Jurnal Reading

Kegunaan Pemeriksaan Ultrasound pada Diagnosis Necrotizing Enterocolitis

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PROGRAM PENDIDIKAN DOKTER SPESIALIS RADIOLOGI FAKULTAS KEDOKTERAN UNIVERSITAS SEBELAS MARET / RSUD DR MOEWARDI SURAKARTA
2018

P

- 9 neonatus yang terdiagnosis NEC

I

Ultrasonografi

C

- Imaging abdomen polos

O

- Peran USG dalam diagnosis NEC

PENDAHULUAN

NEC adalah salah satu kondisi gastrointestinal yang berat dan kegawatan tersering pada neonatus

Mortalitas NEC tinggi (20-60%)

Diagnosis yang cepat dan penanganan yang tepat merupakan hal yang penting

X-ray abdomen merupakan modalitas yang penting dalam penilaian awal kasus NEC

Karena kemampuannya untuk memvisualisasi dinding intestinal, lumen gastrointestinal dan struktur disekitarnya, US abdomen dapat menjadi pemeriksaan tambahan, terutama ketika temuan x-ray meragukan

TUJUAN

Untuk mengevaluasi peran USG dalam diagnosis kasus Necrotizing Enterocolitis serta nilainya untuk implementasi terapi yang tepat

METODE

Desain Studi	• Studi retrospective
Subyek	• 9 Neonatus yang didiagnosis NEC dan dilakukan pemeriksaan x-ray abdomen dan USG abdomen
Tempat & Waktu	• St. Jadwiga, the Queen Provincial Hospital No. 2 di Rzeszow, Poland • September 2009 - April 2013

METODE

Retrospektif

Pasien terdiagnosis NEC

Menjalani pemeriksaan x-ray dan USG abdominal dengan jarak waktu tidak lebih dari 24 jam

Sampel yang diinklusi n= 9

- Tanda radiologis NEC berdasarkan Bell's classification
- Temuan USG
- Data epidemiologis, faktor risiko dan terapi

USG dilakukan oleh spesialis radiologi yang telah berpengalaman dalam diagnosis pediatrik dan traktus gastrointestinal

METODE

Table 1. Bell's classification of necrotizing enterocolitis according to radiographic findings.

Stage	Radiologic signs
I	• Normal • Mild distension of intestinal loops
II	• Distension of intestinal loops • Intestinal pneumatosis/portal venous gas • Obstruction
III	• Pneumoperitoneum • Ascites

HASIL PENELITIAN

HASIL

Table 2. Radiographic and ultrasonographic findings identified in the course of NEC in the analyzed group of neonates.

Radiographic findings	Ultrasonographic findings
• Intramural air bubbles • Features of intestinal obstruction • Paucity of bowel gas	• Increased intestinal wall echogenicity • Thickening of intestinal wall • Intramural air bubbles • Portal venous gas • Distended intestinal loops filled with fluid, with reduced/absence of peristalsis – sign of obstruction • Hyperechogenic, collapsed intestinal wall with reduced or absence of peristalsis – sign of intestinal immaturity • Anechogenic free peritoneal fluid • Echogenic peritoneal fluid – sign of perforation • Free air in abdominal cavity – sign of perforation • Peritoneal calcifications – sign of previous peritonitis

HASIL

- Mayoritas neonatus yang terinklusi dalam studi ini lahir preterm (24-32 minggu) dengan berat lahir 540-1960 g
- Neonatus aterm yang terinklusi (38-40 minggu) lahir dengan berat 2160-2600 g
- Gejala NEC pada kelompok preterm muncul antara minggu 1-4 kehidupan, dimana pada aterm muncul pada minggu pertama.
- Faktor risiko NEC pada preterm, disertai dengan gangguan respirasi (Respiratory Distress Syndrome atau pneumonia) terdapat pada semua kasus preterm, dimana gangguan cardiovaskuler berupa PDA ditemukan pada 4 anak (67%) dan coarctation aorta pada 1 anak (16%).
- Sedangkan pada kelahiran aterm, faktor risiko yang ditemukan adalah berat bayi lahir rendah.

HASIL

Table 3. Comparison of findings typical of NEC in ultrasound examinations and plain abdominal radiography in a group of preterm and full term infants.

Patient data	Preterm neonates (<37 week of gestation)					Term neonates (>37 week of gestation)				No. (%)
	B.c.M.	B.s.M.	B.s.I	D.s.A.	D.c.B.	K.c.K.	P.P.	R.W	S.L.	
Radiographic findings					+/–					
Distended intestinal loops	–	–	–	–	+	–	–	–	–	1 (11%)
Signs of obstruction of various degrees (fluid levels)	–	–	–	+	–	–	+	–	–	2 (22%)
Presence of air bubbles within intestinal walls	–	–	–	–	–	–	+	–	–	1 (11%)
Presence of air bubbles in portal vein	–	–	–	–	–	–	–	–	–	0
Ascites	–	–	–	–	–	–	–	–	–	0
Intraperitoneal free air	–	–	–	–	–	–	–	–	–	0
Other: paucity of bowel gas	+	+	–	–	–	–	–	–	–	2 (22%)
Grade of disease progression acc. to Bell's radiological criteria	0	0	0	II	I	0	II	0	0	

HASIL

Ultrasonographic findings	+/–									
Increased intestinal wall echogenicity	+	–	–	+	+	–	–	–	–	3 (33%)
Thickening/edema of intestinal wall	+	+	+	+	+	+	–	+	+	8 (89%)
Thinning of intestinal wall	–	–	–	–	–	–	–	–	–	0
Presence of air bubbles within intestinal walls	+	–	–	–	+	–	+	–	+	4 (44%)
Presence of air bubbles in portal vein	–	–	–	–	–	–	+	–	–	1 (11%)
Distended intestinal loops filled with fluid, with reduced/absence of peristalsis – sign of obstruction	–	+	+	+	+	–	+	–	–	5 (56%)
Hyperechogenic, collapsed intestinal wall with reduced/absence of peristalsis – sign of intestinal immaturity	+	+	–	+	+	–	–	–	–	4 (44%)
Anechogenic intraperitoneal fluid	–	–	+	+	+	–	–	+	–	4 (44%)
Echogenic intraperitoneal fluid	–	–	–	–	–	+	–	+	+	3 (33%)
Intraperitoneal free air	–	–	–	–	–	–	+	–	–	1 (11%)
Peritoneal calcifications – sign of previous peritonitis	–	–	–	–	–	+	–	–	–	1 (11%)

HASIL

Table 4. Comparison of findings in ultrasound and plain abdominal radiography examinations.

Signs	Number (%) of children, who presented with certain features in US	Number (%) of children, who presented with certain features in x-ray examination
Intestinal pneumatosis	4 (44%)	1 (11%)
Portal venous gas	1 (11%)	0
Distended intestinal loops/signs of obstruction	5/5 (56%)	3 (33%)/2 (22%)
Signs of perforation	1 (11%)	0
Features of intestinal immaturity in US (absence/reduced peristalsis)/paucity of bowel gas in x-ray examination	4 (44%)	2 (22%)
Ascites	6 (67%)	0

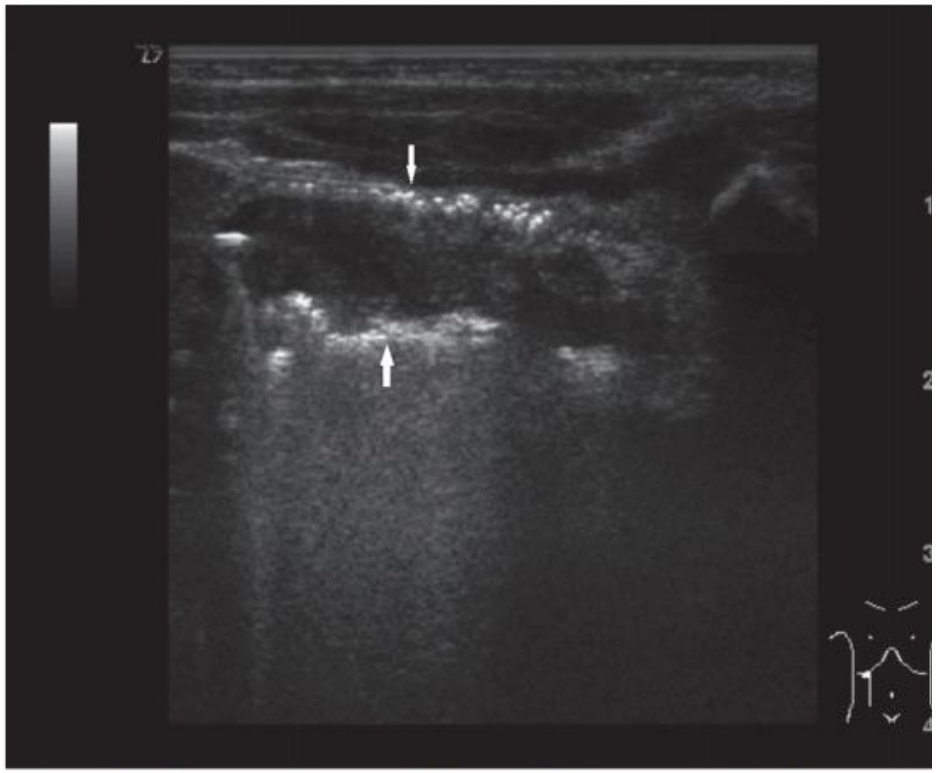


Figure 1. Ultrasound image of intestinal pneumatosis of large intestine (arrows).

