

# Anesthesia Protocol for Pediatric Cardiac Surgery Procedures



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## Introduction

This anesthetic protocol is applied to a patient population scheduled for routine procedures and / or urgency; special cases and special surgical procedures require dedicated care procedures. Patients undergoing cardiac surgery, with or without the use of extracorporeal circulation (CEC), as per protocol are rarely extubated in the operating room. In recent years there have developed anesthetic techniques of fast track anesthesia which however provide for a restoration of spontaneous breathing nently post-operative period with an extubation in the first four hours after the end of the surgical procedure. The use of sugammadex turns out to be of great help in all those doubtful cases where lack of or inadequate return of spontaneous ventilation is difficult to prove as related to depth of anesthesia and / or neuromuscular blockade, or to causes related to the disease, to the surgical procedures or cardiovascular conditions of the patients.

The use of sugammadex is obliged in all those situations in which a missed intubation or a technical difficulty may lead rapid deterioration in cardiac status in patients with complex disease, premature, malformed babies and heart disease. In this sense, our experience leads us to consider the sugammadex in the same way as a life-saving drug as it is an antidote.

## Special Cases

Syndromic patients, malformed, patients presenting notoriously difficult intubations:

- i. Availability in SW of fiberoptic bronchoscope and / or video laryngoscope; flexible 2.8 mm, 3.5 mm, 5 mm with tubes 3, 3.5, 4, 5 preassembled on flexible appropriate gauge.
- ii. Not my resolution.
- iii. Rapid induction with midazolam, propofol, TPS, sevoflurane, ketamine represented in the port to age, weight, condition, type of surgical procedure.
- iv. Larynx topical anesthesia with xylocaine 12 mg / kg (neonates, infants, up to 30 kg weight body)
- v. Intubation to be sedated.

- vi. Rocuronium from 0.9 to 1.2 mg / kg after certain intubation.

## Monitoring

### Induction

- i. Heart rate.
- ii. NIBP SpO<sub>2</sub>.

### Post Intubation

- i. Invasive Blood Pressure.
- ii. Pediatric Surgery / ENT.
- iii. Central venous pressure SpO<sub>2</sub>.
- iv. peripheral temperature.
- v. central temperature.
- vi. NIRS device two channels.

### Additional Monitoring in Particular Cases

- i. Surgical left atrial pressure (post CEC).
- ii. Pulmonary artery pressure.
- iii. Scvo<sub>2</sub>.

## Patients from Hyperflow Shunt Left-Right with or without Pulmonary Hypertension

### Patient weight <5 kg

- i. Premedication and research venous access
- ii. If you do infuse suspend feeding three hours before the procedure
- iii. You do not need give premedication to the patient
- iv. If there is cannulation of the umbilical vein induce anesthesia from such access and continue anesthesia from such access, which will be removed at the end of intervention
- v. If the peripheral venous access is difficult to obtain, induce anesthesia with sevoflurane 3.5-4% (titrate)

- vi. Not do more than two attempts to cannulate a peripheral vein or external jugular vein
- vii. Then find a central venous access.

### Anesthesia

**a. Induction:** Midazolam 1-2 mg / kg in slow bolus. Rocuronium 1.2 mg / kg.

**b. Retention:** Except that in particular conditions, maintenance procedures should be started immediately after the arterial cannulation, or immediately in hypertensive patients (eg: aortic coarctation) or in patients in whom we proceed to surgical cannulation of the vessels. TIVA: midazolam 2 to 8 mcg / kg / min. Alfentanil from 1 to 3 mcg / kg / min (do not administer boluses)- Rocuronium 1 mg / kg / h in continuous infusion. Rocuronium 0.5 mg / kg before incision; 0.5 mg / kg before entering the CEC. Possible supplementary dose of morphine 0.1 mg / kg bolus if the systemic arterial pressure is unstable upward sevoflurane 1-3%. Suspension of rocuronium immediately after the CEC, or during the sternal closing phase in the patient not in the CEC [1].

### Sugammadex

The administration of sugammadex is provided in all cases of fast track anesthesia for non-complex procedures even if carried out with the aid of CEC and in patients of this weight is not TOF guided due to problems of reliability of the detected value in the premature infant or low weight.

**a. Failure Intubation:** Sugammadex: 16 mg / kg in 30 seconds with restoration of spontaneously produce ventilation in 180 seconds. If not resume breathing spontaneously within 180 seconds repeat. Sugammadex: 6 mg / kg and then it repeats protocol as Special cases.

**b. Extubation Routine:** Sugammadex: 4 mg / kg bolus in a minute with restoration of spontaneous ventilation in 180 seconds.

