

How to choose right inotrope for newborn ?

Dr Sachin Shah

MD, DM

Fellowship in Neonatology (Australia)

Fellowship in Pediatric Critical Care (Canada)

Director,

Intensive care services

Surya Mother and Child Superspeciality Hospital, Pune



Dr Sachin S Shah

MD (Pediatrics), DM (Neonatology)

Fellowship in Neonatology (Australia)

Fellowship in Pediatric critical care (Canada)

- **Director, Intensive care services, Surya Mother and Child Superspeciality Hospital, Pune**
- **Over 20 years of experience after graduation. Worked for 6 years in Australia and Canada, out of which 3 years were spent in Hospital for sick children , Toronto which is one of the most advanced Pediatric hospitals in the world.**
- **Over 25 publications in indexed journal.**
- **Reviewer for Cochrane collaboration**
- **PG teacher – Fellowship in Neonatology**
- **Areas of interest – clinical epidemiology, ventilation, hemodynamic monitoring, etc**

What do we currently know ?

- **Nothing**



How do we choose therapy ?

- **Depending on clinical findings**
- **Depending on BP**
- **Depending on Echo**

Evidence supporting these therapies

Shock

- **Not synonymous with hypotension**
- **CRT – adapted from term infants, ≤ 2 secs**
- **HR**
- **Colour - Off colour**
- **CV02**
- **Lactate**
- **Functional Echocardiography**

Definition of Hypotension

- **Statistically low BP**
- **Unsafe BP**
- **Operational/Target BP > GA in weeks**

BAPM. Arch Dis Child 1992;67:868

Target BP

- **Mean BP > 30
OR > GA in
weeks**



Functional Echo

- **Assessment of CO/ function**
- **Permits assessment of response to the therapeutic interventions**
- **SVC flow provides shunt independent assessment of flow to upper body**

Functional Echo

- **Low SVC flow – adverse outcome**
- **PPV of low SVC flow for adverse outcome is low**
- **Therapy aimed as preventing low flow has not been shown to be beneficial**

Functional Echo

- **Diagnosis of PDA**

Current therapies

- **Volume**
- **Vasoactive drugs**
 - **Dopamine**
 - **Dobutamine**
 - **Milrinone**
 - **Adrenaline**
 - **Vasopressin**
- **Steroids**

Volume

- **Most preterms with hypotension are normovolemic**
- **Rapid fluid boluses are associated with IVH**
- **Liberal fluids increase risk of CLD**
- **Most do not respond to volume**

Dempsey EM. Clin Perinatol 2009;36:75-85

Volume

- **Useful only in hypovolemic shock**
– **abruption, placenta previa, feto-maternal transfusion**
- **NS, RL preferred to Colloids**
- **10 ml/kg over 30-60 mins**
- **Occ. O negative blood may be used in severe anemia**

Evans N. Arch Dis Child Fetal Neonatal Ed 2006;91:213

Reasons for using vasoactive drugs

- **Optimising end organ/tissue perfusion**
- **Optimising cardiac output**
- **Optimising BP**

Common conditions needing vasoactive drugs

- **Septic shock**
- **Hypovolemic shock**
- **Cardiogenic shock – PDA**
- **PPHN**

Shock in preterm infants

- **Treatment must be tailored to etiology and pathophysiology of shock**
- **Etiology is difficult to determine usually ? Hypovolemia
? Myocardial dysfunction
? Abnormal vasoregulation**

Shock in preterm infants

- **Response to inotropes is unpredictable**
- **B receptor maturation lags behind that of alpha receptors.**
- **Alpha receptor actions predominate**

Shock in first 24 hours

- **Low SVC flow during 6-12 hours, normalises by 24 hours**
- **Due to cord clamping, SVR increases and CO drops**

First 24 hours

- **Pressure and flow based approach**
- **Targeted Echo at 6 hours and 12 hours or if hypotensive**
- **Treat if SVC flow $< 50\text{ml/kg/min}$ OR RVO $< 150\text{ ml/kg/min}$, even if MBP is normal**

First 24 hours

- **First Line - Dobutamine (10-20 ug/kg/min)**

Will increase BP in most babies

Useful in improving low SBF in the first 24 hours.

