmicity.[6] Hypercarbia can only be avoided by a compensatory hyperventilation by increasing the tidal volume of ventilation in anesthetized patients. In our case intra-abdominal pressure was kept below 14 mm Hg and minute ventilation was adjusted to prevent hypercarbia.

Retroperitoneal insufflation of carbon dioxide used for urological procedures may potentially cause CO_2 accumulation. The retroperitoneal space is very vascular and contains areolar tissue, so that absorption of CO_2 may be greater during retroperitoneal than intraperitoneal laparoscopy.[7] Studies differed concerning the extent of CO_2 absorption during retroperitoneoscopy. But Streich et al.[7] and Wolf et al.[8] found that retroperitoneal CO_2 insufflation causes more absorption of it than intraperitoneal insufflation and controlled ventilation should be increased if hypercapnia should be avoided. Streich et al also proposed that during retroperitoneal insufflation carbon dioxide absorption persists after exsufflation; and persistent CO_2 accumulation during the early postoperative period should be considered in the postoperative care of compromised patients. On the other hand retroperitoneal laparoscopy has some advantages compared with transperitoneal laparoscopy. It causes only a small increase in IAP; Chiu et al. reported an increase of 3 mmHg.[9] With retroperitoneoscopy, there is little stimulation of the peritoneum and, hence, less sympathetic response and less catecholamine release; as a result fewer hemodynamic changes occur.[10]

Maintenance of good acid base balance and body temperature will also minimize attacks of paroxysmal supraventricular tachycardia (PSVT). The incidence of cardiac arrhythmias occuring during laparoscopy was studied by Scott et al. comparing carbon dioxide and nitrous oxide insufflation.[11] They found multiple arrhythmias in CO_2 group, the commonest variety being fusion beats due to ventricular ectopic beats which were referred to the higher levels of $PaCO_2$ in the blood gas determinations.

We preoperatively discussed the patient with the team planning the surgery about the procedure and surgical technique. As the team was experienced on laparoscopy they preferred laparoscopic intervention rather than open nephrectomy in order to get use of advantages of laparoscopy regarding less blood loss, less postoperative complications including cardiorespiratory ones and fast recovery. They also preferred retroperitoneal insufflation rather than intraperitoneal, as retroperitoneoscopy maintains a small increase in intraabdominal pressure and less sympathetic response and less catecholamine release, all of which could be advantageous for such a patient. The potential of CO_2 accumulation due to retroperitoneal insufflation necessitates optimum monitorization of carbon dioxide. Perioperatively we used radial artery catheterization for frequent blood gas analysis (ABG) in accordance with end-tidal CO_2 monitorization in order to prevent hypercarbia. For general anesthesia in patients with WPW the anesthetic plan should reduce sympathetic outflow during periods of stress, such as induction and stimuli of laryngoscopy which can trigger supraventricular tachycardia (SVT). Anesthetic drugs tend to change the physiology of the atrio-ventricular conduction. In dealing with the sudden manifestation of WPW pattern intraoperatively, drugs that can precipitate tachycardia (atropine, glycopyrrolate, ketamine) resulting in PSVT or atrial fibrillation should be avoided. Pancuronium should be avoided for muscle relaxation because of its sympathomimetic activity, which reportedly caused a supraventricular tachycardia with ventricular rate of 280 bpm in a neonate with WPW.[12]

Vecuronium because of its cardiostable effect may be preferable over pancuronium, Of the never muscle relaxants cis-atracurium may be the agent of choice because of its high autonomic safety ratio and absence of histamine release.[13] Neostigmine by slowing AV nodal conduction may facilitate transmission via the accessory pathway and has been implicated to cause atrial fibrillation

with a rapid ventricular rate.[13] Avoidance of neostigmine has also been recommended in patients of WPW syndrome. As we monitored neuromuscular blockade of vecuronium we used during the operation, extubation of the patient without decurarization with neostigmin could be possible and safe for us.

Propofol has no clinically significant effect on the electrophysiologic expression of the accessory pathway and the refractoriness of the normal AV conduction system. In addition, propofol has no direct effect on SA node activity or intraatrial conduction.[14-16] So it is a preferred induction agent. There are references showing disappearance of delta waves on propofol induction.[17] Taken all these data into account, we chose propofol for the induction and maintenance of anesthesia.

Depth of anesthesia may influence the neurohumoral release, including catecholamines. It is desirable that the depth of anesthesia is adequate to suppress any sympathetic response to surgical stimulation to prevent the induction of tachyarrhythmia. Opioids depress general sympathetic activation in a dose-dependent manner so in our case we used remifentanil infusion for the maintenance of anesthesia. To our knowledge, we think it has not been used in the anesthetic management of any patient with Wolff-Parkinson-White syndrome in the literature but we have chosen it for TIVA, as it is a short-acting opioid and it is easy to manipulate the dosage under infusion according to heamodynamics and anesthesia depth. Other opioids such as fentanyl, sufentanil and alfentanil have been used for the anesthesia of WPW patients. The effect of fentanyl on atriovetricular (A-V) conducting system and accessory pathway is controversial. Gomez-Arnau et al. found that fentanyl had no effect on accessory pathway conduction in patients with WPW.[18] However a previous study in dogs of the effects of fentanyl on conduction in the normal A-V conduction system demonstrated prolongation of nodal conduction and functional refractory periods.[19] Whereas sufentanil has minimal effect on conduction.[20] Alfentanil shares many of the cardiovascular properties of fentanyl and sufentanil, however it has been shown to have no effect upon A-V conduction or accessory pathways.[21]

Unfortunately we didn't have the opportunity to monitore the depth of anesthesia objectively by means of bispectral index monitoring, but we maintained and arranged remifentanil infusion according to clinical clues of anaesthesia depth such as tachycardia, hypertension, pupil size and sweating. It was a limitation of our case in that aspect.

Drugs that prolong the refractory period of the AV node result in a higher rate of transmission through the accessory pathway and paradoxically increase the ventricular rate. This could have disastrous consequences possibly causing the arrhythmia to deteriorate into ventricular fibrillation. Thus, such drugs including lidocaine are contraindicated in WPW associated atrial fibrillation (AF). Akhtar et al showed that 100mg and 150mg lidocaine had no effect on ventricular rate in patients with a short effective refractory period of the accsessory pathway and a rapid ventricular response during AF in patients with WPW, but they don't still recommend to use lidocaine in such patients unless facilities for immediate cardioversion are available.[22] We used 1 $mg.kg^{-1}$ lidocaine safely to suppress response to laryngoscopy before induction of anesthesia as the patient's rhythm was neither atrial fibrillation nor any other arrhythmia which was confirmed by the preoperative ECG findings shown on Figure 1. But it can be omitted during induction as well, under a well management of deep anesthesia.

CONCLUSİON

The present case report suggests that laparoscopic operations, even retroperitoneoscopy, which has previously been shown to cause more carbon dioxide accumulation shall be safe and uneventful for the patients with Wolff-Parkinson-White syndrome under a well-managed anesthesia. Moreover, the duration of retroperitoneal insufflation and the skill and experience of the surgeon are also of great importance. Our study demonstrates that total intravenous anesthesia with propofol and remifentanil

infusions for anesthetic management of retroperitoneoscopy of patients with WPW syndrome is safe and effective provided that the meticulous monitorization and adequate care is maintained. But still further controlled studies are needed to define appropriate conditions.

Although combination of propofol and remifentanil proved useful, the report of a solitary case does not justify their use, and planned human trials are mandatory to ensure their efficacy in cardiac patients with accessory conduction pathway.

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