HEALTH HOLDING

HAFER ALBATIN HEALTH CLUSTER
MATERNITY AND CHILDREN HOSPITAL

Department:	Neonatal Intensive Care Unit		
Document:	Departmental Policy and Procedure		
Title:	Management of Hypotension in Neonates		
Applies To:	All NICU Staff		
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1. PURPOSE:

1.1 To guide and provide information to improve and standardize caring and management of the neonates with hypotension depend on the best available evidence in the literatures.

1.2 Deviation from the guidelines depend on the expertise, knowledge and clinical judgment may be Appropriate.

2. DEFINITIONS:

2.1 Definition of Hypotension

There is no standard definition of hypotension in neonates. In clinical trials and in practice, hypotension is defined as any blood pressure (BP) value that falls below the 5th percentile for gestational and postnatal age. The most accepted definition of physiologic hypotension is the point at which cerebrovascular autoregulation is lost, leading to cerebral function compromise and tissue ischemia.

In extremely low birth weight infants (ELBWs), hypotension within the first 24 hours after birth is most commonly caused by the premature infant's inability to properly transition to extra-uterine life, marked by immaturity of the myocardium. Other contributing factors may include anemia, adrenal insufficiency, a patent ductus arteriosus (PDA), and less commonly, hypovolemia. The incidence of hypotension increases with decreasing gestational age.

3. POLICY:

3.1 Diagnosis / Clinical Assessment - Signs and symptoms of inadequate tissue perfusion may include:

- 3.1.1 Urine output (oliguria/anuria)
- 3.1.2 Capillary refill time (CRT) >3 seconds
- 3.1.3 Base deficit >5
- 3.1.4 Lactate >4mmol/L
- 3.1.5 Pallor
- 3.1.6 tachycardia
- 3.1.7 Cold/Warm extremities
- 3.1.8 Weak pulses(femoral palpation best in hypotensive infants)
- 3.1.9 Apnea and bradycardia
- 3.1.10 Low blood pressure.

3.2 Monitoring - Infants with hypotension should ideally be monitored closely:

- 3.2.1 Continuous monitoring of mean arterial pressure via arterial access if available
- 3.2.2 Cuff BP set to 15minute readings which are recorded if arterial access not available.
- 3.2.3 Abnormal tissues perfusion by NIRS
- 3.2.4 Continuous heart rate and saturation monitoring.
- 3.2.5 Central capillary refill time.
- 3.2.6 Urine output.
- 3.2.7 Regular blood gas/lactate monitoring.

3.3 Echocardiography - Echocardiography for structural & Hemodynamic assessment (if expertise is available)

4. PROCEDURE:

4.1 Management based on clinical findings and pathophysiology in common clinical conditions:

- 4.1.1 PDA
  - 4.1.1.1 Presenting features: Low SAP and DAP, severe end-organ dysfunction, pulmonary hemorrhage
  - 4.1.1.2 Management approach:
    - 4.1.1.2.1 First line: Volume (crystalloid, blood products), Vasopressor agents: e.g., Norepinephrine
    - 4.1.1.2.2 Second line: Vasopressor agents: e.g., Vasopressin.
    - 4.1.1.2.3 Third line: Hydrocortisone (if refractory hypotension).
- 4.1.2 Sepsis/NEC (Warm shock)
  - 4.1.2.1 Presenting features: Low DAP, tachycardia.
  - 4.1.2.2 Management approach:
    - 4.1.2.2.1 First line: Volume (crystalloid, blood products), Vasopressor agents: e.g., Norepinephrine.
    - 4.1.2.2.2 Second line: Vasopressor agents: e.g., Vasopressin.
    - 4.1.2.2.3 Third line: Hydrocortisone (if refractory hypotension).
- 4.1.3 Sepsis/NEC (Cold shock)
  - 4.1.3.1 Presenting features: Low SAP or severe/ combined hypotension.
  - 4.1.3.2 Management approach:
    - 4.1.3.2.1 First line: Modest use of volume expansion (crystalloid or blood products Positive inotropic agent: e.g., Low dose (ß dose) Epinephrine/ Dobutamine
    - 4.1.3.2.2 Second line: Hydrocortisone (if refractory hypotension).
- 4.1.4 Hypoxic ischemic injury:
  - 4.1.4.1 Presenting features: Low SAP
  - 4.1.4.2 Management approach:
    - 4.1.4.2.1 First line: Positive inotropic agent: e.g., Low dose dose) Epinephrine/Dobutamine.
    - 4.1.4.2.2 Second line: Hydrocortisone (if refractory hypotension).
- 4.1.5 PPHN:
  - 4.1.5.1 Presenting features: Hypoxemia, low SAP
  - 4.1.5.2 Management approach: (need an Echocardiography assessment to confirm PPHN and to rule out congenital heart disease)
    - 4.1.5.2.1 First line: Norepinephrine
    - 4.1.5.2.2 Second line: vasopressin