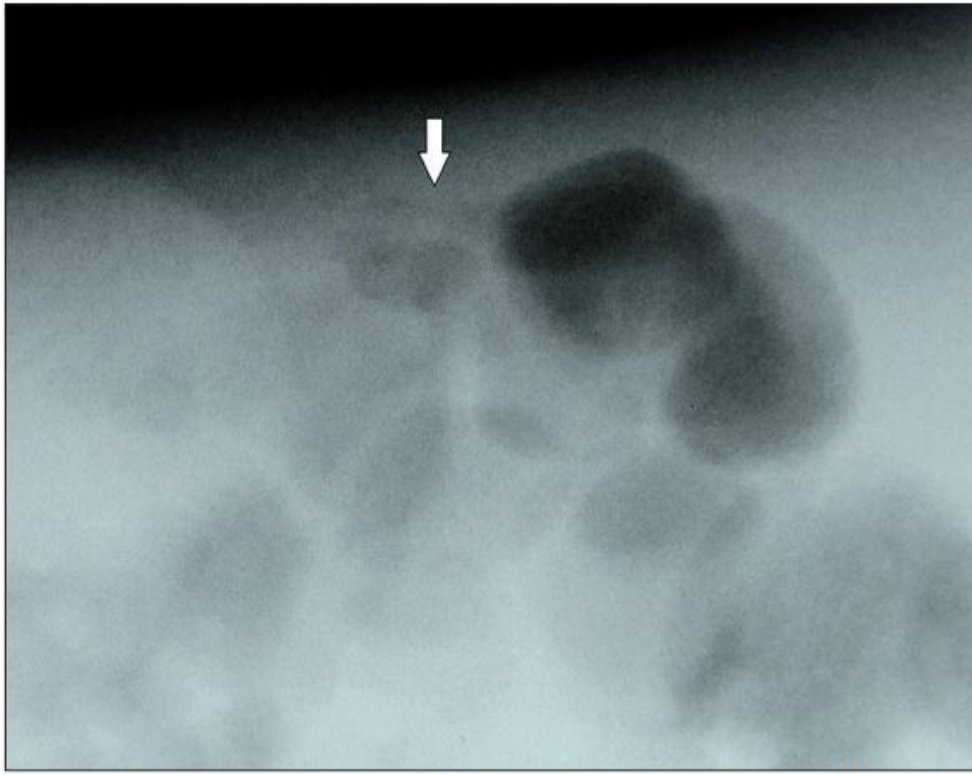


Figure 2. Plain x-ray performed in left lateral decubitus position: tiny air bubbles within intestinal wall (arrow).

- Pneumatosis intestinal merupakan tanda patognomonic pada kasus NEC

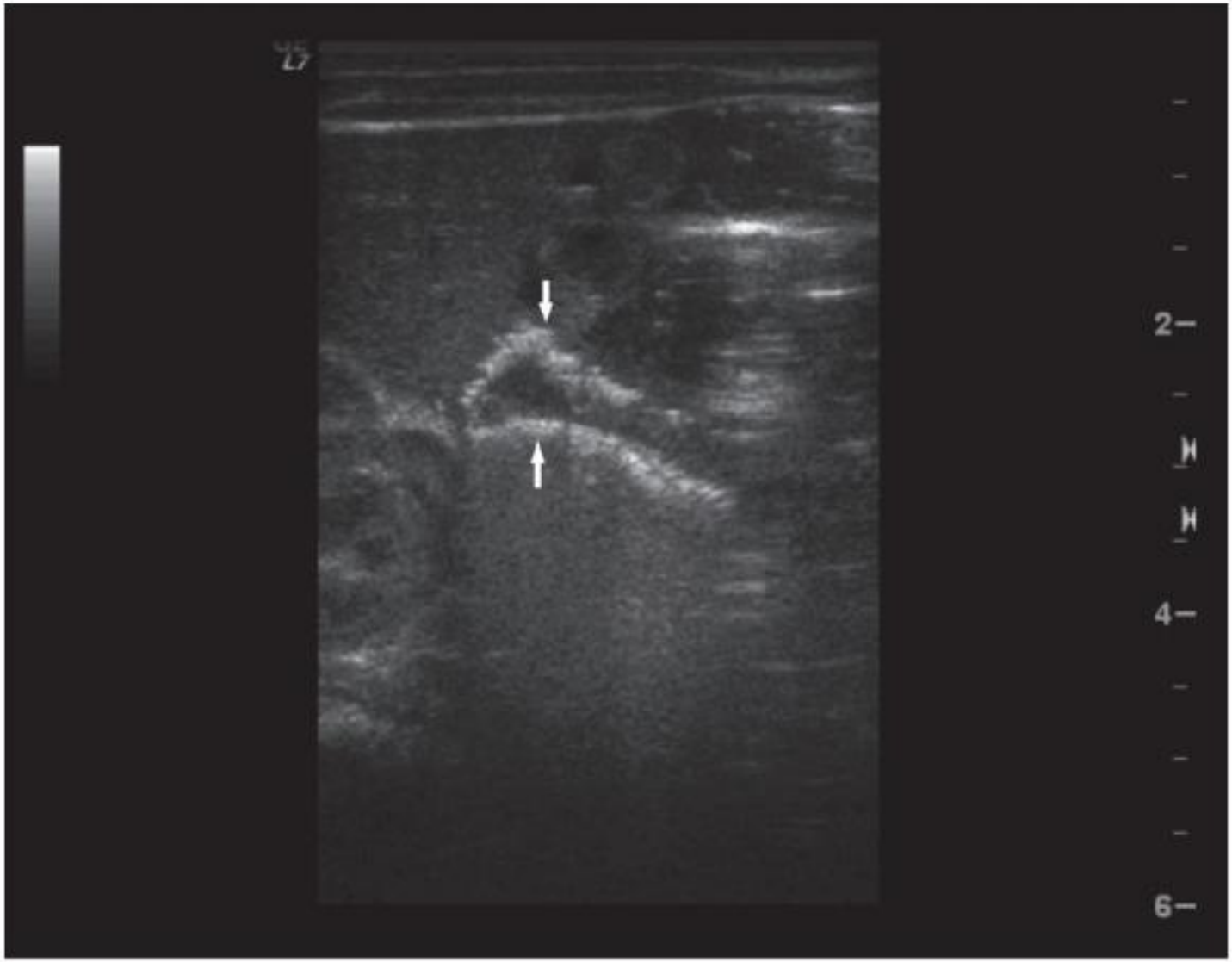


Figure 3. Ultrasound image of portal venous gas (arrows).

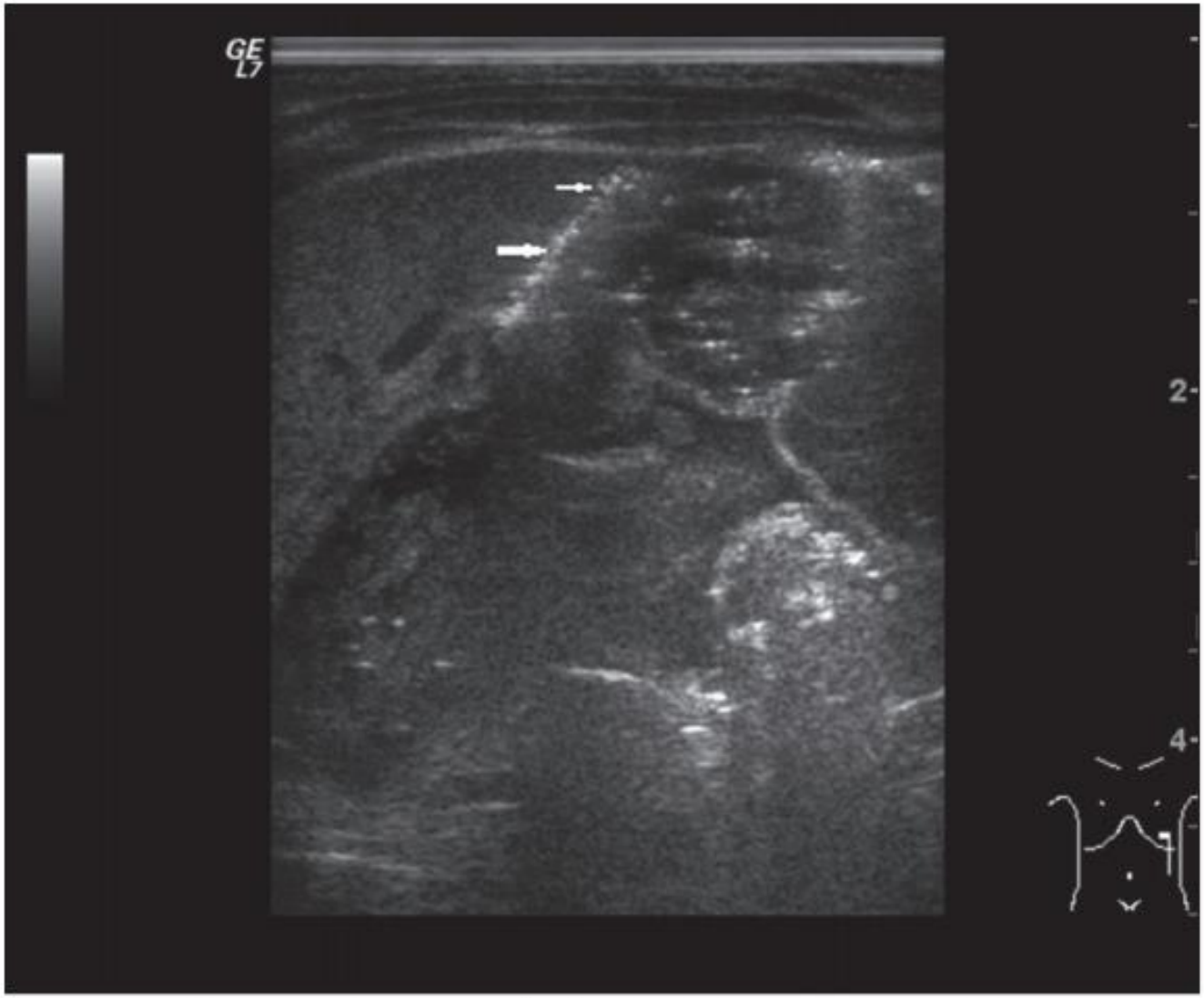


Figure 4. Ultrasound image of subsplenic intraperitoneal free air (arrows).

