Anesthetic management of Wolff-Parkinson-White Syndrome

Daniel Crosby, BSN
Westminster College

December 13, 2013
dannygcrosby@gmail.com

Keywords: Wolff-Parkinson-White syndrome, accessory pathway, arrhythmia, general anesthesia, ventricular pre-excitation

Wolff-Parkinson White syndrome (WPW) is a ventricular pre-excitation syndrome resulting from an aberrant conduction pathway between the atria and ventricles known as "bundle of Kent." Undiagnosed WPW can be worrisome under anesthesia because some anesthetic drugs have a tendency to alter the physiology of atrioventricular (AV) conduction resulting in life-threatening arrhythmias. Also, any increase in sympathetic activity can be arrhythmogenic in patients with WPW. Therefore, anesthetic management of these patients should be customized according to the surgical procedure and the presenting condition of the patient. The following is a case report for WPW under general anesthesia for diagnostic laparoscopy.

Case Report

A 19-year-old female with a past medical history significant for mild congestive heart failure, cerebrovascular accident, ventricular septal defect (VSD), WPW, gastroesophageal reflux disease (GERD), and a five pack-year smoking history presented for diagnostic laparoscopy due to chronic pelvic pain and severe dysmenorrhea unresponsive to medical treatment. The patient had undergone general anesthesia once previously for repair of VSD without any anesthetic or surgical complications. The patient's medication regime included only omeprazole 20 mg daily. She did not have any drug allergies. On pre-anesthetic evaluation, the patient was comfortable with a heart rate of 100 beats per minute, blood pressure of 129/84 mm Hg, SpO₂ was 98%, and respirations were unlabored at 14 breaths per minute. A complete blood count and a type and cross match were drawn with no abnormal results.

The patient was premedicated with midazolam 2 mg and fentanyl 50 mcg intravenously (IV) in the preoperative holding area. Once in the operating room, one hundred percent oxygen was administered via facemask and standard AANA monitors were applied in addition to a Zoll® monitor with defibrillator pads. Antiarrhythmic drugs including adenosine, esmolol, lidocaine, and amiodarone were also available and prepared for use. Following preoxygenation, IV fentanyl 100 mcg, lidocaine 80 mg, propofol 170 mg, and rocuronium 45 mg were administered for induction of anesthesia. Placement of a 7.0 mm oral endotracheal tube was confirmed by the presence of bilateral breath sounds, and end tidal CO₂ on capnography.
General anesthesia was maintained with delivery of 2.5% expired Sevoflurane in combination with oxygen 1 L/min and air 1 L/min. Fentanyl was administered in 50 mcg intervals and IV morphine was titrated to a respiratory rate of 11 breaths per minute towards the end of the case with a total of 4 mg given. Lead II was used for intraoperative electrocardiograph (ECG) monitoring which sustained the expected findings of a shortened PR interval, delta wave, and widened QRS as seen on the preoperative 12-lead ECG. Neuromuscular blockade was antagonized with administration of IV glycopyrrolate and neostigmine. An uneventful deep extubation was performed and the patient had a smooth emergence. An agreeable postoperative recovery without any adverse events or anesthetic complaints ensued. In post-anesthesia recovery, she was comfortable, alert, and oriented. Vital signs included a pulse rate of 99 beats per minute, blood pressure of 121/84 mm Hg, respiratory rate of 12 breaths per minute, and 100% SpO₂.