4.2 Special Considerations:

- 4.2.1 Uses Hydrocortisone for Hypotension in neonates as 2nd line management only if refractory Hypotension or suspect adrenocortical insufficiency. (Cortisol level need to be taken before starting the management.)
- 4.2.2 Try to avoid normal saline boluses for extreme preterm babies (628 weeks GA) without evidence of Hypovolemia

4.3 Measurement of Blood Pressure in Neonates

- 4.3.1 The "gold standard" for determining BP in the critically ill neonate is a direct reading from an indwelling arterial line, and should be used whenever arterial access is available.
- 4.3.2 Mean blood pressure (MBP) is considered most reflective to decide to start the treatment (inotropes) and to wean the treatment.
- 4.3.3 SBP/DBP should be considered to decide which pathophysiology causing hypotension. The cuff is inflated greater than the systolic BP. As the cuff gradually deflates, the maximal amplitude of the arterial pulsation is determined to be the mean arterial BP.24 using computer-generated algorithms specific to each device manufacturer, systolic and diastolic BP values are then calculated.
- 4.3.4 Oscillometric BP measurements should be obtained by placing an appropriate size cuff around the infant's right bicep with the cuff bladder overlying the brachia artery.

4.3.5 The cuff bladder width should be approximately 40% of the arm circumference at a point midway between the olecranon and the acromion, and the bladder length should cover 80% to 100% of the circumference of the arm at that point (Fig. I). A variety of BP cuff sizes are available, which can be used to obtain BP values from any extremity. However, noninvasive BP values obtained from the right arm are considered optimal because they best reflect BP in the ascending aorta.4,25 Because systolic and diastolic BP are calculated based on device-specific algorithms, values can vary significantly.

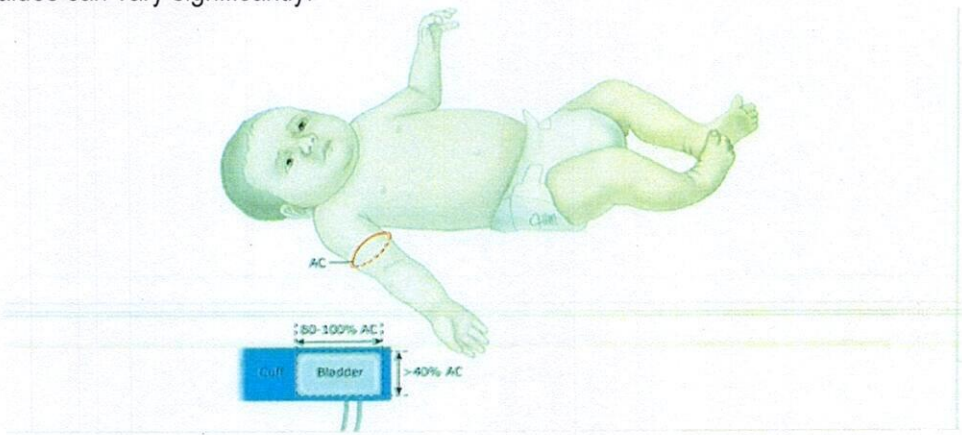

Fig. I. Blood pressure cuff placement for neonates. AC, arm circumference. Reproduced with permission from: Batton B. Assessment and management of low blood pressure in extremely preterm infants. In: UpToDate, Post TW (Ed), UpToDate, Waltham, MA. (Accessed on [Datel.) Copyright 2020 UpToDate, Inc. For more information visit www.uptodate.com.