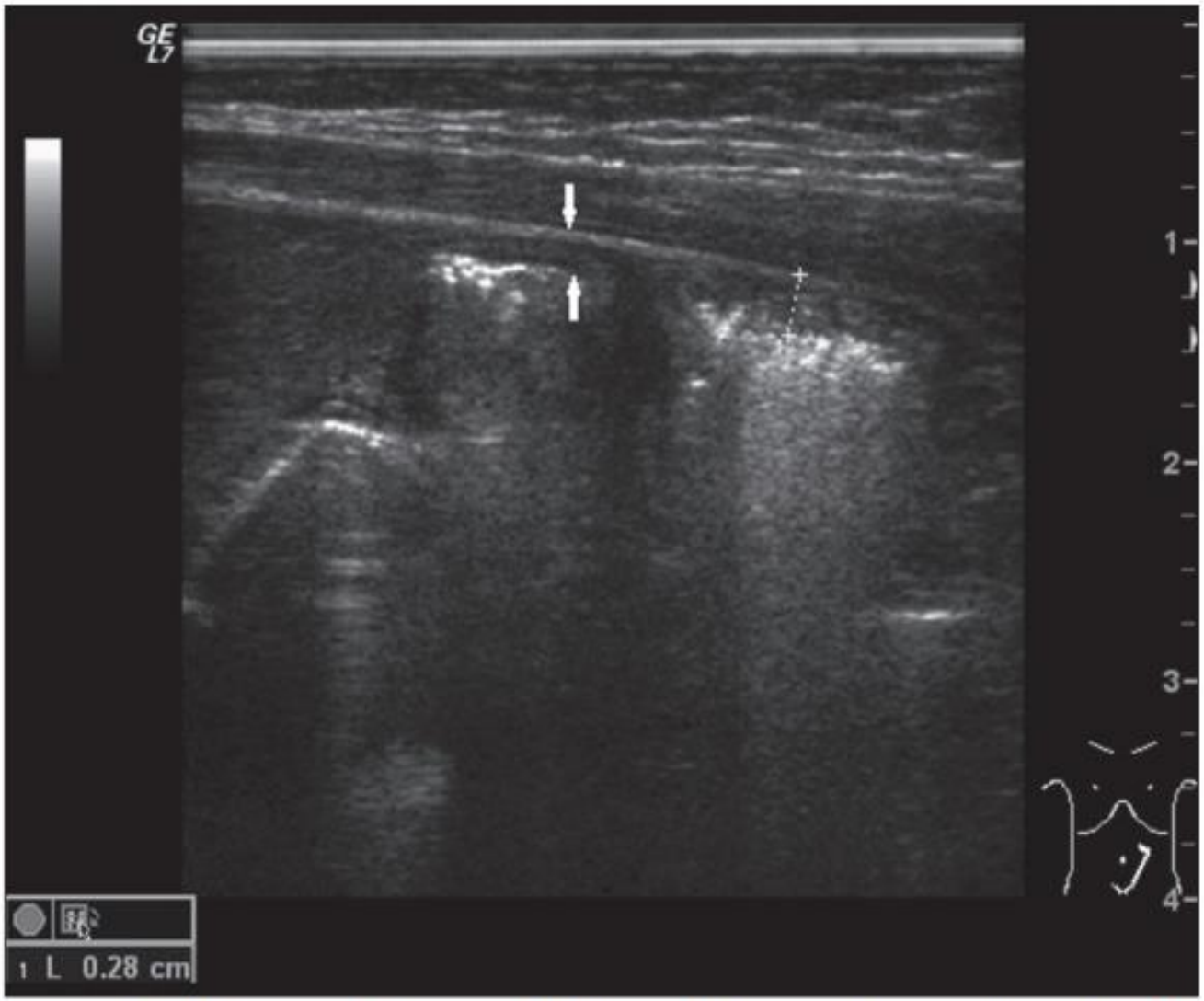


Figure 5. Ultrasound image of thickened, hyperechogenic bowel wall (arrows).

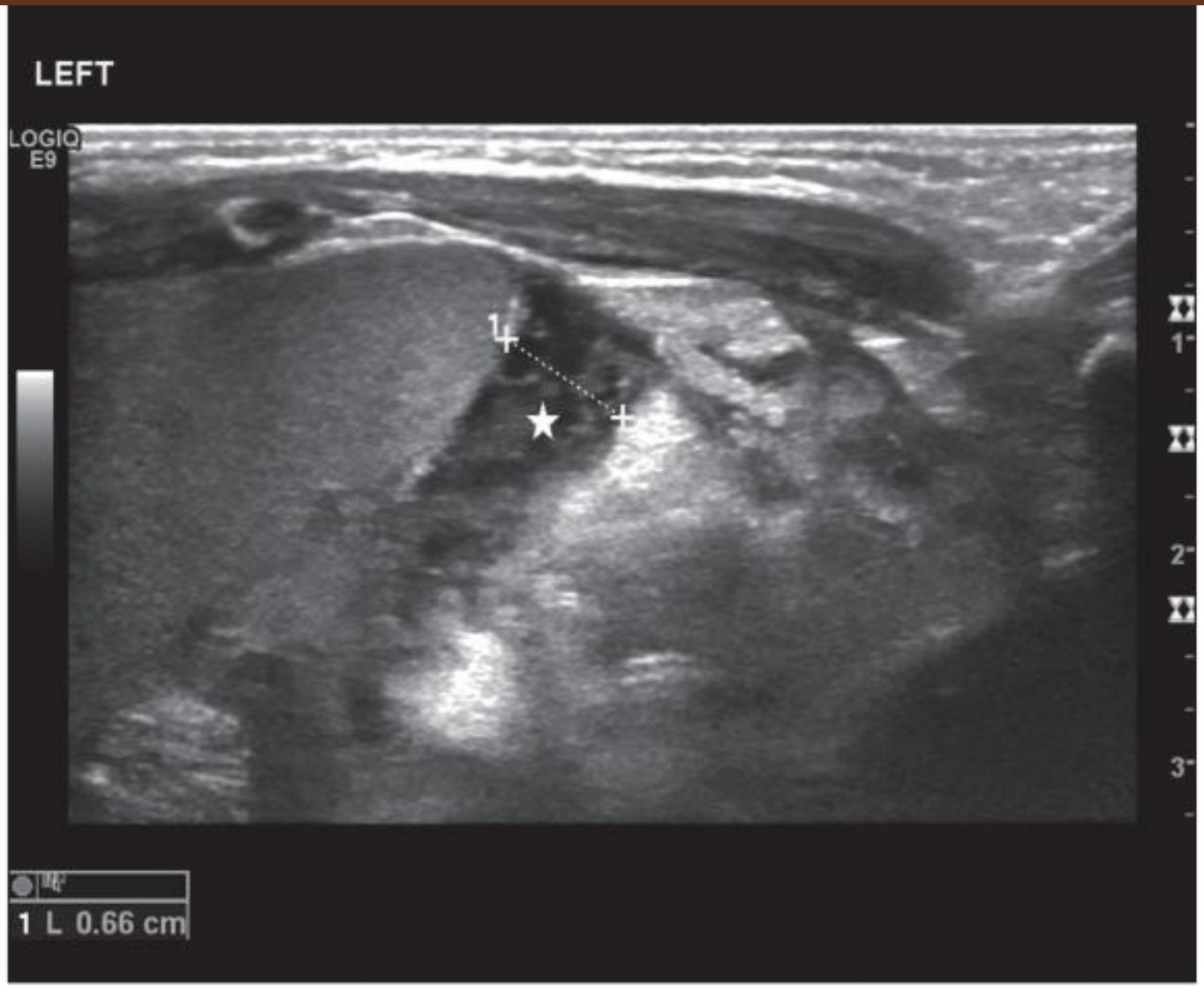


Figure 6. Ultrasound image of echogenic subhepatic intraperitoneal free fluid (star).

Figure 7. Ultrasound image of tiny intraperitoneal calcifications (arrows).

DISKUSI

Dalam berbagai literatur NEC ditemukan lebih sering pada preterm dan berat lahir rendah (Neu J 2011)

- Terkonfirmasi pada studi ini

Literatur menyatakan gejala banyak timbul pada minggu ke 2-3 kehidupan (Schnabi 2008)

- Pada studi ini bayi preterm muncul gejala pada minggu 1-4, sedangkan bayi aterm pada minggu pertama

- NEC → mortalitas yang tinggi (hingga 60%) (Holman , 2006) → diagnosis yang cepat merupakan hal yang penting.
- X ray → imaging pilihan

  US → modalitas tambahan, terutama x-ray yang kurang meyakinkan
- Imaging x-ray, klinis dan lab → menentukan derajat progresif NEC berdasarkan klasifikasi Bell's untuk kepentingan manajemen

  (stage I-II konservatif, stage III pembedahan)
- Tanda radiologis yang termasuk dalam Bell's kriteria dapat juga diidentifikasi dengan US
- US mampu melihat lebih teliti morfologi intestinal dan struktur disekitarnya, serta membedakan cairan anechogenik dan echogenik,dan mengevaluasi fungsi perfusi intestinal (Silva, 2007)

Pneumatosis intestinal merupakan tanda patognomonic kasus NEC

- Lebih banyak ditemukan pada US (44%) dibandingkan x-ray (11%)

Portal venous gas akibat resorbsi air bubble dari intestiinal ke sistem vena porta, kemampuan diagnosis US lebih tinggi dibanding US (Bohnhorst,2013).