Discussion

WPW syndrome is the most common form of preexcitation, which refers to early depolarization of the ventricles by an abnormal conduction pathway from the atria. However, WPW, with an incidence of approximately 0.3%, is not extremely common in the general population. This cardiac conduction disorder may not always be detected preoperatively, as it is rarely recognized without an accompanying arrhythmia. Diagnosis may be accomplished via a thorough history along with telltale ECG changes which include a slurring of the QRS complex known as a delta wave, a shortened PR interval, and a lengthened QRS complex. These notorious ECG changes are the result of ventricular contraction being triggered by the confluence of a faster, aberrant pathway impulse with the normal AV nodal pathway impulse. When an action potential follows the deviant pathway, it bypasses the AV node and its physiologic delay in impulse transmission, resulting in early depolarization of the part of the ventricle where the accessory pathway ends. This is the source of the short PR interval and slurring of the QRS complex. The rest of the ventricular muscle is usually depolarized as the normal pathway impulse catches up, resulting in a widened QRS complex. These patients are susceptible to life threatening tachyarrhythmias such as paroxysmal supraventricular tachycardia, atrial fibrillation (A-fib), atrial flutter, ventricular tachycardia, and ventricular fibrillation. In addition, preexcitation can be associated with other cardiac anomalies, including Ebstein's anomaly, mitral valve prolapse, and cardiomyopathies. Situations and factors which can trigger arrhythmias related to the delivery of anesthesia include drug administration, direct laryngoscopy, tracheal intubation, surgical stimulation, light plane of anesthesia, pain, hypercapnia, acidosis, and even transient hypoxia. Therefore, regional anesthesia is the preferred anesthetic technique when appropriate, due to the avoidance of direct laryngoscopy and anesthetic drugs that can alter AV nodal physiology. Epidural is preferred over spinal anesthesia due to controlled, segmental block, avoidance of polypharmacy, and better hemodynamic stability.
Drugs which precipitate tachycardia such as the antimuscarinics (atropine, glycopyrrolate), histamine releasing agents (atracurium), vagolytics (pancuronium) and sympathomimetics (ketamine, ephedrine), particularly beta-1 agonists, can be disadvantageous in patients with WPW and should be avoided when possible.\textsuperscript{2} Sevoflurane and isoflurane have no effect on accessory pathway conduction, and isoflurane is the preferred volatile agent for WPW as it actually suppresses the accessory pathway.\textsuperscript{3} Other drugs that have either a beneficial effect or no effect on aberrant pathway conduction and can be safely used include propofol, fentanyl, droperidol, thiopental, rocuronium, cis-atracurium, mivacurium, benzodiazepines, and nitrous oxide. Additional drugs that can be detrimental and should be avoided include halothane, neostigmine, digitalis, verapamil, and oxytocin. Digitals and verapamil can dangerously accelerate the ventricular response in A-fib and atrial flutter because they decrease conduction through the AV node, thus favoring conduction via the accessory pathway.\textsuperscript{1,2,3,4}

Laparoscopic surgery usually necessitates general anesthesia and endotracheal intubation in order to prevent aspiration and respiratory compromise from induction of pneumoperitoneum. There are however, several case reports of laparoscopic surgery being performed under regional anesthesia including spinal and epidural blockade. With this particular patient's history of GERD, it was determined that a balanced general anesthetic with modified rapid sequence induction and endotracheal intubation with cricoid pressure was the safest option. Had isoflurane been available at this particular facility, it would have been the agent of choice for maintenance of general anesthesia. Sevoflurane was the next best available option. The risks and benefits of reversing neuromuscular blockade were weighed judiciously. A slightly lower dose of glycopyrrolate (0.4 mg) with neostigmine 3 mg was given, which produced no significant change in heart rate and sufficient reversal of neuromuscular blockade as evidenced by 4:4 train of four response with sustained tetany. Until a more ideal drug is available, glycopyrrolate is preferred over atropine when antimuscarinic administration is necessary.\textsuperscript{4} Deep extubation is a prudent option to avert the negative consequences of sympathetic stimulation on emergence from general anesthesia. Use of a larngyoatracheal anesthesia kit would also be beneficial in that respect.

