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INFRACLAVICULARBRACHIALPLEXUSBLOCK AND SUGAMMADEX USE IN A PAEDIATRIC PATIENT WITH WOLFF–PARKINSON–-WHITE SYNDROME

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Abstract

Background: Wolff–Parkinson–White (WPW) syndrome is a rare disease that can cause various patterns of tachyarrhythmias. The main goal of anaesthesiologists for the perioperative anaesthetic management of WPW patients must be to avoid sympathetic stimulation and prevent tachyarrhythmias.
Case: A 9-year-old male patient with a diagnosis of WPW syndrome, who underwent emergency surgery for supracondylar humerus fracture, is presented. General anaesthesia in combination with infraclavicular brachial plexus (ICBP) block was performed successfully without any complications. For the reversal of neuromuscular block, sugammadex was uneventfully used. Intraoperative sympathetic discharge due to surgical intervention was prevented with ICBP block. The ICBP block has also provided good postoperative analgesia.
Conclusions: Sugammadex is a good alternative for the reversal of neuromuscular blocks to avoid the undesirable effects of cholinergic drugs. Peripheral regional blocks that require relatively large doses of local anaesthetics can be safely performed with utmost attention in paediatric WPW patients.

Keywords

brachial plexus block • child • orthopaedics • rare diseases • sugammadex • Wolff–Parkinson–White syndrome

Introduction

Wolff–Parkinson–White (WPW) syndrome is a rare disease with the electrocardiogram (ECG) findings of sinus tachycardia, a bundle-branch block QRS morphology and a shortened PR interval. The WPW pattern of ECG is only an ECG diagnosis that may present 10–100 times more frequently in individuals than in those who have WPW syndrome (which represents the patients with symptomatic arrhythmias). The prevalence of WPW syndrome in the population is around 0.3%, and the syndrome is thought to be responsible for 0.5%–4% of sudden cardiac deaths [1].

The main pathophysiology of WPW is the pathological atrioventricular (AV) conduction through an accessory pathway (AP) (bundle of Kent) instead of the AV node [2]. This AP conducts the impulses faster than normal conduction of the AV node, resulting in tachycardias. Additionally, the AP can conduct the impulses in both antegrade (AV) and retrograde (ventriculoatrial) directions, which can cause a variety of tachyarrhythmia patterns including supraventricular tachycardias, re-entry tachycardias, atrial fibrillation and ventricular tachycardias [3].

Almost all of the anaesthetic drugs have several effects on the heart's conduction system. Furthermore, invasive and surgical interventions aggravate sympathetic stimulation. Therefore, the main goal of anaesthesiologists for the perioperative anaesthetic management of WPW syndrome patients must be to avoid sympathetic stimulation and prevent tachyarrhythmias. In this case report, a successful anaesthetic and pain management of a paediatric surgical patient with WPW syndrome is presented.

Case report

Parent consent for publication was obtained. A 9-year-old, American Society of Anaesthesiologists class 2, 31 kg, male paediatric patient was evaluated for emergent surgery for left supracondylar humerus fracture. He was diagnosed as WPW when he was 5 and then prescribed medical treatment, after which he underwent unsuccessful catheter ablation. It was learnt from the parents that he had no symptomatic arrhythmic events in the last year and he discontinued his medical treatment. His preoperative ECG showed a sinus arrhythmia at 97 beats per minute, a delta wave and a short PR interval. Examination of other systems and routine laboratory tests showed them to be

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normal. Paediatric cardiology was consulted preoperatively for further recommendations.

A defibrillator and amiodarone were recommended to be kept readily available in the operating room for the treatment of any potential tachyarrhythmias. Routine monitoring of non-invasive blood pressure, 5-lead ECG and oxygen saturation (SpO_2) were established. The patient's heart rate was 87 bpm (arrhythmic), blood pressure was 121/73 mmHg, and SpO_2 was 99%. He was premedicated with midazolam 1 mg, and anaesthesia induction was done with fentanyl 1 μg kg^{-1} (30 μg), propofol 2 mg kg^{-1} (60 mg) and rocuronium 0.3 mg kg^{-1} (6 mg). Following intubation (No: 5.5, cuffed, spiral tube), the heart rate was 92 bpm. Sevoflurane 1% and 50% oxygen and air mixture, and remifentanil 0.05 μg kg^{-1} min^{-1} were used for the maintenance of general anaesthesia (bispectral index:45±5). Before surgery, the ultrasound-guided infraclavicular block was performed with 9 ml of bupivacaine 0.5% (without adrenaline, 0.3 ml kg^{-1}). Open reduction and stabilisation were performed for the fracture in the right lateral position. The surgery ended after 90 min uneventfully. After detection of a train-of-four ratio of 47% with a neuromuscular monitor, sugammadex 1 mg kg^{-1} was administered as a reversal agent. He was extubated when he gained adequate muscular strength. No ECG changes were observed either during the surgery or following extubation. The patient was followed up in the post-anaesthesia care unit for 30 min. He was fully conscious, cooperative and painless. There were no changes in his postoperative ECG (heart rate: 88 bpm). Then he was transferred to the orthopaedics ward.

The patient was pain free for 7 h postoperatively. Following the end of the sensory block, postoperative pain management was maintained with oral paracetamol. He was discharged from the hospital on the second postoperative day.