- **2nd line – Dopamine (5-10 ug/kg/min) if BP is low**
- **3rd line – adrenaline (0.05-0.1 ug/kg/min)**

After 24 hours

- **More likely that SBF will be normal or high**
- **1st line – Dopa (5ug/kg/min)**
- **2nd line – Adrenaline (0.05-0.1 ug/kg/min)**
- **3rd line – hydrocortisone 1-2mg/kg**

Inotrope resistance

- **Two facets to inotrope resistance**
- **Low SBF**
- **Vasodilatory hemodynamics due to poor vasomotor tone**

- **Adrenaline and Hydrocortisone are increasingly used in this situation**
- **Milrinone is being used for low SBF state**

Clinical evidence



Dopamine v/s Dobutamine

- **5 RCTs, 209 infants < 37 weeks with hypotension**
- **Dopamine more effective in treating hypotension.**
- **Dobutamine more effective in improving CO and SVC flow**
- **No difference in mortality, PVL, IVH**

Subheddar et al. The Cochrane library 2011;issue 3.

Milrinone

- **Double blind RCT in VLBW infants**
- **Milrinone did not prevent Low SVC flow state**
- **No adverse effects noted**

Pardisis M, Evans N, Kluckow M, Osborn D. Randomized trial of milrinone versus placebo for prevention of low systemic blood flow in very preterm infants. *J Pediatr*. 2009;154:189-95.

Milrinone

- **Used in PPHN**
- **Decreases PVR without significant effect on BP**

McNamara PJ et al. Milrinone improves oxygenation in neonates with severe persistent pulmonary hypertension of the newborn. J Crit Care. 2006;21:217–222

Steroids

- **Hydrocortisone improves BP and tissue perfusion**
- **Long term effects not known**
- **Whether clinical outcomes are improved is not known**

Higgins S, Friedlich P, Seri I. Hydrocortisone for hypotension and vasopressor dependence in preterm neonates: a meta analysis. J Perinatol. 2010;30:373-8. Epub 2009 Aug 20.

Steroids

- **Subset of patients who might benefit from hydrocortisone need to identified**
- **? Refractory shock**
- **? Infants with low cortisol levels**

Steroids

- **Do not use simultaneously with indomethacin**
- **Dexamethasone not recommended**

Vasopressin

- **Small neonatal studies**
- **Sepsis**
- **Low-dose AVP (0.0002–0.0007 U/kg/min) appears to decrease catecholamine requirement without associated hyponatremia.**

Bidegain M et al. Vasopressin for refractory hypotension in extremely low birth weight infants. J Pediatr. 2010;157:502–504

Vasopressin in PPHN

- **Selective pulmonary vasodilatory effects of low dose**
- **Post op Cardiac neonates**
- **A case series in 10 neonates with PPHN found that low-dose AVP improved BP, UO and OI while reducing the requirement for inhaled nitric oxide.**

Preterms with hypotension and PDA

- **Single observational study**
- **17 infants < 32 weeks with PDA and hypotension**
- **Dopamine < 10ug/kg/min**
- **Increases PVR and decreases shunting**
- **Increases SBP and systemic blood flow**

Bouissou A, Rakza T, Klosowski S, Tourneux P, Vanderborgh M, Storme L. Hypotension in preterm infants with significant patent ductus arteriosus: effects of dopamine. J Pediatr. 2008;153:790-4.

