

Stabilization and transfer of an infant with a cardiac arrhythmia



For more detailed information, please read the complete guideline

General Management

- Maternal history of connective tissue disorder
- Exclude underlying causes (hypoxia, sepsis)
- Drug history (digoxin, propranolol)
- Previous cardiac surgery
- Investigations
 - o Chest X-ray, 12-lead ECG
 - o U&Es, blood gas & glucose
 - o Septic screen
 - o Echocardiogram to rule out CHD

12-lead ECG interpretation

- P wave (morphology, rate, axis)
- QRS morphology (wide vs narrow)
- QT interval morphology
- QT duration ($QTc = QT / \sqrt{RR} < 0.46s$)

**Early referral to Cardiology for advice
Contact PaNDR for further stabilisation
and need for transfer**

TACHYARRHYTHMIAS

Supraventricular Tachycardia - SVT (are the most common)

ECG: HR > 220, narrow QRS, absence sinus P waves

CVS Stable SVT

- Start vagal maneuvers (cold ice, Valsalva)
- Adenosine IV bolus (see box for dosing)
- Mark on the strip when the Adenosine doses were given.

CVS Unstable SVT

- Synchronous cardioversion at 0.5-1 J/kg (2J/kg if no response to initial shock)
- Conscious patients require sedation or general anaesthesia
- Consider Amiodarone if no response

Atrial Flutter

ECG: HR > 220, regular sawtooth flutter waves, narrow QRS

QRS

Treatment: same as SVT

Ventricular tachycardia (VT)

ECG: Wide-QRS tachycardia, AV dissociation

CVS Stable VT

- Amiodarone 25 mcg/kg/min over 4h, then continue as infusion @10 mcg/kg/min
- Synchronous DC shock 1J/kg if no response to Amiodarone

CVS Unstable VT

- Synchronous cardioversion at 1J/kg and increase to 2J/kg if no response.
- If no response, consider Amiodarone at 5 mg/kg over 20-30 min and repeat a synchronous DC shock
- Consider Magnesium sulphate 25-50mg/kg over 20-30 minutes (max dose 2g) if ECG is in keeping with Torsade de Pointes
- If pulseless VT, follow APLS guidelines using Asynchronous Cardioversion at 4 J/kg

BRADYARRHYTHMIAS (congenital complete heart block or secondary to hypoxia, acidosis, myocarditis, digoxin or B-blocker toxicity, hypothyroidism, raised ICP or associated with congenital heart defects)

- Treat underlying cause and support ABCD
- Give 100% O2 and ensure appropriate ventilation
- Atropine 20mcg/kg if secondary to vagal stimulation
- Adrenaline 0.1 ml/kg (1:10.000)
- Consider adrenaline infusion or external pacemaker if no response

General principles

Ensure ABCD at all times
Treat fever or hypothermia
Ensure normal Electrolytes
(Aim Mg > 1, iCa > 1, K > 3.8)
Continuous rhythm strip while giving adenosine or DC shock

Adenosine

Must be given by rapid IV bolus into a large proximal vein using a 3-way tap and flushing immediately with up to 10mls of saline.

Dosing:

1-12y: 100 mcg/kg (1st), 200 mcg/kg (2nd), up to 500 mcg/kg
>12y: 3mg – 6mg up to 12 mg (max dose) if no response

Contraindicated in pre-excited AFib (broad and irregular tachycardia)

Amiodarone

Effective in most supra- and ventricular tachyarrhythmias
May precipitate cardiac arrest in shocked child
Should be given as slow bolus or infusion

References

- 1) Paediatric Advanced Life Support
- 2) Fetal and Neonatal Arrhythmias Stacy A. S. Killen and Frank A. Fish NeoReviews 2008
- 3) Norfolk and Norwich University Hospitals. 2015. Management of newborn babies with abnormal heart rhythm
- 4) UCSF Children's Hospital. 2004. Neonatal Cardiac Arrhythmias. California: University of California
- 5) Skellet, S., Hampshire, S., et al (2016) European Paediatric Advanced Life Support. Resus Council
- 6) BNF for children



Stabilization and transfer of an infant with a cardiac arrhythmia

1 Scope

For use within the Paediatric and Neonatal Decision Support and Retrieval Service (PaNDR) for the East of England.

2 Purpose

To provide guidance on the management of infants with cardiac arrhythmias during transfer.