- Hanya terdeteksi 1 kasus dengan US

US dapat mendeteksi baik sedikit ataupun banyak gas intraperitoneal. Namun pada tersangka perforasi, x-ray masih merupakan pemeriksaan pilihan (Epelman, 2007)

- X-ray tidak menemukan tanda perforasi, sedangkan US menemukan adanya udara pada satu kasus, namun tidak terkonfirmasi secara operatif karena terapi koservatif

Kemampuan memvisualisasi jumlah, lokasi dan echogenik cairan intraperitoneal merupakan kelebihan US dibanding x-ray yang hanya dapat melihat cairan yang banyak. Meskipun tanda ini tidak spesifik tetapi merupakan tanda pendukung adanya perforasi, walau tidak ditemukan udara bebas (Yost, 2005).

- Cairan echogenic ditemukan pada 33% US. Semua pasien tersebut menjalani operasi dan terkonfirmasi pada2 kasus. Dimana x-ray tidak menemukan adanya cairan intraperitoneal

Mortalitas tinggi, sedangkan pada stadium awal tanda radiologis kurang spesifik. Dikarenakan progresi penyakit yang cepat, diagnosis awal sangat penting, dan peran diagnosis USG mungkin membantu

Beratnya klinis tidak berhubungan dengan gambaran radiologis, oleh karena itu lebih baik dilakukan urgent US.

KETERBATASAN PENELITIAN

- Jumlah sampel penelitian sedikit
- Tidak adanya subjek kontrol
- Sangat bergantung keahlian pemeriksa (operator-dependent)

KESIMPULAN

- Pemeriksaan ultrasound abdomen dengan evaluasi intestinal membantu dalam diagnosis necrotizing enterocolitis, terutama ketika hasil x-ray tidak sesuai dengan status klinis berat pada pasien
- Perubahan morfologi yang dapat diidentifikasi dengan US lebih luas dibandingkan pemeriksaan x-ray
- Pemeriksaan US pada NEC sering dapat mengidentifikasi patologis sebelum tampak pada radiogram
- US mampu menentukan derajat progresif perubahan intestinal, yang mana membantu klinisi memutuskan terapi yang tepat dan implementasi terapi lebih awal.

TELAAH JURNAL

Validitas

1. Apakah research question atau tujuan penelitian jelas?	Ya, tujuan penelitian ini dijelaskan dalam Pendahuluan Untuk mengevaluasi peran USG dalam diagnosis kasus Necrotizing Enterocolitis serta nilainya dalam implementasi terapi yang tepat
2. Apa design penelitian ini? Bagaimana data dikumpulkan, satu waktu (cross-sectional) atau berkelanjutan (longitudinal)? Apa keterbatasan pengumpulan data tersebut?	Retrospektif, diambil dalam satu waktu (cross-sectional) Keterbatasan penelitian secara retrospektif ini, mungkin informasi yang ada tidak lengkap,rentan bias.
3. Bagaimana sample penelitian dipilih? Bagaimana sample mewakili populasi?	Pasien neonatus dengan diagnosis NEC dan menjalani pemeriksaan x-ray dan USG.
4. Jelaskan variable of interest. Jika studi komparasi, variabel apa yang dibandingkan? Bagaimana grup serupa? Bagaimana perbedaannya? Adakah variabel confounding	Hasil x-ray Hasil USG Faktor risiko NEC Variabel confounding : bed-site, pemeriksa

5. Apakah sampel cukup banyak untuk signifikan secara statistik? Apakah analisis kekuatan dilakukan?	Sampel penelitian ini relatif sedikit dan tidak dilakukan analisis kekuatan
6. Adakah potensial terjadinya bias?	Ada. Dijelaskan adanya perbedaan alat dan bed-site dilakukan nya pemeriksaan. Tidak dijelaskan sama atau bedanya pemeriksa
7. Jelaskan apakah penelitian ini reliability dan validity? Apakah pengukuran cukup untuk populasi atau variabel yang diteliti?	Tidak dijelaskan
8. Apakah analisis(statistical methods) dijelaskan dengan detail? Bagaimana distribusi data? Apakah uji korelatif dan komparatif tepat untuk jenis analisis data dan tujuan yang dilakukan ?	Tidak dijelaskan

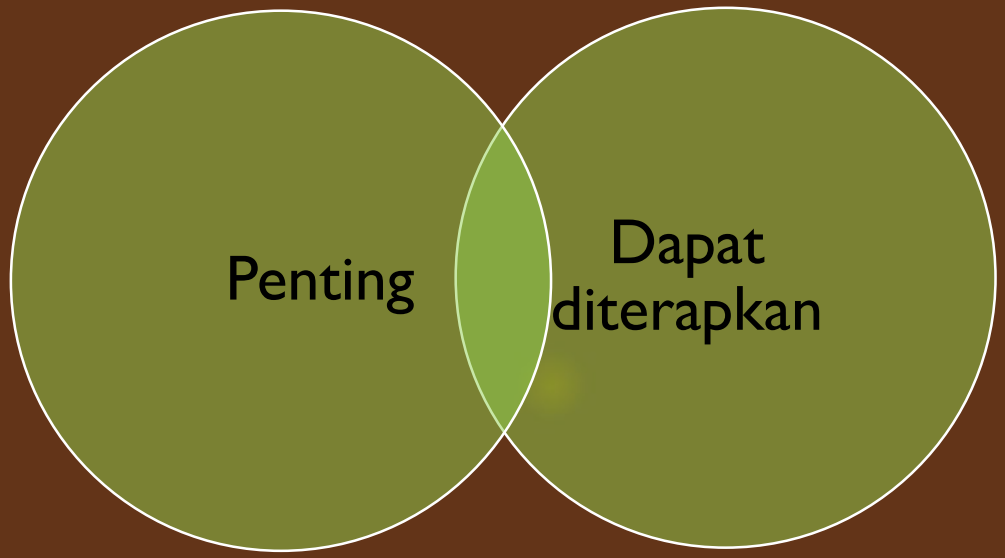
Hasil

1. Bagaimana hasil yang ditemukan ?	Hasil temuan USG didapat lebih teliti dibanding x-ray terutama pada hasil temuan x-ray yang meragukan
2. Apakah clinical significance? Statistical significance?	Tidak dijelaskan
3. Apakah peneliti menempatkan temuannya dalam konteks literatur yang lebih luas	Ya

Kemamputerapan

1. Apa relevansi temuan ini dengan praktek	Peran USG dalam membantu mendiagnosis NEC, sehingga diharapkan mampu mendiagnosis lebih tepat dan menurunkan angka mortalitas
2. Bagaimana temuan ini dapat diaplikasikan dalam praktek	Menjadikan USG menjadi metode pemeriksaan tambahan terutama pada kasus x-ray yang tidak meyakinkan

KESIMPULAN




Thank
you

NECROTIZING ENTEROCOLITIS

DEFINITIONS

- **Necrotizing Enterocolitis:**
  - an acquired neonatal acute intestinal necrosis of unknown etiology

[1] *Gordon PV et al, Emerging trends in acquired neonatal intestinal disease: is it time to abandon Bell's criteria?, J Perinatol. 2007 Nov;27(11):661-71.*

EPIDEMIOLOGY

- Incidence: 0.3-2.4 / 1000 live births

2-5 % of all NICU admissions 5-10 % of VLBW infants

- Over 90 % of cases occur in preterm babies
- About 10 % occur in term newborns: essentially limited to those that have some underlying illness or condition requiring NICU admission.[2]

[2] *Lambert DK et al. Necrotizing enterocolitis in term neonates: data from a multihospital health-care system . J Perinatol. 2007 Jul;27(7):437-43 .*

