

Royal Wolverhampton Hospitals Trust

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Lead Neonatal Consultant :	T Pillay, Simon Hobbs
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Vascular Spasm and Thrombosis in the Neonatal period

Vascular Spasm

Blanching or cyanosis of extremity following insertion or manipulation of peripheral or umbilical arterial lines.

1. Remove Catheter: Review if catheter absolutely essential or can be removed. If in doubt, remove.
2. Elicit reflex vasodilation by warming contraletral limb: Reflex vasospasm on insertion of umbilical arterial catheter can be occasionally corrected by reflex vasodilation through warming the contralateral limb.
3. Volume expansion: If appropriate give 10ml/kg normal saline as volume expander.
4. GTN Patch: use glyceryl trinitrate patch to improve perfusion. (Not trialled or licensed for use in neonates)
5. Investigate for thromboembolism: If ischaemia persists after the above are done, then investigate and treat for vascular thrombosis.

Topical Glyceryl trinitrate (GTN Patches)

- Can reverse peripheral and umbilical catheter induced ischaemic injury in isolated cases.
- Also useful in ischaemia associated with extravasation injuries.

Preparation:

- Deponit ® 5mg/24 hour patch
- Use 1/8th of this 9x9cm patch = 0.5microgram/minute
- Apply over affected artery/proximal part of the affected limb
- See supporting evidence for limited use in neonates; not licensed for neonates; not trialled for this purpose in neonates

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- Review in one hour; see algorithm. If no improvement by two hours, will need haematologist input for anticoagulation, and notify surgeons

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Clinical features suggesting Vascular Thrombosis

Site	Clinical Signs	Diagnostic Imaging
Peripheral or Central (Aorta or Iliac) arterial thrombosis	Pallor, Cold, arm/foot Weak or absent peripheral pulse Discoloration Gangrene Difficulty in establishing a proper pulse oximetry trace Delayed capillary refill time on affected limb	Doppler scan for large vessel thrombus <i>(Sensitivity and specificity uncertain in neonatal period)</i> Real time two dimensional Ultrasound CT scan with contrast Contrast angiography (done at specialised centres)
Renal Artery/Aortic thrombosis	Systemic Hypertension, haematuria, oliguria, renal failure	
Renal vein thrombosis	Flank mass, haematuria, hypertension, thrombocytopenia	
Inferior Vena cava thrombosis	Cool lower limbs, cyanosis, oedema	
Superior vena cava thrombosis	Swelling of upper limbs and head, chylothorax	
Central venous line thrombus	High pressures on long line, SVC obstruction, chylothorax, swelling, discoloration of extremity	
Right atrial thrombus	Heart failure, embolic phenomenon	Echo
Pulmonary thromboembolism	Respiratory failure	Lung perfusion scan (done at specialised centres)

Management of Thrombo-embolism

- Controversial.
- Inadequate controlled trials
- Consultant must be informed
- Correct volume depletion, polycythaemia, electrolyte disturbances, anaemia thrombocytopenia and sepsis
- Paediatric Vascular surgical team useful in assessing limb viability and Doppler assessments
- Anticoagulation/thrombolysis to be discussed in conjunction with vascular team and haematologists

Treatment options:

a) Conservative: observe closely with no intervention eg unilateral renal vein thrombosis

b) Anticoagulate: no controlled neonatal trials.

Follow BCSH guidelines for venous thrombosis, and consult Haematologists.

Use unfractionated heparin for initial anticoagulation (see algorithm).

Use Low Molecular Weight Heparin for long term anticoagulation for venous thrombosis, eg Renal vein thrombosis:

- Dalteparin : 100U/kg BD or 200U/kg OD subcutaneously
- Enoxaparin: 1mg/kg BD or 2mg/kg OD subcutaneously
- Tinzaparin: 175U/kg OD subcutaneously

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Monitor Factor Xa and adjust dose to keep levels between 0.5-1IU/ml

Treat for 3 (secondary thrombosis) to 6(idiopathic thrombosis) months as determined by Haematologists

Reversal: Protamine sulphate 1mg/100Units IV given within 4 hours of injection.

Warfarin is generally not used in neonates.

- c) Thrombolysis : treatment of choice for organ threatening thrombosis.
Use tissue plasminogen activator, Alteplase (250-500microgram/kg/hr for a maximum of 3 hours)
Can be repeated in 12 hours at discretion of vascular team
Keep fibrinogen above 1g/L.
Supplemental plasminogen by giving FFP may be useful.
- d) Surgical: thrombectomy if limb remains pulseless and is determined by size of vessel and clinical instability in neonate. See surgical notes below.