3 Definitions

Bradycardia	HR < 100 beats per minute when awake and <80 beats per minute when asleep (in a neonate)
Bradyarrhythmia	sustained bradycardia associated with either a congenital cause or of secondary aetiology; may be a pre-terminal finding
CATS	Children's Acute Transport Service
ECG	electrocardiogram
ICP	intra cranial pressure
Sinus tachycardia	Sinus rhythm with a rate above the normal limit for age
SVT	Supraventricular tachycardia
Tachyarrhythmia	Abnormal heart rhythm with a rate between 220-300 beats per minute
VF	ventricular fibrillation
AFib	Atrial fibrillation
VT	ventricular tachycardia
SLE	systemic lupus erythematosus
APLS	Advanced Paediatric Life Support
CHD	Congenital heart disease

4 Introduction

Infants with known cardiac arrhythmias will usually be transferred by the PIC PaNDR team or the CATS. However, the NIC PaNDR team may become involved if these teams are unable to undertake the transfer, if the infant is significantly preterm or if a cardiac arrhythmia is discovered during the referral or stabilisation process.

- Arrhythmias are common in 1-2% of foetuses and 1-5% of newborns during the first 10 days of life.
- They are commonly classified as tachyarrhythmias, bradyarrhythmias or irregular arrhythmias.
- Neonatal presentation is variable, with symptom development depending on rate and duration of the arrhythmia. The clinical picture can range from an asymptomatic infant to one with signs of heart failure or shock.
- Rapid assessment of dysrhythmias is vital to ensure haemodynamic stability, and prevent recurrence and avert refractory evolution

4.1 Tachyarrhythmias

Tachyarrhythmias are classified as either narrow complex or wide complex:

- Narrow complex tachyarrhythmias:** SVTs are the most common symptomatic narrow complex tachyarrhythmias and comprise a group of arrhythmias characterized by regular, narrow QRS complexes with heart rates > 220 beats/ minute.
- Wide complex tachyarrhythmias:** these include VT (seen on ECG as AV dissociation with prolonged QT interval) and VF (a chaotic irregular rhythm).

4.2 Bradyarrhythmia

Bradyarrhythmia can present as transient bradycardias which occur in sleep or on vagal stimulation and are usually benign; or sustained as seen in congenital complete heart block or secondary to hypoxia, acidosis, myocarditis, digoxin or B-blocker toxicity, hypothyroidism, raised ICP or associated with congenital heart defects.

- 1st degree AV block** is usually seen with disorders of the AV node and commonly occurs in structural heart defects or inflammatory diseases of the myocardium. The patients are asymptomatic and may require no further therapy.

- b. **2nd degree AV block** and **Complete heart block** generally occur in infants whose mothers have connective tissue disorders such as SLE or Sjogren's syndrome resulting in antibodies (Ro and La) crossing the placenta and affecting the conduction pathways.

Infants undergoing therapeutic hypothermia may have a heart rate < 100 beats/minute which is normal.

4.3 Premature atrial contractions

These irregular arrhythmias account for the majority of premature atrial ectopics and are the most common form of neonatal arrhythmia. They are benign and disappear within the first month of life without any consequences. It is essential to thoroughly examine and investigate to exclude potentially serious arrhythmias in all cases.

5 Approach to management of cardiac arrhythmias

5.1 History

i. Tachyarrhythmias

- Pallor, tachypnoea, antenatal diagnosis,
- congenital heart abnormalities or previous cardiac surgery.

ii. Bradyarrhythmias

- Maternal history of connective tissue disorders, transient episodes in sleep and with vagal stimulation.
- Exclude underlying causes like hypoxia, increased acidosis, raised ICP, abdominal distension, electrolyte abnormalities, hypothermia, hypoglycaemia, digoxin toxicity or propranolol use.

5.2 Clinical assessment

- Airway & Breathing:
 - Increased work of breathing
 - Hypoxia
- Circulation for signs of shock:
 - Prolonged capillary refill time
 - Metabolic acidosis

- Hypotension
- Tachycardia
- Hepatomegaly

5.3 Investigations

- Continuous cardiac monitoring
- 12-lead ECG, and record ECG strip during onset and termination of arrhythmia
- Septic screen
- Electrolytes (Ca^{2+} , Mg^{2+} and K^{+}), blood gas and glucose
- Serum drug levels (i.e. Digoxin) if suspected drug toxicity
- Echocardiogram whenever possible, particularly if strong suspicion of structural CHD or frequent ventricular ectopics on a 24-hour ECG Holter monitor.