Patients who are hemodynamically stable and comfortable usually do not require any treatment pre-operatively.\textsuperscript{5} However, thoughtful preparation, as with most anesthetics, can mean the difference between life and death for patients with WPW. Drugs such as adenosine, phenylephrine, beta blockers, and antiarrhythmics should be available and ready. A defibrillator should also be on hand. If an arrhythmia arises resulting in hemodynamic instability, direct cardioversion is indicated.\textsuperscript{6} In hemodynamically stable patients, class-1 antiarrhythmics such as disopyramide, lidocaine, and procainamide, as well as the calcium channel blocker, diltiazem can be used to interrupt re-entrant tachycardias.\textsuperscript{2,4}

Despite its infrequent occurrence in the general population, WPW will likely be encountered by all anesthesia professionals at some point in their careers. Commonly, patients will not have been diagnosed with WPW, and a sudden manifestation of WPW under anesthesia can be life
threatening. Therefore, it is important for the anesthesia provider to know and understand WPW, the effects of anesthetic drugs, and how to safely manage these patients.

**Mentors:** James Stimpson CRNA, DNP  
jstimpson@westminstercollege.edu  
Dee Bambrough CRNA  
deebambi@hotmail.com
References


Abstract

Wolff-Parkinson White syndrome (WPW) is an electrophysiological abnormality in which an aberrant conduction pathway exists between the atria and ventricles of the heart. With an incidence of 0.3% in the general population, it is likely that WPW will be encountered by almost all anesthesia providers at some point in their careers. Fundamentally, the safe management of these patients necessitates a sound understanding of the pathophysiology of WPW, the effects of anesthetic and adjuvant drugs on cardiac impulse conduction, factors that may precipitate life-threatening arrhythmias, and how these arrhythmias should be treated. Although regional, specifically epidural, anesthesia is the most ideal anesthetic technique for patients who have WPW, these patients can be safely managed under general anesthesia. The anesthetic technique should be suited to the individual patient as well as the procedure requiring anesthesia services. The following case report demonstrates safe management of a 19 year old female with WPW undergoing general anesthesia for diagnostic laparoscopy, provides a review of WPW pathophysiology, and includes a discussion on the essentials of delivering a safe anesthetic and better patient outcomes.
Three objectives that utilize a higher level of learning in Bloom's Taxonomy:

Objective #1- Students will differentiate between Wolff-Parkinson White syndrome and other cardiac conduction abnormalities based on electrocardiogram findings and explain these specific changes related to its pathophysiology.

Objective #2- Students will tailor, revise, and justify modifications in their anesthetic plan to improve patient safety and outcomes for patients with Wolff-Parkinson White syndrome.

Objective #3- Students will appraise the safety of anesthetic drugs, adjuvant medications, and treatment options for patients with Wolff-Parkinson White syndrome to determine the most appropriate medications, techniques and interventions.
Multiple Choice Questions:

#1- Wolff-Parkinson White syndrome may be identified on an electrocardiogram by all of the following, except:
A. a delta wave
B. a shortened PR interval
C. a prolonged PR interval
D. a lengthened QRS complex

Answer- C: Diagnosis may be accomplished via a thorough history along with telltale ECG changes which include a slurring of the QRS complex known as a delta wave, a shortened PR interval, and a lengthened QRS complex.

#2- The anesthetic technique of choice for a patient with Wolff-Parkinson White syndrome undergoing a total vaginal hysterectomy would be:
A. Regional spinal
B. Regional epidural
C. General ETT
D. General LMA

Answer- B: Regional anesthesia is the preferred anesthetic technique when appropriate, due to the avoidance of direct laryngoscopy and anesthetic drugs that can alter AV nodal physiology. Epidural is preferred over spinal anesthesia due to controlled, segmental block, avoidance of polypharmacy, and better hemodynamic stability.