### Patient Weight <10 kg >5 kg

Premedication and research venous access Suspend any fasting from 12 hours and suspend the administration of water from 4 hours. Midazolam 0.09 to 0.1 mg / kg + droperidol 1.25 mg rectally 30 min- utes before entering the operating room. If the peripheral venous access is difficult to obtain, induce anesthesia with sevoflurane 3.5-4% (titrate). Not do more than two attempts to cannulate a peripheral vein or external jugula vein. Find a central venous access [2].

### Anesthesia

**a. Induction:** Midazolam 1-2 mg / kg in slow. Bolus Rocuronium 1 mg / kg for induction.

**b. Retention:** Except that in the maintenance procedures should be started immediately after the arterial cannulation, or immediately in hypertensive patients (eg., coarctation of the aorta) or in patients who proceed to surgical cannulation of the vessels. Midazolam from 2 to 10 mcg / kg / min. Alfentanil from

1 to 3 mcg / kg / min (do not administer boluses). Rocuronium 1 mg / kg / h continuous infusion. Rocuronium 0.3 mg / kg before incision; 0.3 mg / kg prior to entry into CEC. Sevoflurane 1-2%. Suspension of rocuronium immediately after the CEC, or during the closing phase in the patient not in the CEC.

### Sugammadex

The administration of sugammadex is provided in all cases of fast track anesthesia for complex procedures even if not carried out with the aid of CEC and in patients of this weight is not TOF guided due to attendibility problems of the detected value in the patient who weighs less than 10 kg [3].

**a. Failure Intubation:** Sugammadex: 16 mg / kg in 30 seconds with restoration of spontaneously produce ventilation in 180 seconds. If not resume breathing spontaneously within 180 seconds repeat: Sugammadex: 6 mg / kg and then: It repeats protocol as per Special Cases.

**b. Extubation Routine:** Sugammadex: 3 mg / kg bolus in a minute with restoration of spontaneous ventilation in 180 seconds.

### Patient Weight >10 kg <30 kg

Premedication and research venous access suspend any fasting from 12 hours to suspend the administration of water from 4 hours. Midazolam 0.1 to 0.9 mg / kg + droperidol 2.5 mg rectally 30 minutes before entering the operating room. If the peripheral venous access is difficult to obtain, induce anesthesia with sevoflurane 3.5-4% (titrate). Not do more than two attempts to cannulate a peripheral vein or external jugular vein. Then find a central venous access [4].

### Anesthesia

**a. Induction:** Midazolam 0.5 mg / kg in slow. Bolus Propofol 1 mg / kg in a minute Rocuronium 1 mg / kg. Rocuronium 0.2 mg / kg before incision; 0.2 mg / kg prior to entry into CEC.

**b. Retention:** Except that in particular the maintenance procedures should be started immediately after the arterial cannulation, or immediately in hypertensive patients (eg., aortic coarctation) or in patients in whom we proceed to surgical cannulation of the vessels. TIVA: midazolam 2 to 10 mcg / kg / min propofol from 1 to 3 mg / kg / h (as an alternative to midazolam) TIVA: alfentanil from 1 to 3 mcg / kg / Min (do not administer boluses). Rocuronium 1 mg / kg / h in continuous infusion. Rocuronium 0.2 mg / kg before incision; 0.2 mg / kg prior to entry into CEC. Sevoflurane 1-2%. Suspension of rocuronium immediately after the CEC, or during the closing phase in the patient not in the CEC [5].

### Sugammadex

The administration of sugammadex is provided in all cases of fast track anesthesia for complex procedures even if not carried out with the aid of the CEC. TOF tour with TOF> 2. TOF not guided with spontaneous breathing in FR> 15 acts minute and End Tidal PCO2 <35 mmHg.

**a. Failure Intubation:** Sugammadex: 16 mg / kg in 30 seconds with restoration of spontaneously produce ventilation in 180 seconds. If not resume breathing spontaneously within 180 secondary to repeat: Sugammadex: 6 mg / kg and then: It repeats protocol as per Special cases.

**b. Extubation Routine:** Sugammadex: 3 mg / kg bolus in a minute with restoration of spontaneous ventilation within 180 seconds.

### Patient Weight > 30 kg

Premedication and research venous access suspend fasting by 12 hours. Suspend administration of water from 24 hours. Temazepam 5 mg, 1 tablet per os at 22. Temazepam 5 mg, 1 tablet by mouth 45 minutes before entering the operating room.

### Anesthesia

**a. Induction:** Midazolam 0.2 mg / kg bolus. Propofol 1-2 mg / kg bolus in a minute. Rocuronium 0.9 mg / kg.

**b. Retention:** The maintenance should be started immediately after the induction: before and during the patient technique maintain dosages to 50%; immediately before skin incision goes to regimen and after the CEC must be reduced by 50%. TIVA: Midazolam 2 to 10 mcg / kg / min. Propofol 1 to 3 mg / kg / h (as an alternative to midazolam). TIVA: Alfentanil 1 to 3 mcg / kg / min (do not administer boluses) Rocuronium 0.9 mg / kg / h in continuous infusion. Rocuronium 0.2 mg before incision; 0.2 mg before entering the CEC Sevoflurane 1-2%. Suspension of the administration of Rocuronium immediately after the CEC, or in the process of closing the patient in cases not in CEC [6].