5. MATERIAL AND EQUIPMENT:

5.1 Blood pressure cuff (non-Invasive Monitoring)
5.2 Invasive Umbilical and peripheral Artery Catheter

6. RESPONSIBILITIES:

6.1 Physician
6.2 Nurse

7. APPENDICES:

7.1 Inotropes
7.2 Zubrow AB Blood pressure chart
7.3 Flowchart: Approach to neonatal Hypotension

8. REFERENCES:

8.1 Mullaly R, El-Khuffash AF Haemodynamic assessment and management of hypotension in the preterm Archives of Disease in Childhood - Fetal and Neonatal Edition Published Online First: 12 May 2023. doi: 10.1 136/archdischild-2022-324935
8.2 Noori S, Seri I. Neonatal blood pressure support: the use of inotropes, lusitropes, and other vasopressor agents. Clin Perinatol. 2012 Mar;39(I):221-38. doi: 10.1016/j.clp.201 1.12.010. Epub 2012 Jan 20. PMID: 22341548.
8.4 Hypotension in Neonates. Mitali Sahni and Sunil Jain, NeoReviews 2016; 17;e579, DOI: I O. 1542/neo.17- I O-e579
8.5 6Joynt C, Cheung PY. Treating Hypotension in Preterm Neonates With Vasoactive Medications. Front Pediatr. 2018 Apr 13;6:86. doi: 10.3389/fped.2018.00086. PMID: 29707527; PMCID: PMC5908904

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Appendix 7.1 Inotropes

Agent	SV	SVR	PVR
Dopamine	↑	↑↑	↑↑↑
Dobutamine	↑↑	**(no effect)**	**(no effect)**
Norepinephrine	↑ / **(no effect)**	↑↑↑	↓ / **(no effect)**
Epinephrine	↑↑↑	↑↑↑	↑↑
Milrinone	↑↑	↓↓	↓↓
Vasopressin	↓	↑↑↑	↓

SV – Stroke volume; SVR – Systemic Vascular Resistance; PVR – Pulmonary Vascular Resistance