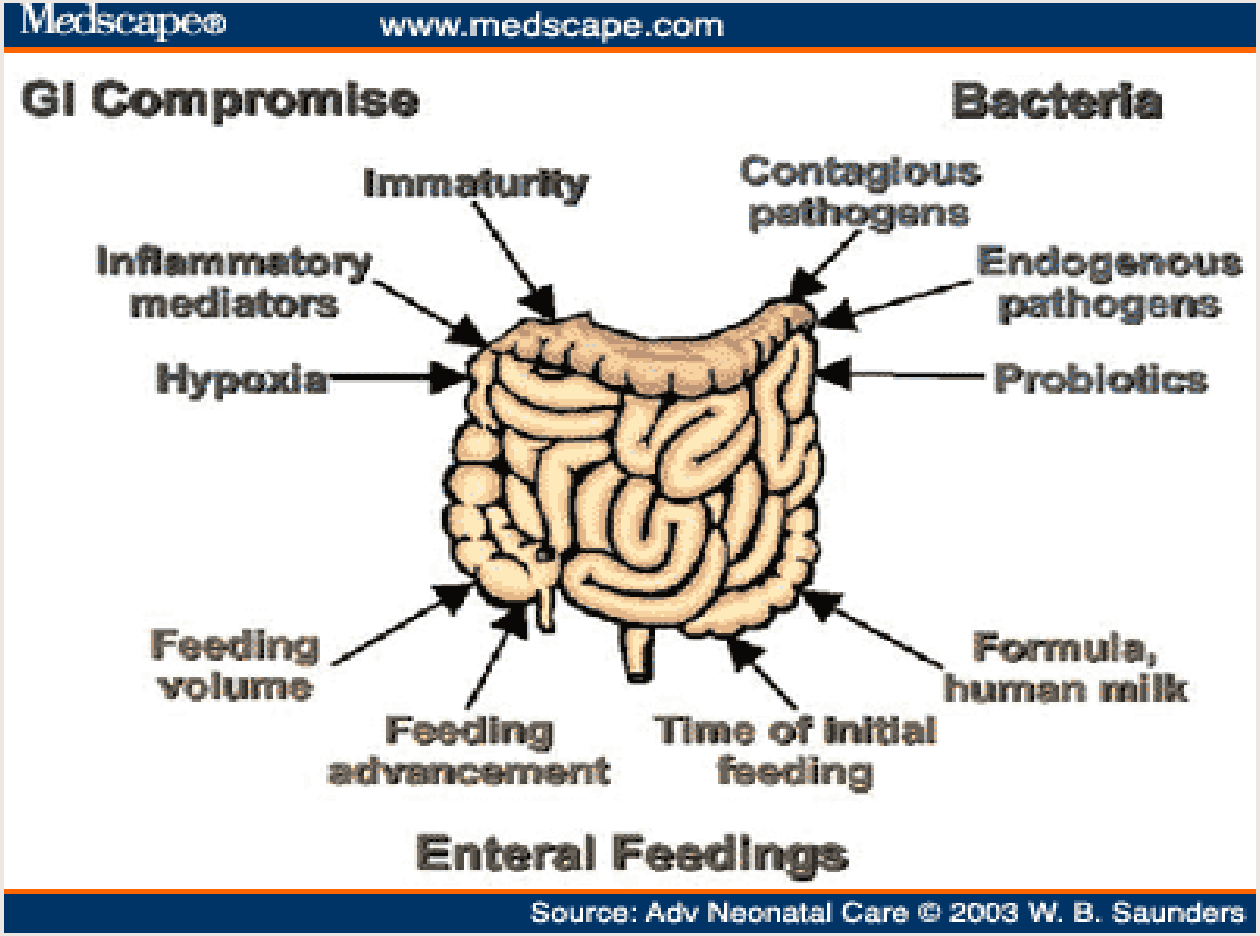
RISK FACTORS: PREMATURITY

- **Prematurity** is the single greatest risk factor
- The risk is inversely related to birth weight and gestational age.[4]

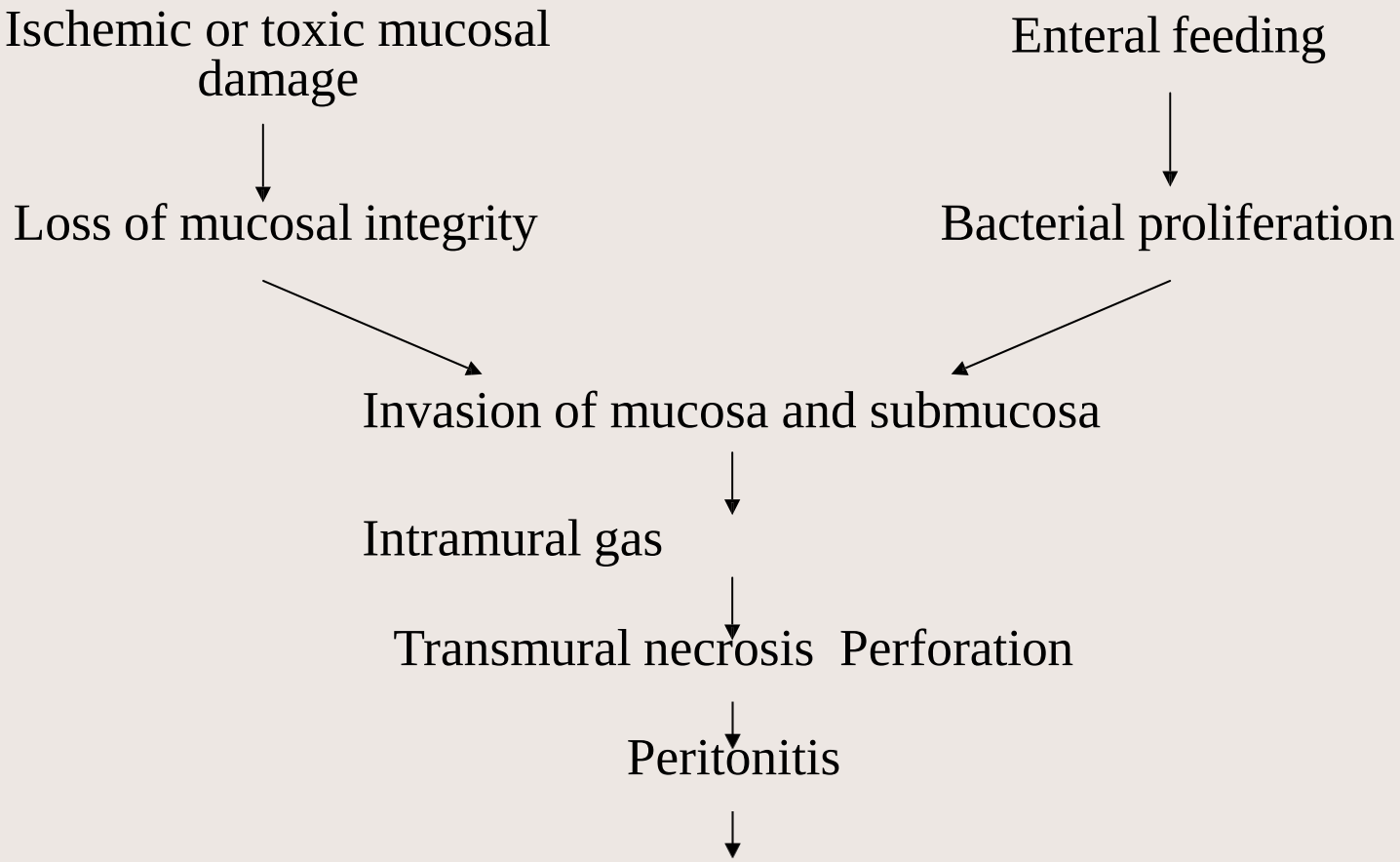
[4] *Lin PW, Stoll BJ. Necrotizing enterocolitis. Lancet. 2006 Oct 7;368(9543):1271-83.*

[5] *Czyrko C et al. Maternal cocaine abuse and necrotizing enterocolitis: outcome and survival. J Pediatr Surg. 1991 Apr;26(4):414-8; discussion 419-21.*

PATHOGENESIS



PATHOPHYSIOLOGY, *IN SUMMARY*



PATHOLOGY

Closeup of intestine of infant showing necrosis and pneumatosis intestinalis. Autopsy

PATHOLOGY

Postmortem photograph of bowel involved with severe NEC. The arrows indicate areas of the bowel wall where there has been so much necrosis and sloughing of the mucosa, submucosa, and muscularis that only the serosa is intact.

[30] *Epelman M et al. Necrotizing enterocolitis, review of state-of-the-art imaging findings with pathologic correlation. RadioGraphics 2007; 27:285–305.*

CLINICAL PRESENTATION

- **Abdominal (enteric) signs:**
  - Distension
  - Tenderness
  - Gastric aspirate, vomiting
  - Ileus
  - Abdominal wall erythema, induration
  - Ascites
  - Abdominal mass
  - Bloody stool

CLINICAL PRESENTATION

DIAGNOSIS, LABORATORY STUDIES

No lab test is specific for NEC

- The most common **triad** (!):
  - Thrombocytopenia
  - Persistent metabolic acidosis
  - Severe refractory hyponatremia
- ↑ WBC, ↓ WBC, ↓ PMN
- Hyperkalemia
- Stool: reducing substances, occult blood

DIAGNOSIS, RADIOLOGIC STUDIES

- **Abdominal X-ray:**
  - Abnormal gas pattern, ileus
  - Bowel wall edema
  - Fixed loop sign
  - Pneumatosis intestinalis
  - Intrahepatic portal venous gas (in the absence of UVC)
  - Pneumoperitonium, left lateral decubitus or cross-table lateral views