#3- Factors that can trigger arrhythmias related to the delivery of anesthesia in patients who have Wolff-Parkinson White syndrome include (select five that apply):
A. direct laryngoscopy,
B. light plane of anesthesia
C. adequate analgesia
D. hypoxia
E. hypercapnia
F. tracheal intubation
G. alkalosis

Answer- A,B,D,E,F: Situations and factors that can trigger arrhythmias related to the delivery of anesthesia include drug administration, direct laryngoscopy, tracheal intubation, surgical stimulation, light plane of anesthesia, pain, hypercapnia, acidosis, and even transient hypoxia.

#4- All of the following may be deleterious when administered to a patient with Wolff-Parkinson White syndrome, except:
A. beta-1 antagonists
B. antimuscarinics
C. histamine releasing agents
D. ketamine
Answer: A: Drugs that precipitate tachycardia such as the antimuscarinics (atropine, glycopyrrolate), histamine releasing agents (atracurium), vagolytics (pancuronium) and sympathomimetics (ketamine, ephedrine), particularly beta-1 agonists, can be disadvantageous in patients with WPW and should be avoided when possible. Beta-1 antagonists may be used to treat tachyarrhythmias associated with WPW.

#5- The volatile anesthetic which suppresses the accessory pathway conduction and is the volatile agent of choice in patients with Wolff-Parkinson White syndrome is:
A. Sevoflurane
B. Desflurane
C. Halothane
D. Isoflurane

Answer: D: Sevoflurane and isoflurane have no effect on accessory pathway conduction, and isoflurane is the preferred volatile agent for Wolff-Parkinson White syndrome as it actually suppresses the accessory pathway.

#6- Two drugs that should be strictly avoided because they can dangerously accelerate the ventricular response to atrial fibrillation and atrial flutter in patients with Wolff-Parkinson White syndrome by decreasing conduction through the AV node are:
A. ketamine and ephedrine
B. verapamil and digoxin
C. benzodiazepines and mivacurium
D. disopyramide and diltiazem

Answer: B: Digitals and verapamil can dangerously accelerate the ventricular response in atrial fibrillation and atrial flutter because they decrease conduction through the AV node, thus favoring conduction via the accessory pathway.

#7- If administration of an antimuscarinic is necessary, which agent is preferred for patients with Wolff-Parkinson White syndrome:
A. ipratropium
B. atropine
C. glycopyrrolate
D. scopolamine

Answer: C: Until a more ideal drug is available, glycopyrrolate is the agent of choice when antimuscarinic administration is necessary.

#8- The incidence of Wolff-Parkinson White syndrome in the general population is approximately:
A. 13%
B. 0.005%
C. 5%
D. 0.3%
Answer- D: With an incidence of approximately 0.3%, WPW is not extremely common in the general population.

#9 You are managing a 19 year old female who has Wolff-Parkinson White syndrome under general anesthesia for a laparoscopic cholecystectomy. Suddenly, a supraventricular tachyarrhythmia arises, resulting in significant hemodynamic instability. Which of the following is indicated:
A. direct cardioversion
B. a diltiazem drip
C. no treatment is required
D. IV lidocaine 1.5 mg/kg

Answer- A: If an arrhythmia arises resulting in hemodynamic instability, direct cardioversion is indicated. In hemodynamically stable patients, class-I antiarrhythmics such as disopyramide, lidocaine, and procainamide, as well as the calcium channel blocker diltiazem, can be used to interrupt re-entrant tachycardias.

#10- Which of the following statements is not true regarding Wolff-Parkinson White syndrome:
A. Patients who are hemodynamically stable and comfortable usually do not require any treatment pre-operatively.
B. WPW may not always be detected preoperatively as it is rarely recognized without an accompanying arrhythmia.
C. WPW is so extremely rare that most anesthesia providers will not encounter it during their career.
D. WPW can be associated with other cardiac anomalies, including Ebstein's anomaly, mitral valve prolapse, and cardiomyopathies.

Answer- C: Despite its infrequent occurrence in the general population, WPW will likely be encountered by all anesthesia professionals at some point in their career. A, B, & D are all true statements.