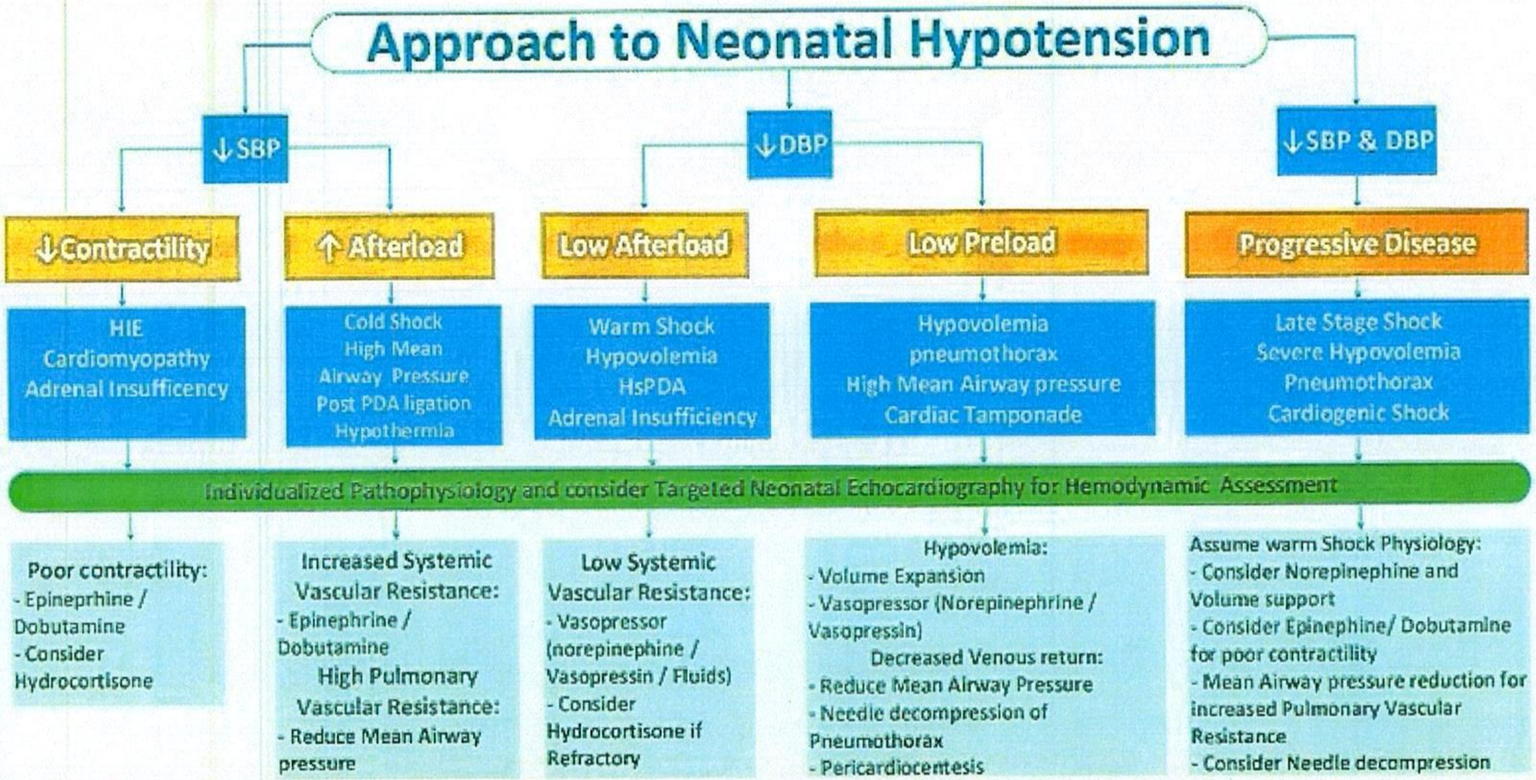
Medications	Mechanism of Action	Doses	Clinical uses	Side effects & Considerations
Dopamine	Doparninergic receptors agonism proposed renotubular effects, intestinal and coronary vasodilation. - β-1Adrenergic receptors agonism mainly chronotropy. - α-1Adrenergic receptors agonism vasoconstriction.	≤ 3 mcg/kg/min ≥5–10 mcg/kg/min ≥10 mcg/kg/min	A vasopressor which increases blood pressure if the "hypotension" requires treatment - Increases urine output (increased renal perfusion pressure and/or natriuresis). - Has a modest effect in cardiac output.	Causes tachycardia Aggravates stress to both ventricles due to increased afterload. At ≥10 µg/kg/min, may cause right to left ductal shunt. (Increased PVR) Decreased effect in long term as indirect pathway substrate becomes depleted.
Dobutamine	β-1Adrenergic receptors agonism chronotropy and inotropy β-2 Adrenergic receptors agonism peripheral vasodilation	≥5–20 mcg/kg/min	An inotrope which increases cardiac output without vasoconstriction, e.g., cardiogenic shock. - Has unpredictable effect on blood pressure	Causes tachycardia. Avoid in cardiac outflow tract obstructions, e.g., infants of diabetic mothers.
Norepinephrine	α-1 (> β-1 > β-2) Adrenergic receptors agonism potent vasoconstriction (and mild inotropy.	0.01–1mcg/kg/min Not recommended > 0.5 mcg/kg/min	A vasopressor which serves as an adjunct to other catecholamines at low dose. – Conditions with significam vasoplegia in refractory sepsis, post-surgical inflammation, asphyxia. – May have mild pulmonary vasodilation effect.	May affect regional tissue perfusion due to potent vasoconstriction.
Epinephrine	- β-1 and some β-2 Adrenergic receptors agonism chronotropy and inotropy - α-1 Adrenergic receptors agonism vasoconstriction.	≥ 0.02 – 0.1 (mcg/kg/min) > 0.1 mcg/kg/min	An inotrope with vasopressive action, e.g., hypotension with decreased cardiac contractile function with or without vasoplegia, e.g., septic shock, asphyxia. – At 0.02–0.05 mcg/kg/min, may increase cardiac output more than SVR.	Causes hyperlactatemia and hyperglycemia. Causes tachycardia. May increase myocardial oxidative stress. Use with caution in cardiac outflow tract obstructions, e.g., infants of diabetic mothers.
Milrinone	Phosphodiesterase type III inhibition with increased cAMP levels inotropy, lusitropy, and pulmonary (and possible systemic) vasodilation.	0.25-0.75 mcg/kg/min	- An inotrope/lusitrope with mild pulmonary vasodilation (inodilator), e.g., pulmonary hypertension with ventricular dysfunction, post-PDA ligation. - Loading do e is not needed while the onset of action may take 1–2 h.	Slow onset. Tachycardia. Hypotension if decreased intravascular volume or administration of a loading dose. Decreased platelet aggregation. Decreased clearance with kidney dysfunction.
Vasopressin	V1a receptors agonism vasoconstriction.	0.1-0.6 mU/kg/min	A vasopressor which increases blood pressure in catecholamine-resistant hypotension or shock	Hyponatremia. Transient thrombocytopenia. Liver necrosis. Limb necrosis.