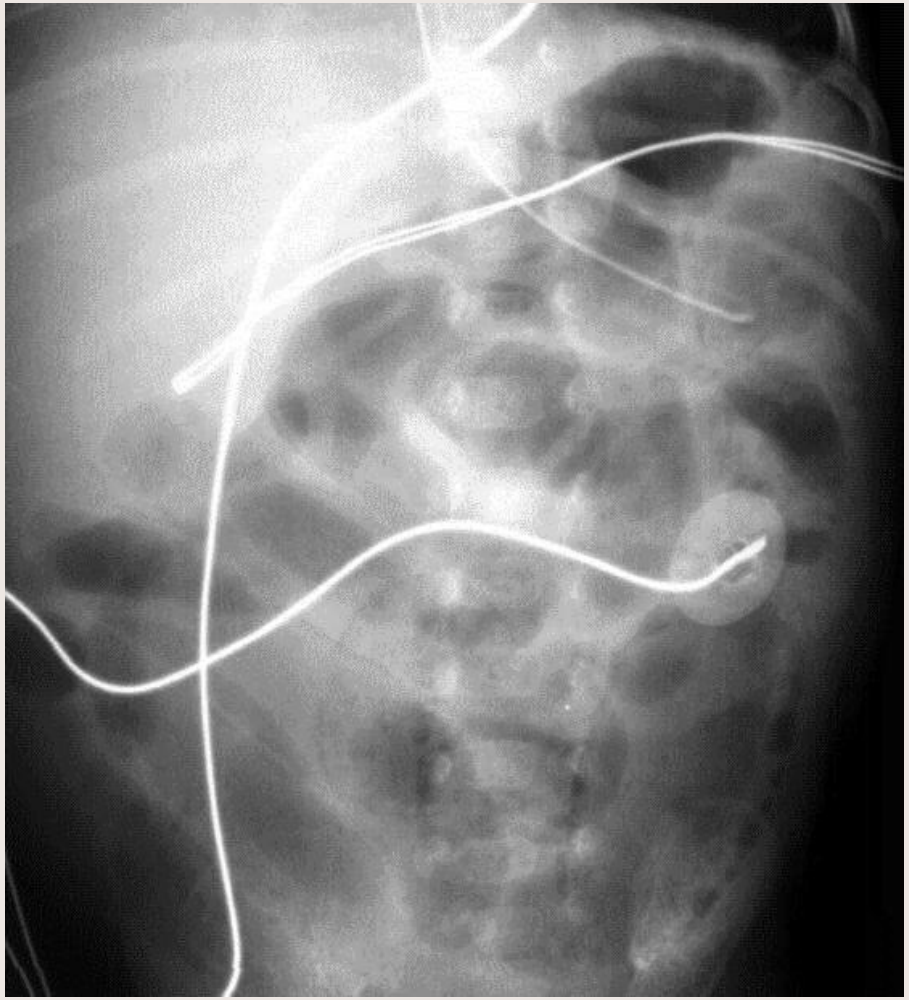
DIAGNOSIS, RADIOLOGIC STUDIES

Supine radiograph of the abdomen of a normal neonate shows a normal bowel gas pattern. Gas is distributed throughout the small and large bowel, and it is difficult to differentiate the small bowel from the large bowel. Each loop causes impressions on adjacent loops, giving each loop a multifaceted appearance; the overall pattern resembles that of a mosaic. The loops are generally not rounded or elongated.

[30] *Epelman M et al. Necrotizing enterocolitis, review of state-of-the-art imaging findings with pathologic correlation. RadioGraphics 2007; 27:285–305.*

DIAGNOSIS, RADIOLOGIC STUDIES

Pneumatosis intestinalis. Very obvious case. Tremendous amount of air in bowel walls

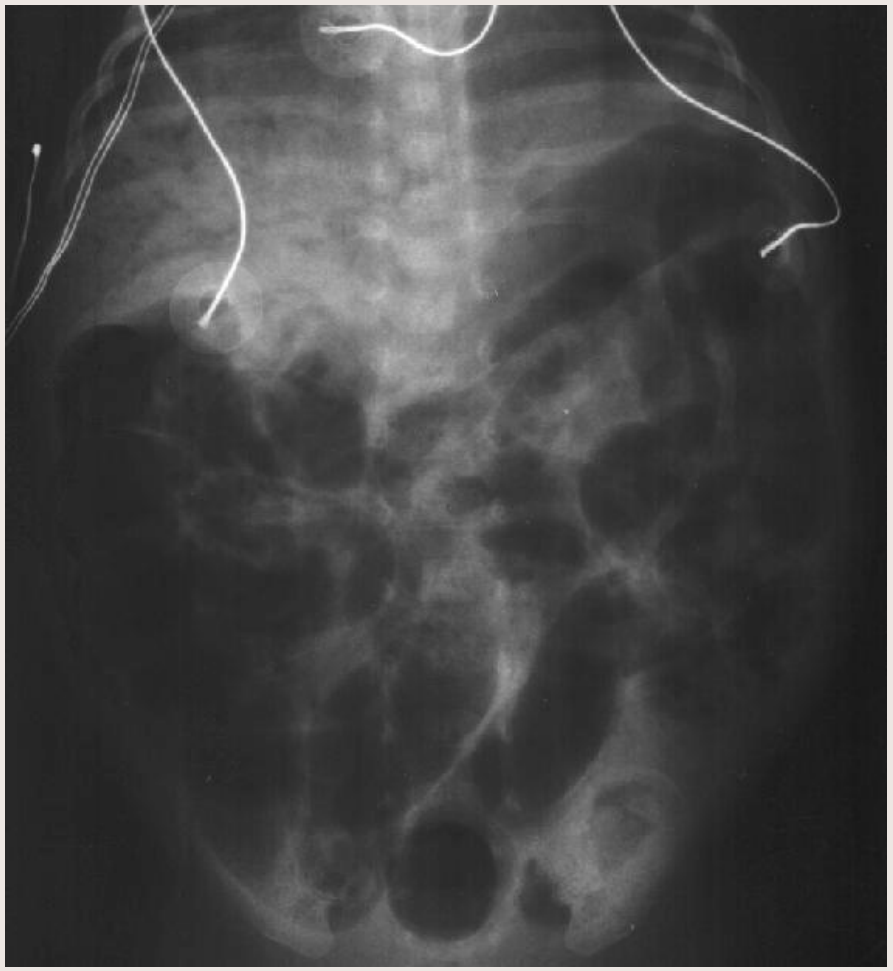


Reference:

Radiology Cases In Neonatology

DIAGNOSIS, RADIOLOGIC STUDIES

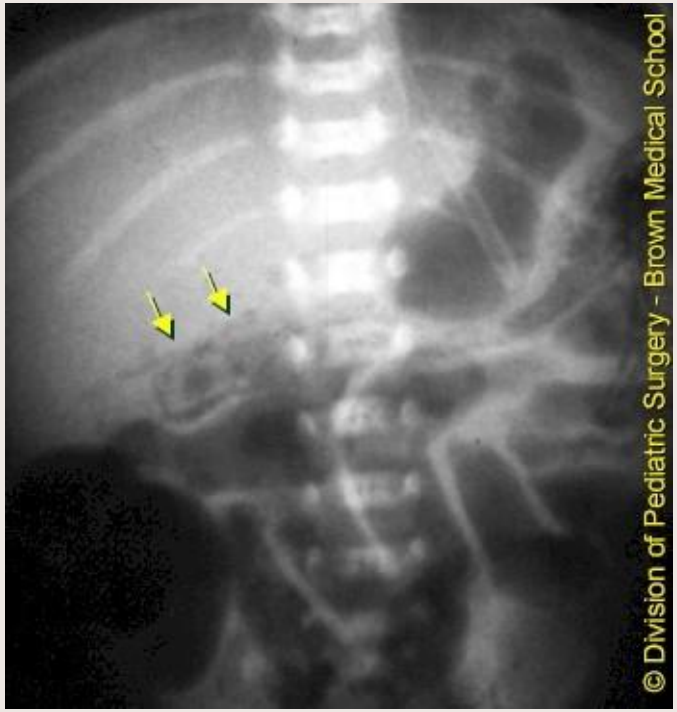
Pneumatosis intestinalis. Note the air visible in the bowel wall. The air dissects the bowel wall giving it a double lined appearance (ie., railroad tracks without the ties)



Reference:

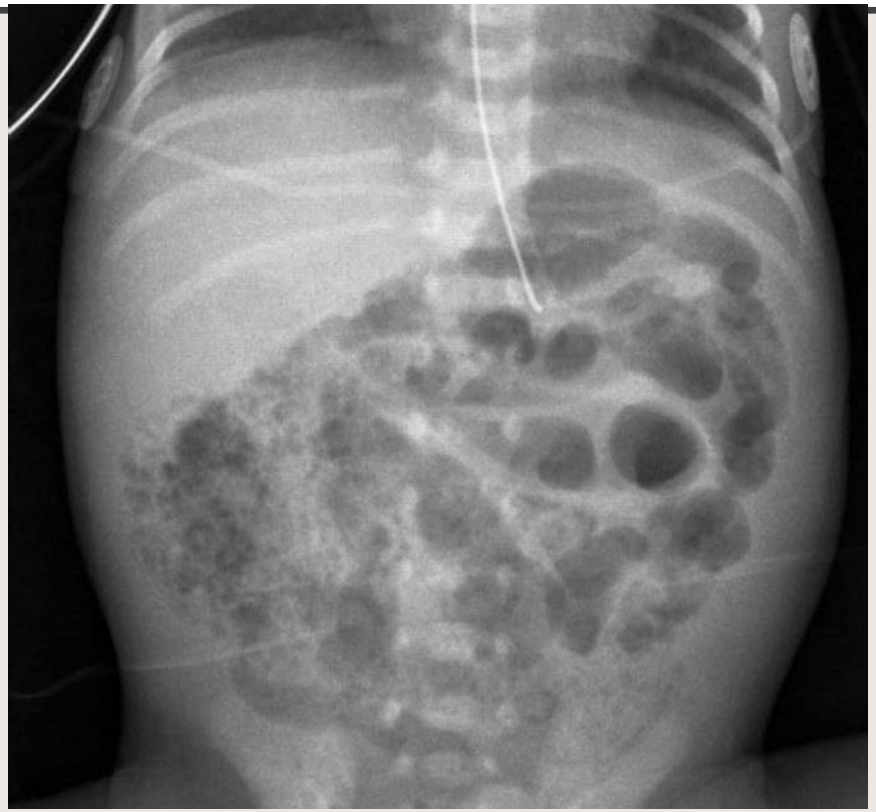
Radiology Cases In Neonatology

DIAGNOSIS, RADIOLOGIC STUDIES



Pneumatosis intestinalis

DIAGNOSIS, RADIOLOGIC STUDIES

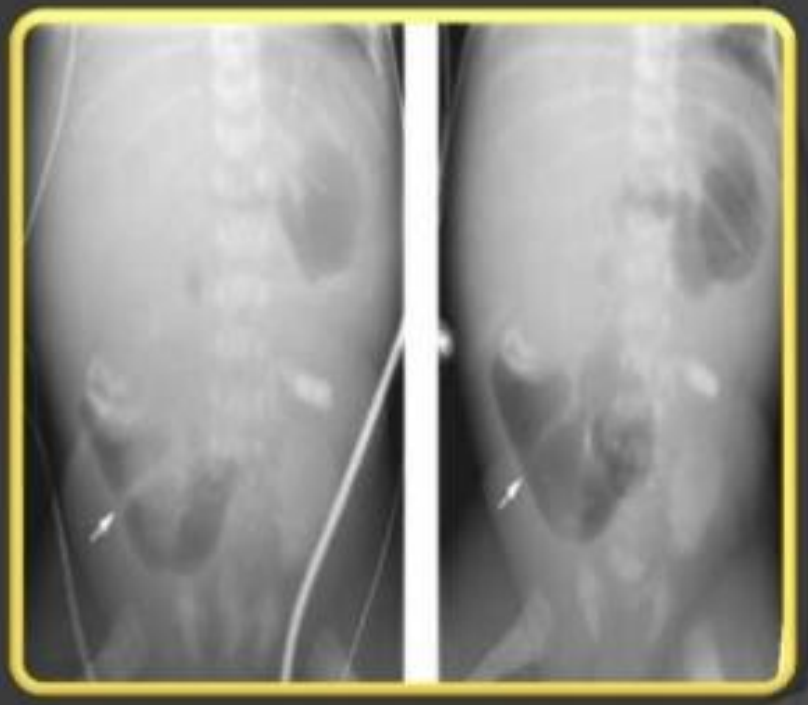


Supine AXR, The bowel is mildly dilated with gas, mainly on the left side. The bubbly pattern of gas seen mainly in the right lower quadrant represents intramural gas.