6 TREATMENT

○ Stable SVT (absence of shock)

- Vagal manoeuvres:** Placing icepacks on the infant's head or Valsalva manoeuvres (in older children have the child blow through a straw)
- Adenosine:** has a very short half life (< 10 seconds) so must be given by rapid IV injection into a central vein or large proximal vein using a 3 way tap and flushing immediately with up to 10mls of saline.
 - Onset of action is instantaneous.
 - Dosage: 1-12yrs: Start at 100 microgram/kg, ↑ by 100microgram/kg if no response to max 500 microgram/kg (neonates resistant to lower doses) >12yrs: Start at 3mg, increased to 6mg then 12mg if no response
 - Seek advice from the paediatric cardiologist.
 - Attach defibrillator and record a continuous ECG rhythm strip with printing.
 - Mark on the strip when the Adenosine doses were given.
 - **Contraindicated in pre-excited AFib (broad and irregular tachycardia)**
- If no IV access, start preparing for electric cardioversion (see below) while IV access is gained

○ Unstable SVT (in the presence of shock)

- Adenosine whilst setting up for cardioversion

- b. **Electric cardioversion using the synchronous mode.** Initial energy dose is 0.5-1 J/kg (2J/kg if no response to initial shock). **Conscious patients require sedation or general anaesthesia for cardioversion**
- c. Consider use of Amiodarone if no response with advice from the paediatric cardiologist.
- **Stable VT (absence of shock)**
 - a. Load with Amiodarone 25 mcg/kg/min over 4h, then reduce to 10 mcg/kg/min
 - b. Consider synchronous DC shock 1J/kg if no response to Amiodarone after seeking advice from paediatric cardiologist.
 - c. Consider Magnesium sulphate 25-50mg/kg over 20-30 minutes (max dose 2g) if ECG is in keeping with *Torsade de Pointes*
- **Unstable VT (presence of shock with pulse)**
 - a. Give a **Synchronous DC shock at 1J/kg** and increase to 2J/kg if no response.
 - b. If no response, consider Amiodarone at 5 mg/kg slowly over 45-60 min and repeat a synchronous DC shock after seeking advice from the paediatric cardiologist.
 - c. If patient is pulseless, follow cardiac arrest shockable rhythm algorithm from APLS international guidelines using Asynchronous Cardioversion at 4 J/kg.
- **Stable bradyarrhythmia**
 - a. Treat the underlying cause.
 - b. Supportive care.
 - c. Remember the cooling baby whose heart rate may be less than 100 beats per minute and will be stable.
- **Unstable bradyarrhythmia**
 - a. Assess and stabilize the airway, breathing and circulation.

- b. Give 100% oxygen and ensure appropriate ventilation .
- c. If secondary to vagal stimulation resulting from hypoxia or following intubation give **Atropine 20mcg/kg** (min dose is 100 mcg, max 500mcg in small children, 1mg in adolescents)
- d. If not likely due to vagal excitation, give **Adrenaline 0.1 ml/kg** (10mcg/kg of 1:10,000)
- e. Seek advice from paediatric cardiologist.
- f. An Adrenaline infusion or external cardiac pacing may be needed if no response.

7 Monitoring compliance with and the effectiveness of this document

The PaNDR consultants will monitor compliance with this document by reviewing the paperwork of all transfers of infants with cardiac arrhythmias. Any significant deviations from the guideline will be discussed with the lead consultant and the team members involved.

The effectiveness of the document will be monitored by review of any reported incidents via the lead nurse for risk. These incidents will be shared with the team and consideration given to adjusting the guideline if concerns are identified.

8 References

- 1) Rhythm disturbances: Paediatric Advanced Life Support (Part 10).
https://www.ahajournals.org/doi/10.1161/circ.102.suppl_1.I-291
- 2) Fetal and Neonatal Arrhythmias Stacy A. S. Killen and Frank A. Fish NeoReviews 2008; 9; e242; e252 DOI: 10. 1542/neo. 9-6-e242.
- 3) Children's Acute Transport Service guidelines on Supraventricular Tachycardias January 2016.
- 4) Guideline for the management of narrow and wide QRS complex tachycardia. Royal Brompton & Harefield Hospitals. July 2021
- 5) Neonatal Transfer Service London Guidelines on management of Tachyarrhythmias and Bradyarrhythmias June 2016



