HYPERTENSION

RECOGNITION AND ASSESSMENT

- Hypertension (HTN) is rare in neonates, unlike hypotension
- Low-birth-weight (<1500 g) and prematurity (<32 weeks' gestation) have been linked to HTN and other cardiovascular disease later in life
- Normal blood pressure (BP) values increase with increasing weight and postnatal age
- rises by 1–2 mmHg/day in the first week and then 1–2 mmHg/week over the next 6 weeks
- these changes are significant, particularly in preterm babies

DEFINITION

Systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) >95th percentile for gestation and postnatal age

Table 1: BP values beyond 2 weeks of age in babies 26–44 weeks' post-conceptional age

Post conceptual age		50th percentile	95th percentile	99th percentile
26 weeks	SBP	55	72	77
	DBP	30	50	56
	Mean BP	**38**	**57**	**63**
28 weeks	SBP	60	75	80
	DBP	38	50	54
	Mean BP	**45**	**58**	**63**
30 weeks	SBP	65	80	85
	DBP	40	55	60
	Mean BP	**48**	**63**	**68**
32 weeks	SBP	68	83	88
	DBP	40	55	60
	Mean BP	**49**	**64**	**69**
34 weeks	SBP	70	85	90
	DBP	40	55	60
	Mean BP	**50**	**65**	**70**
36 weeks	SBP	72	87	92
	DBP	50	65	70
	Mean BP	**57**	**72**	**77**
38 weeks	SBP	77	92	97
	DBP	50	65	70
	Mean BP	**59**	**74**	**79**
40 weeks	SBP	80	95	100
	DBP	50	65	70
	Mean BP	**60**	**75**	**80**
42 weeks	SBP	85	98	102
	DBP	50	65	70
	Mean BP	**62**	**76**	**81**
44 weeks	SBP	88	105	110
	DBP	50	68	73
	Mean BP	**63**	**80**	**85**

SIGNS

- Asymptomatic
- Respiratory distress
- Increased tone
- Lethargy
- Cyanosis
- Apnoea
- Feeding difficulties

- Congestive heart failure
- Mottling
- Irritability/seizures
- Abdominal distension
- Cardiogenic shock
- Cerebral haemorrhage

MEASURING BLOOD PRESSURE IN NEONATES

Method

- **Invasive:** intra-arterial BP monitoring (umbilical artery, radial artery, posterior tibial artery)
- **Non-invasive:** oscillometric device, doppler flow ultrasonography (most reliable non-invasive method of BP measurement)

Technique

- Cuff length must cover ≥80% length of right upper arm and bladder width should be 60% of circumference (narrow cuffs give falsely raised readings)
- For oscillometric readings, measure BP 1.5 hr after feeds/medical intervention with baby supine or prone
- Place cuff, wait 15 min and note state of baby (awake/asleep). Take 3 readings at 2 min intervals
- Check BP in legs (normally higher) as well as arms. If leg BP < arm BP consider diagnosis of coarctation of the aorta (COA)
- For umbilical arterial catheter (UAC) *in situ*, ensure catheter is free of clots/air bubbles and that transducer is calibrated

Physiological variance

- Transient rise: feeding, sucking, pain (post-surgical babies), agitation, being suctioned, crying (increases SBP 17–25 mmHg) or an upright position
- Physiological rise in BP (increasing weight and postnatal age) in the first few weeks of life
- SBP can be 5 mmHg lower in sleeping babies

HISTORY

- Antenatal history (foetal scans, maternal HTN, TORCH screen, tocolytic non-steroidal anti-inflammatory drugs, maternal drug abuse, e.g. cocaine, heroin)
- Perinatal history (mode of delivery, type of anaesthesia given during delivery, maternal steroids)
- Postnatal history (neonatal drugs e.g. caffeine, steroids, inotropes; umbilical lines, neurological status, BP measurement technique)

EXAMINATION

- Full general examination (check for syndromic facies)
- Systemic examination including checking for murmurs, bruits; femoral pulses in both lower limbs (absent or decreased in COA) and abdomen for palpable renal masses (tumours, polycystic kidneys)