Investigations

Baseline:

- FBC and Platelet count
- U/S head
- aPTT
- PT
- Fibrinogen

Specific investigations for thrombo-embolic disorders (discuss with haematologists)

- Antiphospholipid/anticardiolipin antibody
- Lupus anticoagulant
- Protein C activity
- Protein S
- Antithrombin activity
- Homocysteine
- Lipoprotein a
- Factor VIIC
- Heparin cofactor II
- Factor V G1691A PCR
- Prothrombin G20210A
- Methylenetetrahydrofolate reductase C677T

Complications:

- Bleeding, from anticoagulation and thrombolysis
- Peripheral artery thrombo-embolism: loss of limb, gangrene
- Renal vein thrombosis: atrophy of kidney, hypertension
- Umbilical artery catheter related thrombo-embolism: hypertension, abnormal renal function, abnormal leg growth, abdominal aortic aneurysm, acquired coarctation.

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Contraindications to Thrombolysis

- Recent Surgery
- Grade 3-4 IVH
- Other cerebral bleeds
- DIC
- Thrombocytopaenia

Relative contraindications

- Recent neonatal seizures
- Severe neonatal sepsis

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Surgical Notes of Neonatal Interest:

Most cases follow femoral catheterisation for cardiac diagnosis and the problem centres around Common Femoral Artery level, combining artery wall trauma with local thrombotic occlusion, with variable proximal and distal propagation.

In neonatal units complications of thrombus forming around umbilical artery cannulas arise and this can cause aortic, iliac or femoral occlusion.

The ability to recognise acute ischaemia and observe its progress is crucial

- The 6 "P"s need to be recorded, comparing the affected and normal limbs, and evolution over time noted. (eg pain, paraesthesia, paralysis, pallor, pulses)
- Doppler insonation in both limbs should record signals above and below the level of injury.
- Most limbs will show spontaneous improvement.
- A cold pale immobile limb with no Doppler signal and no improvement within 2 hours of onset needs to be taken seriously.
- The onset of mottling is ominous and fixed mottling means that fasciotomy will be needed, as well as revascularisation.
- Collateral recruitment to restore distal perfusion beyond an occlusion takes about 2 hours so if signs of acute ischaemia persist longer than this (and in fact nearly all cases do improve) there is a serious problem that requires a vascular opinion.

Pure arterial spasm induced by catheter trauma

- should also resolve within 2 hours of the catheter being removed providing cardiac function, blood volume and systemic and environmental temperatures are optimised.
- Ischaemia persisting beyond this time is likely to be due to intra-luminal thrombus or artery wall injury.

Consequently a trial of conservative treatment should commence if signs of acute ischaemia do not improve within 2 hours of onset or de-cannulation

In the rare cases where conservative measures are ineffective surgical revascularisation will be needed.

- Full-blown signs of acute ischaemia progressing to mottling within 2 hours represent the worst case scenario and in such cases if revascularisation is not accomplished tissue loss can be established in 6 hours.
- Surgery usually comprises CFA thrombectomy and vein patching.
- Proximal and distal clot can be extracted with a 2 Fogarty catheter or if this is too large then aspiration through a fine venflon may succeed.

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- Magnification 3-4x is needed in neonates and 8-0 Prolene sutures, ideally interrupted.

By far the most common scenario is the limb that is cooler and paler than its fellow, still mobile, with absent pulses and reduced but not completely absent Doppler signals

- These limbs should remain viable and although conservative measures are appropriate and can restore normality surgery can be avoided.
- Such a viable but moderately ischaemic limb should undergo initial vascular assessment and then be followed up, as a proportion will manifest chronic CFA occlusion which is likely to propagate back up to the iliac bifurcation, with the limb surviving adequately on internal iliac collaterals. Loss of axial inflow tends to leave the limb with a 10% or greater pulse pressure deficit and this is likely to cause undergrowth if uncorrected in the long term.
- Ilio-femoral revascularisation to prevent limb hypoplasia requires autologous grafting with as large a vein as possible and it is advisable to pre-arterialise the normal contra-lateral LSV by anastomosis to the above-knee popliteal for 3 months before harvest, during which time it will double or treble in diameter.

NB:

- The great majority of problems can be resolved locally.
- The key is to avoid complacency and not assume that all cases will resolve spontaneously. Although infants have enormous capacity to recruit collaterals, in other respect the rules of managing their limb ischaemia are the same as for adults.

Malcolm Simms

Royal Wolverhampton Hospitals Trust

Clinical Algorithm for Management of Arterial Thrombosis affecting limb perfusion (Any gestation and birth weight)