### Sugammadex

The administration of sugammadex is provided in all cases of fast track anesthesia for complex procedures even if not carried out with the aid of the CEC. TOF tour with TOF > 2. TOF not guided with spontaneous breathing in FR > 15 acts minute and End Tidal PCO<sub>2</sub> < 35 mmHg.

**a. Failure Intubation:** Sugammadex: 16 mg / kg in 30 seconds with restoration of spontaneous ventilation within 180 seconds. If not resume breathing spontaneously within 180 secondary to repeat. Sugammadex: 10 mg / kg then it repeats protocol as per Special cases extubation routine. Sugammadex: 2 mg / kg bolus in a minute with restoration of spontaneous ventilation within 180 seconds.

### Pathology Patients with Type Cyanogen

#### Patient Weight < 5 kg

Premedication and research venous access if you do infuse suspend feeding three hours before the procedure you do not need premedication the patient if present cannulation of the umbilical vein induce anesthesia from such access and continue anesthesia from such access, which will be removed at the end of intervention if the peripheral venous access is difficult to obtain, induce anesthesia with sevoflurane 3.5-4% (titrate) not do more

than two attempts to cannulate a peripheral vein or external jugular vein then find a central venous access.

### Anesthesia

**a. Induction:** If the patient has a natural history of Tetralogy of Fallot (no s/p MBTS) co-administering immediately after venous cannulation 2 mEq / kg NaHCO<sub>3</sub>- and from 5 to 10 ml / kg of plasma expander solution. Midazolam 2 mg Midazolam further slow bolus 1 mg / kg. Ketamine 1-2 mg / kg slowly in at least 4 minutes Rocuronium 1-2 mg / kg.

#### b. Retention

Except in special maintenance procedures should be initiated immediately after the arterial cannulation, or immediately in patients who proceed to surgical cannulation of the vessels [6]. TIVA: Midazolam 2 to 8 mcg / kg / min. Ketanemine from 10 to 40 mcg / kg / h (non-administered boluses) Rocuronium 1 mg / kg / h

Rocuronium 0.2 mg before incision; 0.2 mg before entering the CEC. Possible supplementary dose of morphine 0.1 mg / kg bolus if the arterial pressure is unstable or there is severe desaturation (eg., In the case of no systemi-pulmonary shunt).

### Sugammadex

The administration of sugammadex is provided in all cases of fast track anesthesia for complex procedures even if not carried out with the aid of CEC and in patients of this weight is not guided TOF because of problems of attention's credibility of the detected value in premature babies or low weight.

**a. Failure Intubation:** Sugammadex: 16 mg / kg in 30 seconds with restoration of spontaneous ventilation nea within 180 seconds. If not resume breathing spontaneously within 180 secondary to repeat: Sugammadex: 6 mg / kg and then: It repeats protocol as per special cases.

#### b. Extubation Routine

Sugammadex: 4 mg / kg bolus in a minute with restoration of spontaneous ventilation within 180 seconds.

### Patient weight < 10 kg > 5 kg

Premedication and research venous access suspend any fasting from 12 hours to suspend the administration of water from 4 hours. Midazolam 0.09 to 0.1 mg / kg + droperidol 1.25 mg rectally 30 min- utes before entering the operating room. If the peripheral venous access is difficult to obtain, induce anesthesia with sevoflurane 3.5-4% (titrate) [7]. Not do more than two attempts to cannulate a peripheral vein or external jugular vein then find a central venous access.

### Anesthesia

**a. Induction:** If the patient has a natural history of Tetralogy of Fallot (no s/p MBTS) co-administering immediately after venous cannulation 2 mEq / kg NaHCO<sub>3</sub>- and from% to 10 ml / kg of plasma expanders. Midazolam 2 mg in slow bolus.

Midazolam additional 1 mg / kg bolus. Ketamine 1-2 mg / kg slowly in at least 4 minutes Rocuronium 1-2 mg / kg.

**b. Retention:** Except in special maintenance procedures should be initiated immediately after the arterial cannulation, or immediately in patients who proceed to surgical cannulation of the vessels. TIVA: midazolam 2 to 10 mcg / kg / min. Ketamine from 10 to 40 mcg / kg / h (non-administered boluses) Rocuronium 1 mg / kg / h in continuous infusion. Rocuronium 0.2 mg / kg before incision; 0.2 mg / kg prior to entry into CEC. Morphine 0.1 mg / kg in repeated boluses if tachycardic Sevoflurane 1-2%.