Discussion

Patients with WPW are susceptible to sympathetic activity; therefore, these patients are at high risk of perioperative lethal arrhythmias [4]. All precautions should be taken to prevent and treat perioperative tachyarrhythmias. In haemodynamically stable patients, supraventricular tachyarrhythmias can be treated pharmacologically with drugs such as adenosine, phenylephrine and beta-blockers [5]. However, if the patient is haemodynamically unstable, cardioversion is indicated [6]. For prevention of increasing blood catecholamine levels in the perioperative period, the preferred anaesthetic agents must have minimal haemodynamic effects. Accordingly, the use of regional anaesthetic techniques would be beneficial to blunt sympathetic activity and reduce polypharmacy [5]. However, if the choice is general anaesthesia, supraglottic airways are recommended to avoid the stress response to laryngoscopy and intubation, if possible [7]. In the present case, an infraclavicular brachial plexus block was performed after the induction of general anaesthesia. Nevertheless, endotracheal intubation was preferred because of the lateral positioning. Laryngoscopy was gently performed with a minimal sympathetic response.

Patients with WPW syndrome usually need general anaesthesia for electrophysiology studies (EP) or non-EP surgeries. In EP procedures, anaesthetic drugs should not have any effect (or have only minimal effect) on the cardiac conduction system because a suppressed AP would lead to difficulty in mapping and ablation of AP [7]. However, in non-EP surgeries, anaesthetic drugs should not induce (or must prevent) WPW-related arrhythmias.

Propofol is thought to be an appropriate anaesthetic drug for EP studies. Although there have been studies supporting the idea that propofol has no direct effects on the sinoatrial node (SA), AV node and AP conduction, it was stated in a recent study that AP conduction can be suppressed with propofol [8]. Thiopentone is considered to be safe, but it has negative haemodynamic effects. Ketamine should be avoided because of its sympathetic stimulant effect [9]. Etomidate may be preferred for its property of a stable cardiovascular profile.

Volatile agents have various effects on the cardiac conduction system. Volatile anaesthetics may both induce dysrhythmias or act as class III anti-arrhythmic drugs [10]. Of the volatile agents, sevoflurane has been shown to have no effects on the SA node, AV and AP conduction in adult patients with WPW syndrome [11, 12]. Thus, this feature makes sevoflurane a suitable agent for both EP studies and non-EP procedures. Desflurane has a prolonging effect on the refractory period of AP, and no adverse effects have been reported regarding nitrous oxide [13]. Halothane is the least favourable agent because it sensitises the myocardium to catecholamines. Enflurane has more prolonging effect on the refractory period of AP than isoflurane, which makes enflurane more suitable for WPW patients who undergo non-EP procedures [14]. In this case, sevoflurane was used without any complications.

Regarding opioids, it is better to avoid pethidine due to its atropine-like effect [15]. Alfentanil, sufentanil and fentanyl do not have any effect on the refractory period of AP [11, 14]. Remifentanil may inhibit both interatrial conduction and sinus node automaticity, but it does not affect conduction through the AV node [16]. Furthermore, fentanyl and propofol combination is shown to be more likely to enhance cardiac vagal tone [17]. In this report, balanced anaesthesia was provided for the paediatric patient, and no haemodynamic fluctuations were observed during the maintenance of anaesthesia.

For muscle relaxants, succinylcholine is known to have an arrhythmogenic effect on the heart. Among the non-depolarising muscle relaxants, atracurium may cause autonomic instability due to histamine release and pancuronium may trigger supraventricular tachycardias by accelerating AV conduction

and heart rate. Rocuronium, vecuronium and cisatracurium may be the optimal choices for general anaesthesia.

The reversal of neuromuscular blockade is a challenge for anaesthesiologists. Combinations of anticholinesterase and anticholinergic drugs may cause severe arrhythmias. Atrial fibrillation with a wide QRS complex has been reported after administration of neostigmine in a patient with WPW syndrome [18]. Atropine and glycopyrrolate act by accelerating conduction that leads to tachycardia. To date, two cases of successful sugammadex use for the reversal of neuromuscular block have been described [19, 20]. Sugammadex was also used uneventfully in this case.

To prevent a sympathetic discharge in response to surgical intervention, infraclavicular brachial plexus block, which has been increasingly used in the paediatric population, was performed in this youngster. This report represents that peripheral regional blocks with bupivacaine can be safely administered without any cardiac complications in children with WPW syndrome. Besides, care should be taken to avoid accidental intravascular injection, especially in regional blocks performed with large volumes of local anaesthetic. Although regional anaesthesia is the recommended technique, there are only a few reports in the literature regarding the use of neuraxial anaesthesia in WPW patients [5, 9, 21–24]. Most of the reported complications due to regional blocks in hereditary heart diseases were encountered following a high level of neuraxial blocks (because of sympathetic denervation) [7, 25, 26]. Local anaesthetic toxicity has not yet been reported in WPW patients, even in epidural anaesthesia which requires a relatively large dose of local anaesthetic. In this case, ultrasound-guided infraclavicular brachial plexus block was performed with a reduced volume of bupivacaine [27] without any toxic events. While pain itself can cause sympathetic activation, postoperative pain management is very important in these patients as well. The infraclavicular brachial plexus block has also provided good postoperative analgesia and reduced the analgesic requirements in this patient.

In conclusion, sugammadex is a good alternative for the reversal of neuromuscular blocks to avoid the undesirable effects of cholinergic drugs. Regional blocks that require relatively large doses of local anaesthetics can be safely performed with utmost attention in paediatric WPW patients.

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