[30] *Epelman M et al. Necrotizing enterocolitis, review of state-of-the-art imaging findings with pathologic correlation. RadioGraphics 2007; 27:285–305.*

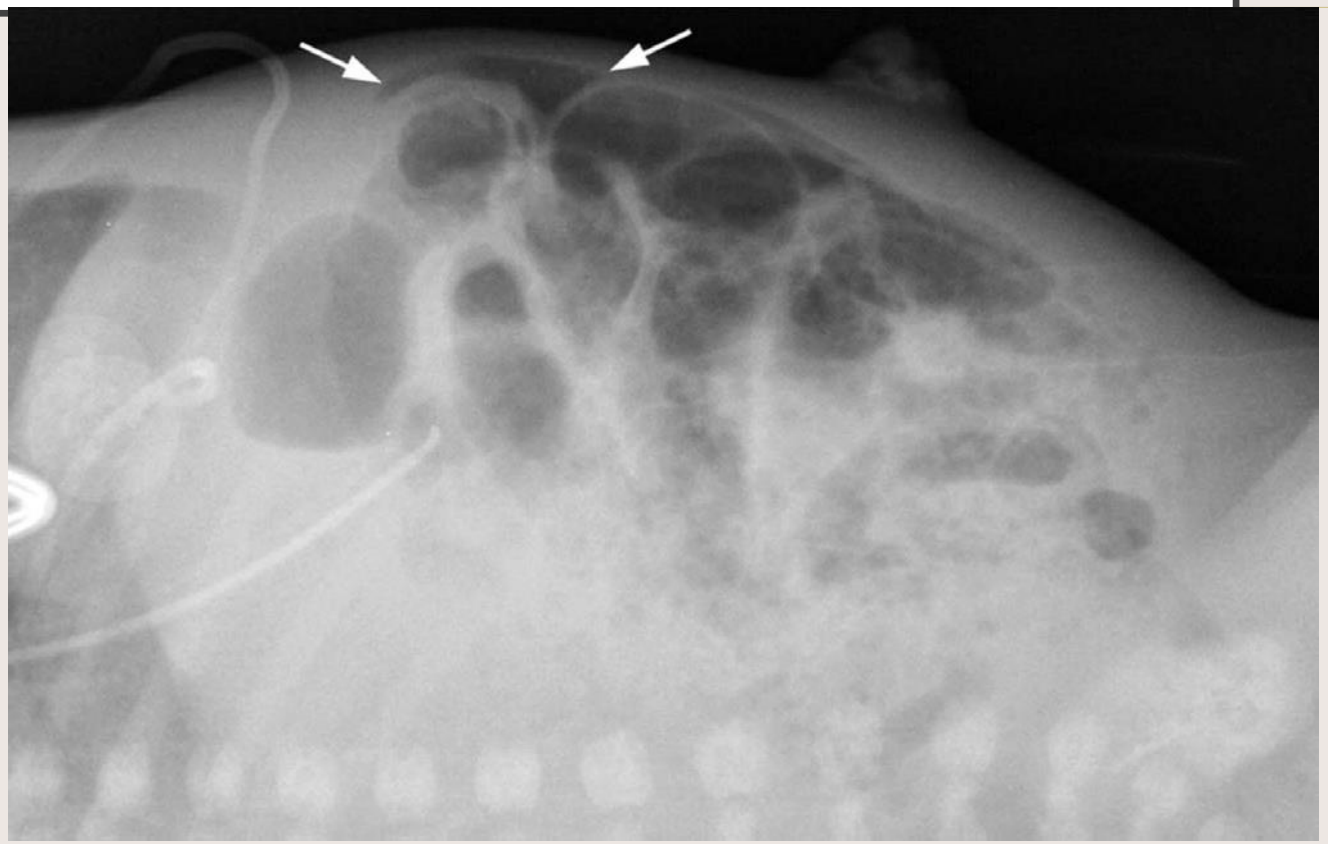
Fixed Loop Sign

The finding of a single loop or several loops of dilated(enlarged) small intestine that remain unchanged in position for 24 to 36 hours is referred to as the persistent "rigid" loop sign and suggests lack of movement of the intestine due to death of a segment of intestine




Portal Air
Dilated stomach &
loops of bowel

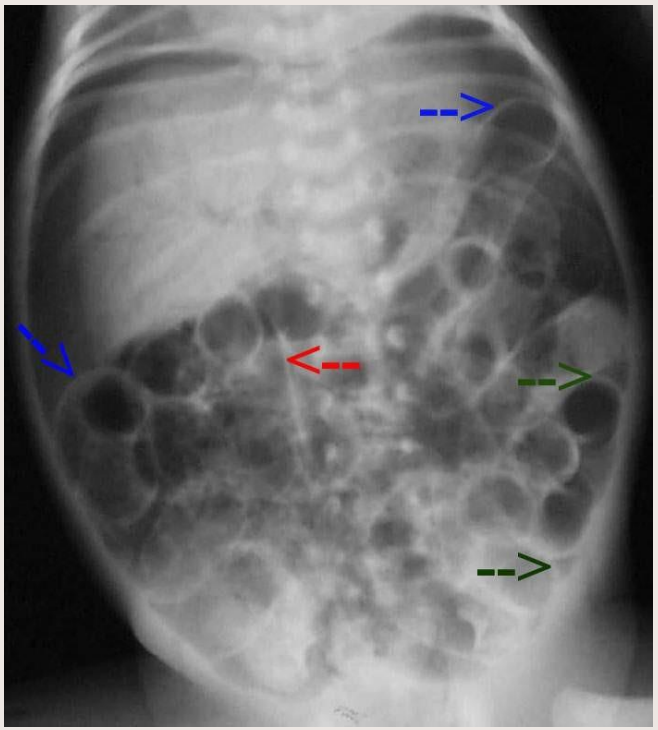
DIAGNOSIS, RADIOLOGIC STUDIES



Free intraperitoneal gas is present anteriorly (arrows)

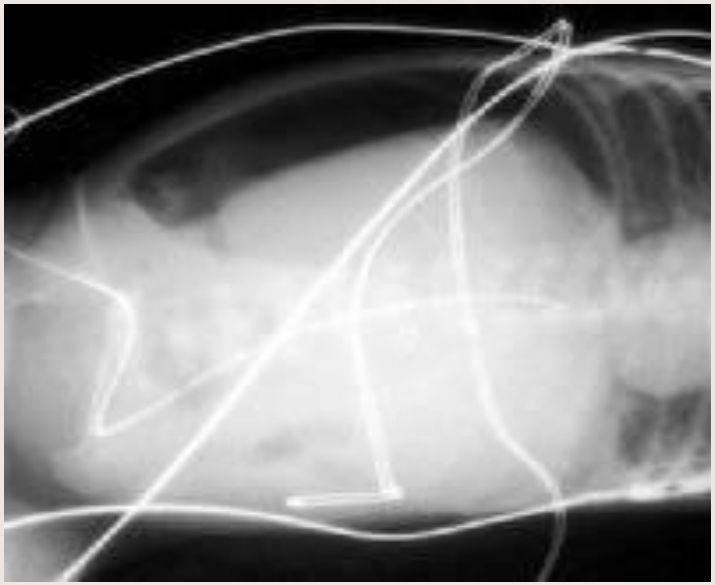
[30] *Epelman M et al. Necrotizing enterocolitis, review of state-of-the-art imaging findings with pathologic correlation. RadioGraphics 2007; 27:285–305.*