Septic Shock

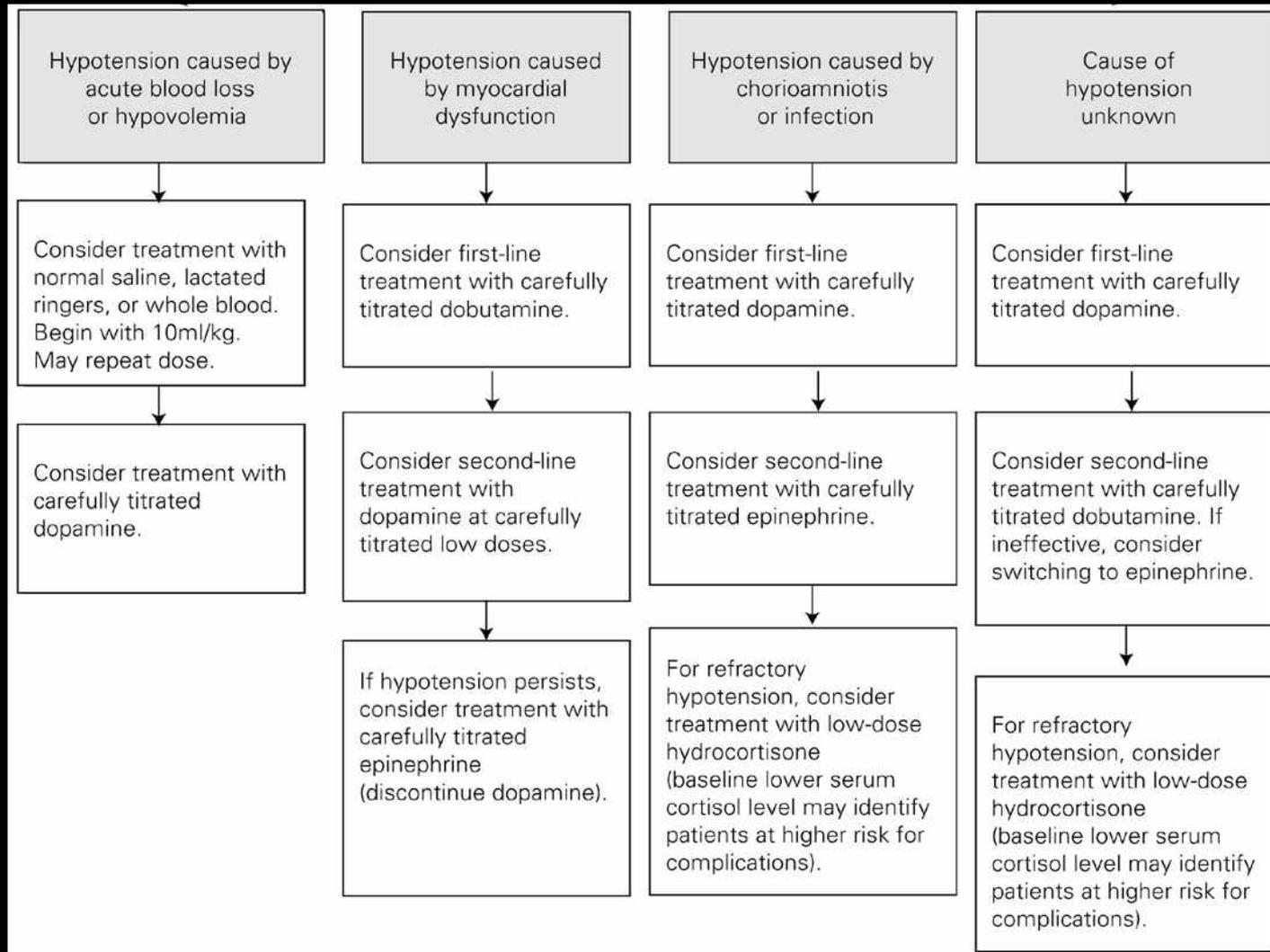
- **Dopamine preferred**
- **Adrenaline**

- **Myocardial dysfunction happens relatively late.**

Other Interventions

- **Maintain Euglycemia**
- **Maintain Normocalcemia
(monitor iCa and substitute if
low)**
- **Avoid overventilation**

Vargo L, Seri I. New NANN Practice Guideline: the management of hypotension in the very-low-birth-weight infant. Adv Neonatal Care 2011; 11:272.



Nursing issues in fine tuning inotropes

- **Purge till the solution drips from the end of ext tubing.**
- **Do not mix inotropes**
- **The most important inotrope is connected most distally (nearer to the patient)**

Nursing issues

- **Keep new syringes loaded when the pumps give alarm of nearly empty.**
- **Use pumps with battery backup.**
- **Do not flush the inotrope lumen.**
- **Do not use the inotrope lumen for sampling.**

Conclusions

- **Judicious understanding about physiology is important.**
- **Reason for using the inotrope should be identified. Remember that one size does not fit all.**

- **Vasoactive drugs have to be titrated at the bedside against predetermined endpoints.**
- **Always think of Cardiac output**
- **Frequent assessments needed**
- **Comprehensive assessment and not single organ approach**



THANK YOU !!!!!