### Sugammadex

The administration of sugammadex is provided in all cases of fast track anesthesia for complex procedures even if not carried out with the aid of CEC and in patients of this weight is not TOF guided due to attendability problems of the detected value in the patient who weighs less than 10 kg [8].

**a. Failure Intubation:** Sugammadex: 16 mg / kg in 30 seconds with restoration of spontaneous ventilation nea within 180 seconds. If not resume breathing spontaneously within 180 seconds secondary to repeat: Sugammadex: 6 mg / kg and then: It repeats protocol as Special cases.

**b. Extubation Routine:** Sugammadex: 3 mg / kg bolus in a minute with restoration of spontaneous ventilation within 180 seconds.

### Patient weight > 10 kg < 30 kg

Premedication and research venous access suspend eventual supply by 12 hours. suspend administration of water from 4 hours. Midazolam 0.2-0.3 mg / kg + droperidol 2.5 mg rectally 30 minutes before entering the operating room if the peripheral venous access is difficult to obtain, induce anesthesia with Sevoflurano 3,5-4% (titate) not do more than two attempts to cannulate a peripheral vein or external jugular vein then find a central venous access.

### Anesthesia

**a. Induction:** Midazolam 5 mg slow bolus. Ketamine 1-2 mg / kg slowly in at least 4 minutes Rocuronium 0.9 mg / kg for induction.

**b. Retention:** Except in the maintenance procedures should be initiated immediately after the arterial cannulation or immediately in patients who proceed to surgical cannulation of the vessels. TIVA: midazolam 2 to 10 mcg / kg / min. TIVA: Ketanest- from 10 to 40 mcg / kg / h (non-administered boluses) Rocuronium 1 mg / kg / h in continuous infusion. Rocuronium 0.2 mg / kg before incision; 0.2 mg / kg prior to entry into CEC. Morphine 0.1 mg / kg in repeated boluses if tachycardic% Sevoflurane 1-2. Keep deep anesthesia until the end of the procedure.

### Sugammadex

Administration of sugammadex is provided in all cases of anesthesia fast track to avoid complex procedures even if carried

out with the help of CEC:

i. TOF tour with TOF > 2.

ii. TOF not guided with spontaneous breathing in FR > 15 acts minute and End Tidal PCO<sub>2</sub> < 35 mmHg.

**a. Failure Intubation:** Sugammadex: 16 mg / kg in 30 seconds with restoration of spontaneous ventilation nea within 180 seconds. If not resume breathing spontaneously within 180 seconds secondary to repeat: Sugammadex: 6 mg / kg and then: It repeats protocol as per Special cases.

**b. Extubation Routine:** Sugammadex: 3 mg / kg bolus in a minute with restoration of spontaneous ventilation within 180 seconds.

### Patient Weight > 30 kg

Premedication and research venous access suspend power by 12 hours suspend administration of water from 24 hours Temazepam 5 mg, 1 tablet per os at 22 Temazepam 5 mg, 1 tablet orally 45 min before entering the operating room.

### Anesthesia

**a. Induction:** Midazolam 0.3 mg / kg bolus Propofol 1-2 mg / kg in slow bolus Rocuronium 0.9 mg / kg for induction.

**b. Retention:** The maintenance should be started immediately after the induction: before and during the TECHNIQUES cation maintain dosages to 50%; immediately before skin incision goes Por- tato in regimen and after the CEC must be reduced by 50%. TIVA: propofol from 1 to 3 mg / kg / h. Ketamine from 10 to 30 mcg / kg / h (non-administered boluses) Rocuronium 1 mg / kg / h in continuous infusion. Rocuronium 1 mg / kg before incision; 1 mg / kg prior to entry into CEC Sevoflurane 1-2%. Keep deep anesthesia until the end of the procedure.

### Sugammadex

Administration of sugammadex is expected in the first four hours post-operative where it has not had a proper restoration of spontaneous breathing in all cases of fast track anesthesia for non-complex procedures even if carried cuted using CEC. TOF tour with TOF > 2. TOF not guided with spontaneous breathing in FR > 15 acts minute and End Tidal PCO<sub>2</sub> < 35 mmHg.

**a. Failure Intubation:** Sugammadex: 16 mg / kg in 30 with return of spontaneous ventilation within 180 seconds. If not resume breathing spontaneously within 180 seconds repeat: Sugammadex: 10 mg / kg. It repeats protocol as per Special cases.

**b. Extubation Routine:** Sugammadex: 2 mg / kg bolus in a minute with restoration of spontaneous ventilation within 180 seconds.

### Conclusion

The dosages of rocuronium and sugammadex used in this protocol are being off-label claims and experience the fruit of the author, do not comply with those indicated for product, therefore, MSD, and those who represent it is exempted from liability if

others want to adopt such assays. MSD and its representatives inform the medical community to use dosages of rocuronium and sugammadex as indicated in the product CPR.

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