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- 6) Norfolk and Norwich University Hospitals. 2015. Management of newborn babies with abnormal heart rhythm. [CA6034]. Norwich
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- 8) UCSF Children's Hospital. 2004. Neonatal Cardiac Arrhythmias. California: University of California
- 9) Skellet, S., Hampshire, S., et al (2016) European Paediatric Advanced Life Support. 4th Edition. Resuscitation Council (UK0
- 10) BNF for children January 2017

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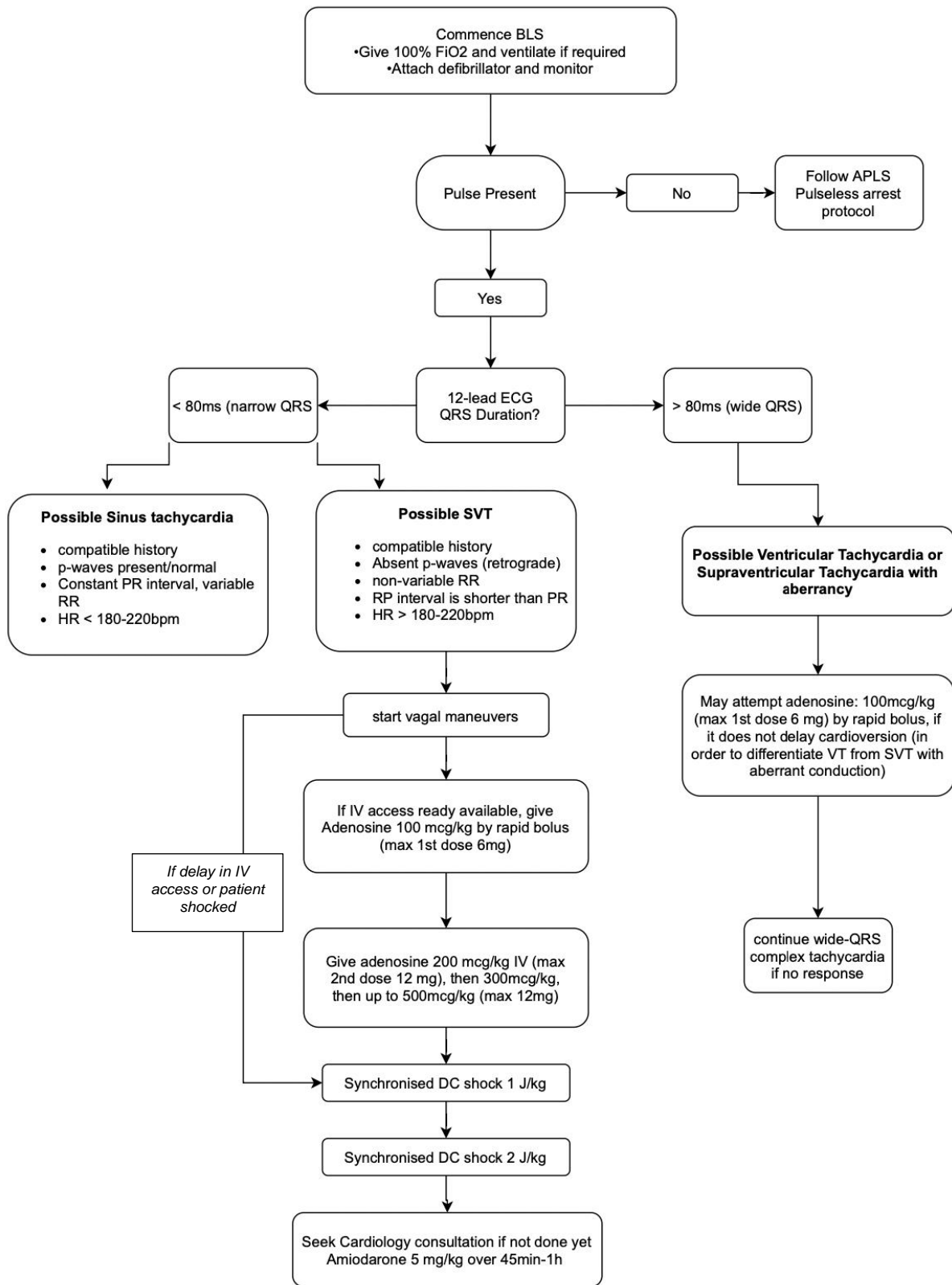