Appendix 7.2 Zubrow AB Blood pressure chart

Blood Pressure Values by Corrected Post-conceptional Age after 24h of Life									
GA	Systolic			Diastolic			Mean (Calculated)		
	95th CI	Mean	5th CI	95th CI	Mean	5th CI	95th CI	Mean	5th CI
23	68	49	33	46	29	14	53	36	20
24-25	69	51	36	47	30	15	54	37	22
26-27	71	54	40	49	32	18	56	39	25
28-29	73	56	42	51	34	20	58	41	27
30-31	78	61	46	53	36	22	61	44	30
32-33	81	63	50	55	38	24	64	46	33
34-35	84	69	52	57	40	26	66	50	35
36-37	89	72	57	59	42	28	69	52	38
38-39	91	78	60	60	44	30	70	55	40
40-41	93	81	62	62	46	31	72	58	41
42-43	97	83	65	64	48	33	75	60	44
44-45	100	88	69	66	50	35	77	63	46

Blood Pressure Values by GA (at birth) for first 24h of Life									
GA	Systolic			Diastolic			Mean (Calculated)		
	95th CI	Mean	5th CI	95th CI	Mean	5th CI	95th CI	Mean	5th CI
22-23	56	40	23	32	24	15	40	29	18
24-25	58	43	26	34	26	17	42	32	20
26-27	61	45	29	36	28	19	44	34	22
28-29	64	48	33	38	30	21	47	36	25
30-31	68	51	36	40	32	23	49	38	27
32-33	70	53	38	42	34	25	51	40	29
34-35	73	57	41	44	36	27	54	43	32
36-37	76	60	44	46	38	29	56	45	34
38-39	79	62	47	48	40	31	58	47	36
40-41	82	65	50	50	42	33	61	50	39
42	84	67	51	51	43	34	62	51	40

Appendix 7.3 Flowchart: Approach to neonatal Hypotension


Approach to Neonatal Hypotension
↓SBP
↓DBP
↓SBP & DBP
↓Contractility
↑Afterload
Low Afterload
Low Preload
Progressive Disease
HIE
Cardiomyopathy
Adrenal Insufficency
Cold Shock
High Mean
Airway Pressure
Post PDA ligation
Hypothermia
Warm Shock
Hypovolemia
HsPDA
Adrenal Insufficiency
Hypovolemia
pneumothorax
High Mean Airway pressure
Cardiac Tamponade
Late Stage Shock
Severe Hypovolemia
Pneumothorax
Cardiogenic Shock
Individualized Pathophysiology and consider Targeted Neonatal Echocardiography for Hemodynamic Assessment
Poor contractility:
- Epineprhine / Dobutamine
- Consider Hydrocortisone
Increased Systemic Vascular Resistance:
- Epinephrine / Dobutamine
High Pulmonary Vascular Resistance:
- Reduce Mean Airway pressure
Low Systemic Vascular Resistance:
- Vasopressor (norepinephine / Vasopressin / Fluids)
- Consider Hydrocortisone if Refractory
Hypovolemia:
- Volume Expansion
- Vasopressor (Norepinephrine / Vasopressin)
Decreased Venous return:
- Reduce Mean Airway Pressure
- Needle decompression of Pneumothorax
- Pericardiocentesis
Assume warm Shock Physiology:
- Consider Norepinephine and Volume support
- Consider Epinephine/ Dobutamine for poor contractility
- Mean Airway pressure reduction for increased Pulmonary Vascular Resistance
- Consider Needle decompression

Blood Pressure Parameters after 24 hours

GA	Wean if above 25th percetile			Lowest acceptable 5th percentile		
	SBP	DBP	MBP	SBP	DBP	MBP
23	41	22	28	33	14	20
24-25	44	23	30	36	15	22
26-27	46	24	32	40	18	25
28-29	48	27	34	42	20	27
30-31	50	29	36	46	22	30
32-33	52	31	38	50	24	33

GA	Wean if above 25th percetile			Lowest acceptable 5th percentile		
	SBP	DBP	MBP	SBP	DBP	MBP
34-35	54	33	40	52	26	35
36-37	56	35	42	57	28	38
38-39	58	37	44	60	30	40
40-41	60	39	46	62	31	41
42-43	62	41	48	65	33	44
44-45	64	43	50	69	35	46

Created by: Dr. T Altamimi & Dr A Hamedi, Consultants, Neonatal Haemodynamics, 07 Jan 2024, NICU, WHH, MNGHA

Modified from the following references:

1. Dilli D, Soyla H, Tekin N. Neonatal hemodynamics and management of hypotension in newborns. Turk Pediatri Ars. 2018
2. Giesinger RE, McNamara PJ. Hemodynamic instability in the critically ill neonate: An approach to cardiovascular support based on disease pathophysiology. Semin Perinatol. 2012
3. Zubrow AB, Hulman S, Kushner H, Falkner B. Determinants of blood pressure in infants admitted to neonatal intensive care units: a prospective multicenter study. Philadelphia Neonatal Blood Pressure Study Group. J Perinatol. 1995

Appendix 7.4 Management of suspected Septic Shock