

US in the Complex NICU Patient

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Relevant Financial Relationships

- I have no disclosures to make

US in the NICU

- US is a powerful, inexpensive and ubiquitous tool
- Particularly suitable for diagnosis and treatment of critically ill neonates
- Certain imaging procedures and operative management may be impractical or impossible due to marginal clinical status of these patients
- Minimally invasive bedside diagnostic and interventional techniques highly desirable

US Diagnosis

- Radiographic chest opacities
- Vascular thrombosis
- Diaphragmatic paralysis
- Neonatal sepsis
- Visceral anatomy in patients with heterotaxy

Radiographic Chest Opacities

- US used to distinguish pleural from parenchymal causes of opacification
- Transudates anechoic or echogenic
- Exudates more often complex collections with fibrin septations
 - associated pleural thickening and parenchymal abnormality
 - hemothorax and empyema appear complex with thick fluid and septations
- Consolidated lung is echogenic and contains air-filled and/or fluid-filled bronchi

Vascular Thrombosis

- Great vessels
- Portal vein
- Renal vein
- Peripheral veins

Aortic Thrombosis

- Usually in neonates
- Complication of umbilical artery catheterization
- Clotting and cardiovascular disorders
- Associated with renal artery thrombosis
- Most patients symptomatic
 - catheter dysfunction, hematuria, hypertension
- Duplex and color Doppler US determine extent of thrombosis and monitor changes in flow during treatment
- Flow reconstituted via collateral vessels
- Long-term sequelae:
 - hypertension and lower extremity growth impairment

Vena Caval Thrombosis

- Indwelling catheters
- Dehydration
- Sepsis
- Tumor
- Usually due to spread from veins in lower limb, pelvis, kidney or liver
- Focal expansion of vessel lumen
- Echogenicity of thrombus depends on its age
 - chronic thrombi may calcify
- Color Doppler reveals intraluminal filling defect
- Spectral analysis produces no signal

Portal Vein Thrombosis

- Dehydration
- Shock
- Umbilical vein catheterization
- Coagulopathy
- Cirrhosis
- Budd-Chiari syndrome
- Tumor
- Pylephlebitis

Renal Vein Thrombosis

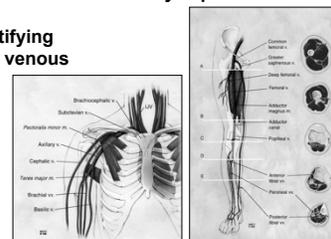
- More common than renal artery thrombosis
- Prematurity
- Prothrombotic abnormalities
- Central venous line
- Diabetic mother
- Asphyxia
- Infection
- Infants:
 - thrombosis initiated in interlobular and arcuate veins
- Older children:
 - thrombosis initiated in IVC and extends into renal vein

Renal Vein Thrombosis

- Acute:
 - flank pain, hematuria
- Chronic:
 - venous collaterals, insignificant symptoms
- Outcome varies from complete recovery to severe renal atrophy:
 - depends on rapidity and extent of venous occlusion
 - venous recanalization and/or collaterals result in decreased edema, arterial reperfusion and improved outcome

Peripheral Veins: Indications for US

- Chronic occlusion due to IV catheter use and venous thrombosis results in difficult central venous access in many hospitalized and chronically ill patients
- US ideal for identifying suitable sites for venous access



Diaphragmatic Paralysis

- **Phrenic nerve injury**
 - birth trauma, cardiac surgery, TE fistula repair, chemical injury from parenteral fluid extravasation
- **Infants dependent on diaphragmatic function for adequate ventilation**
 - poorly developed intercostal muscles, mobile mediastinum
- **Prompt diagnosis permits early diaphragmatic plication which reduces incidence of severe lung infections and mortality in selected patients**
- **Advantage of US diagnosis over fluoroscopy is lack of ionizing radiation and portability**

Neonatal Sepsis

- **Early-onset in first week of life**
 - maternally transmitted prior to or during delivery
 - risk factors include group B streptococcal infection during pregnancy, preterm delivery, prolonged rupture of membranes, chorioamnionitis
- **Late-onset between days 8 and 89 days of life**
 - risk factors include prolonged hospitalization, indwelling catheters
- **US useful in identifying focal sites of infection, including abscesses and fluid collections**

Visceral Anatomy in Patients with Heterotaxy

- **Disordered development of left-right body axis with abnormal arrangement of thoracic and/or abdominal viscera**
- **Ciliopathy**
- **Group of genetically and phenotypically heterogeneous disorders**
- **Ciliary dysfunction common pathological mechanism**
- **Specific clinical features dictated by subtype, structure, distribution, and function of affected cilia**

Heterotaxy

- **Male-to-female ratio 2:1**
- **Known environmental risk factors:**
 - twin gestation, maternal diabetes, maternal cocaine use
- **Wide phenotypic spectrum and range of associated congenital anomalies has hindered clinical care and research**
- **Clinical evaluation focused on delineating anatomy and managing the congenital anomalies**
- **Visceral situs anomalies, congenital heart defects, asplenia or polysplenia, biliary atresia, midline defects**

Conclusion

- **US is a versatile, noninvasive tool that provides rapid anatomical and physiological information critical to the management of the fragile NICU patient**