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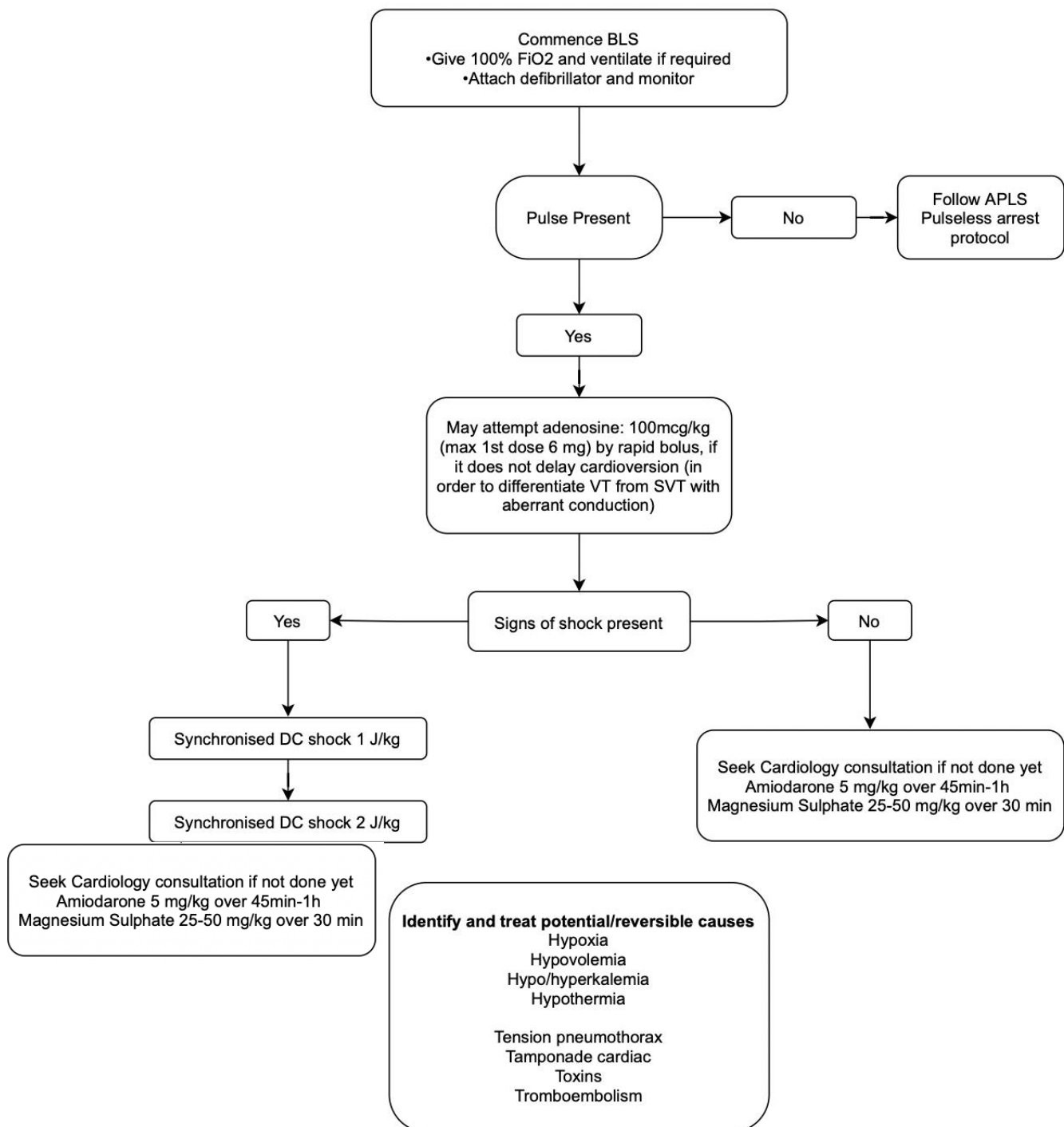
Document management

Approval:	Via PaNDR Governance March 2022		
JDTC approval:	14/06/2022		
Owning department:	PaNDR		
Author(s):	Dr. Francesc Torres-Andres, Consultant for PaNDR		
Pharmacist:	Nigel Gooding		
File name:	Stabilization and transfer of an infant with a cardiac arrhythmia		
Supersedes:	n/a (new document)		
Version number:	2	Review date:	
Local reference:		Document ID:	

Appendix 1: Narrow-QRS complex tachycardia algorithm



Appendix 2: wide-QRS complex tachycardia algorithm



Appendix 3: bradycardia algorithm