INVESTIGATIONS

- Renal function tests
- elevated serum creatinine/urea signifies renal insufficiency which may be associated with HTN
- Urinalysis
- haematuria: obstruction, infection, renal vein thrombosis
- proteinuria: renal parenchymal disease
- Urine culture
- exclude pyelonephritis
- Thyroid function tests, cortisol, plasma renin and aldosterone
- plasma renin elevated in renovascular disease and low in primary hyperaldosteronism

- renin levels are higher in neonates than children and adults. Elevated plasma renin activity may not always indicate underlying renal disease
- medication such as caffeine can raise renin levels
- Abdominal ultrasound
- abdominal masses and renal obstruction
- Doppler flow ultrasonography can rule out arterial/venous causes (detects renal artery stenosis but can miss branch artery stenosis)
- if UAC *in situ*, check aorta and renal arteries for thrombi
- Cranial ultrasound
- intra-ventricular haemorrhage (IVH)
- cerebral oedema
- Echocardiogram
- COA
- signs of end organ damage (left ventricular hypertrophy or decreased contractility)
- Other investigations to consider following discussion with the relevant specialist
- arteriography – renovascular disease
- venocavography – renal vein thrombosis
- CT/MR angiogram – renovascular disease and middle aortic pathology
- MCUG
- DMSA
- serum and urine metanephrines – exclude pheochromocytoma
- urine 17-hydroxysteroid and 17-ketosteroid levels – Cushing's and CAH
- gene expression array
- fundoscopy
- ECG
- CXR

DIFFERENTIAL DIAGNOSIS

- Renal parenchymal disease
- Reno-vascular causes
- Pain
- Acquired renal conditions
- Neurological
- Pulmonary
- Cardiovascular causes
- Medication related (maternal and neonatal)
- Endocrine causes
- Idiopathic

TREATMENT

- Determined by severity of HTN, whether baby is symptomatic and presence of end organ damage (e.g. left ventricular hypertrophy, encephalopathy, haematuria, proteinuria, hypertensive retinopathy)
- Treat cause (e.g. correcting fluid overload, treating pain, removing iatrogenic agents that may have contributed to HTN)
- Start each medication at lowest recommended dose
- Monitor BP at least every 15 min in the first 2 hr of treatment and then hourly to avoid hypotension and hypoperfusion
- Surgery may be indicated for the treatment of secondary HTN, e.g. COA, renal artery stenosis HTN, renal vein thrombosis, polycystic kidney disease, tumours or ureteral obstruction to avoid long-term anti-hypertensive medical treatment although, in some cases, this is not guaranteed
- COA: if suspected, discuss with consultant on whether to use prostin (see **Prostaglandin infusion** guideline) in an attempt to reopen the duct
- if baby ventilated, higher doses can be used safely following discussion with cardiologist
- Treat the following 3 categories of neonates:
- SBP 95–99th centile and symptomatic or evidence of end organ damage

- asymptomatic with SBP >99th centile
- symptomatic with SBP >99th centile (hypertensive crisis)

HYPERTENSIVE CRISIS

- Discuss with renal and cardiac teams
- IV treatment to reduce BP slowly to <90th centile
- one third total reduction in first 12 hr
- next one third total reduction in second 12 hr
- final one third total reduction over next 24 hr
- If BP drops suddenly – fluid bolus and reduce drug dose
- IV drug options include:
- labetalol
- hydralazine
- nicardipine (caution with perinatal asphyxia)
- if cardiac function poor and no systemic obstruction, milrinone (on advice of paediatric cardiologist)

NON HYPERTENSIVE CRISIS

- Use oral agents, options include:
- amlodipine oral
- hydralazine
- propranolol
- diuretics e.g. furosemide, spironolactone
- ACE inhibitors (captopril at half normal test dose) not usually used due to significant side effect profile (profound hypotension, acute renal failure, delayed renal maturity in preterm babies, neurological complications)

PROGNOSIS

- Depends on aetiology, timing of diagnosis and management (e.g., repaired COA has excellent prognosis but lifelong cardiology follow-up will be required)
- Usually resolves in majority of babies, especially those with UAC complications
- HTN secondary to renal parenchymal disease requires long-term specialist follow-up