DIAGNOSIS, RADIOLOGIC STUDIES



NEC with perforation

DIAGNOSIS, RADIOLOGIC STUDIES



Left lateral decubitus radiograph shows free air

Ref: Necrotizing Enterocolitis, emidicine.com, Beverly P Wood, MD, MS, PhD

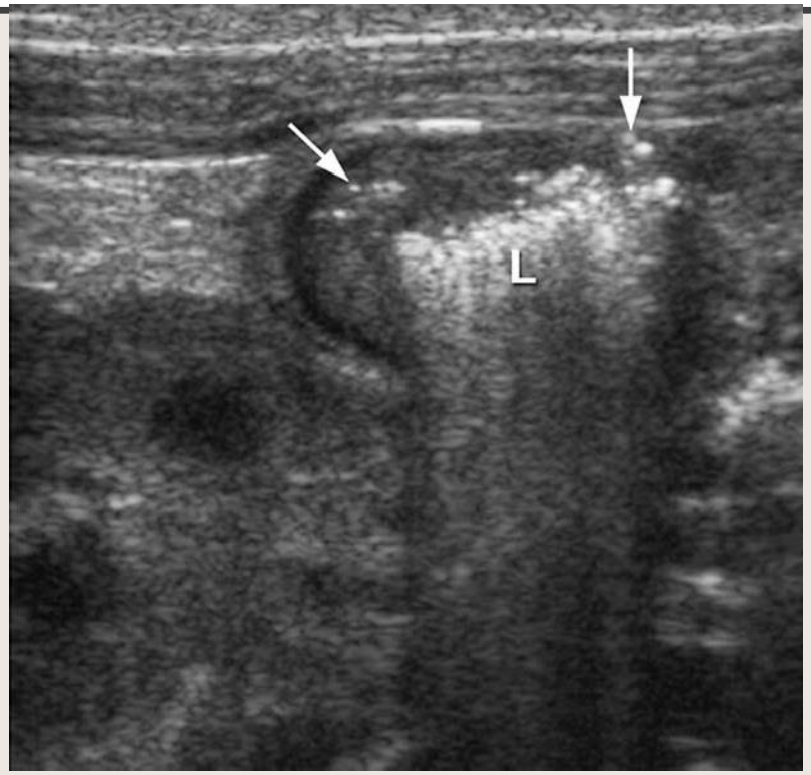
DIAGNOSIS, RADIOLOGIC STUDIES

- **Abdominal ultrasound:**
  - Thick-walled loops of bowel with hypomotility.
  - Intraperitoneal fluid is often present.
  - Intramural gas can be identified in early-stage NEC [31]
  - In the presence of pneumatosis intestinalis, gas is identified in the portal venous circulation within the liver.
  - Color Doppler US is more accurate than abdominal radiography in depicting bowel necrosis in NEC. [32]

[31] *Kim WY et al. Sonographic evaluation of neonates with early-stage necrotizing enterocolitis. Pediatr Radiol. 2005 Nov;35(11):1056-61.*

[32] *Faingold R et al. Necrotizing Enterocolitis: Assessment of Bowel Viability with Color Doppler US, Radiology 2005;235:587-594.*

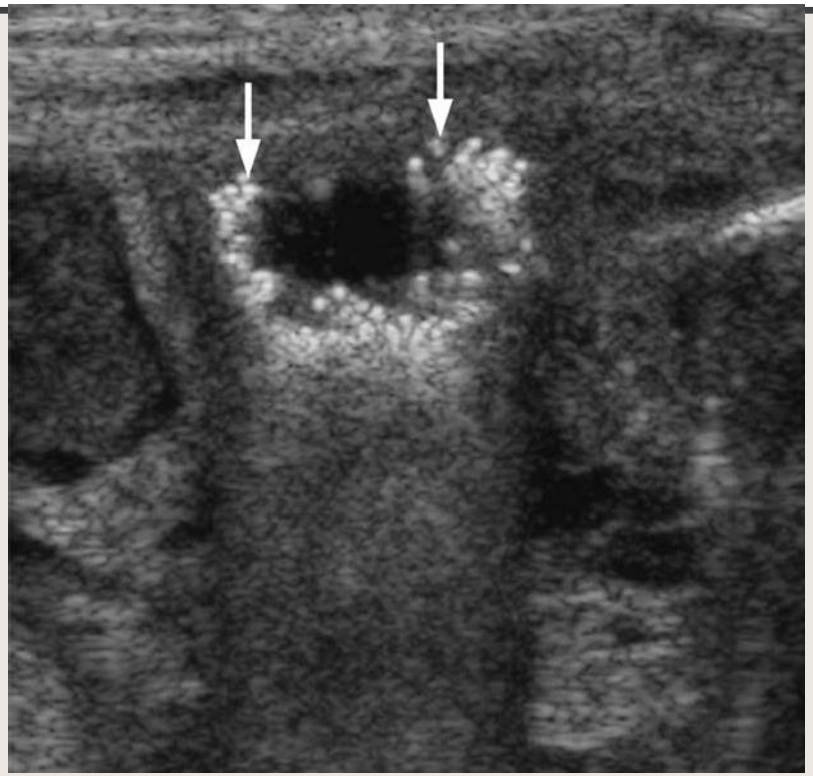
DIAGNOSIS, RADIOLOGIC STUDIES



Sonogram of a bowel loop shows differentiation of intraluminal gas from intramural gas. The intraluminal gas *(L)* is surrounded by a thickened bowel wall. Within the bowel wall are multiple hyperechoic foci (arrows), which represent intramural gas.

[30] *Epelman M et al. Necrotizing enterocolitis, review of state-of-the-art imaging findings with pathologic correlation. RadioGraphics 2007; 27:285–305.*

DIAGNOSIS, RADIOLOGIC STUDIES



Sonogram shows a bowel loop with a large amount of intramural gas (arrows) in the more dependent and vertically oriented parts of the loop. This gives the bowel wall a typical granular appearance and causes a posterior artifact.

[30] *Epelman M et al. Necrotizing enterocolitis, review of state-of-the-art imaging findings with pathologic correlation. RadioGraphics 2007; 27:285–305.*

DIAGNOSIS, RADIOLOGIC STUDIES

- Abdominal Doppler ultrasound:
  - **Murdoch et al.,** in a prospective cohort study, concluded that neonates with high resistance patterns of blood flow velocity in the superior mesenteric artery on the first day of life are at increased risk of developing necrotizing enterocolitis. [33]

[33] *Murdoch EM et al. Doppler flow velocimetry in the superior mesenteric artery on the first day of life in preterm infants and the risk of neonatal necrotizing enterocolitis. Pediatrics. 2006 Nov;118(5):1999-2003.*

Staging NEC – Bell's Classification

Stage	Clinical findings	Radiographic findings
I: Suspected NEC		
Ia	Temp instability, apnea, lethargy, increased residuals, abd distention.	Normal or mild ileus.
Ib	See above. + grossly bloody stool.	
II: Proven NEC		
IIa	See above. + absent bowel sounds. +abd tenderness. Appear mildly ill.	Intestinal dilation, ileus, ascites, pneumatosis intestinalis.
IIb	See above. Appear moderately ill. +metabolic acidosis. +thrombocytopenia.	
III: Advanced NEC		
IIIa	See II. Bowel intact. Hypotension, bradycardia, apnea. +peritoneal signs. DIC, neutropenia.	Portal venous gas. Pneumoperitoneum (football sign) – specific for stage IIIb.
IIIb	See III. + Bowel perforation.	

MODIFIED BELL'S STAGING CRITERIA

- **Stage I :** Suspected NEC
  - Clinical signs and symptoms
  - No diagnostic radiograph

MODIFIED BELL'S STAGING CRITERIA

- **Stage II :** Definite (confirmed) NEC
  - **A:** Mild NEC
    - Sign & symptoms, absent B/S, gross blood in stool
    - AXR: ileus, focal areas of pneumatosis intestinalis
  - **B:** Moderate NEC
    - Systemically ill
    - AXR: extensive pneumatosis intestinalis, early ascites, possible intrahepatic portal venous gas

MODIFIED BELL'S STAGING CRITERIA

- **Stage III:** Advanced NEC
  - **A:** Severe NEC without perforation
    - Critically ill
    - Abdominal wall induration, extensive erythema
    - AXR: prominent ascites, paucity of bowel gas, persistent fixed loop
  - **B:** Severe NEC with perforation

DIFFERENTIAL DIAGNOSIS

- Systemic infection: sepsis, pneumonia
- Infectious enterocolitis
- Allergic collitis
- Feeding intolerance

MANAGEMENT, MEDICAL

Basic NEC protocol: for all stages

- NPO
- NGT with low pressure suction
- Close monitoring of vital signs & abdominal girth
- Remove UAC and UVC
- Septic workup: blood, urine, and stool cultures
- LP and CSF culture: controversial
- Antibiotics: ampicillin + gentemicin or cefotaxime

add metronidazole or clindamycin if peritonitis or perforation is suspected

MANAGEMENT, MEDICAL

Basic NEC protocol *…..continued*

- Monitor for GI bleeding
- Fluid balance: maintain urine output 1-3 ml/kg/hr
- Lab.: CBC, PLT, electrolytes q 8-12 hrs PT, PTT, LFT's as indicated
- CRP [34]
- Radiology: serial AXR q 6-8 hrs in the first 2-3 days
- Family support

MANAGEMENT, MEDICAL

- **Stage I**
  - Basic NEC protocol
  - If all cultures are negative, the infant improved clinically, and AXR is normal, antibiotics can be stopped after 2-3 days and feeding can be resumed.

MANAGEMENT, MEDICAL

- **Stage II**
  - Basic NEC protocol
  - NPO for 14 days
  - TPN, 90-110 kcal/kg/day
  - Antibiotics for 14 days
  - Respiratory support
  - ± Inotropic support
  - Surgical consultation

MANAGEMENT, MEDICAL

- **Stage III**
  - As stage II
  - Inotropic support
  - Treat anemia, thrombocytopenia, coagulopathy
  - Surgical intervention

MANAGEMENT, SURGICAL

- Early Surgical Consultation
- Indications for surgery:
  - Perforation: 20-30 % of cases

    12-48 hrs after onset
  - Full-thickness necrosis
  - Deterioration despite aggressive medical treatment

MANAGEMENT, SURGICAL

Surgical Approach:

- Exploratory laparotomy
- Peritoneal drainage

MANAGEMENT, SURGICAL

Exploratory laparotomy:

- The most commonly used approach.
- Intestinal resection with enterostomy.
- Primary anastomosis. [35, 36]

[35] *Hall NJ et al. Resection and primary anastomosis is a valid surgical option for infants with necrotizing enterocolitis who weigh less than 1000 g. Arch Surg. 2005 Dec;140(12):1149-51.*

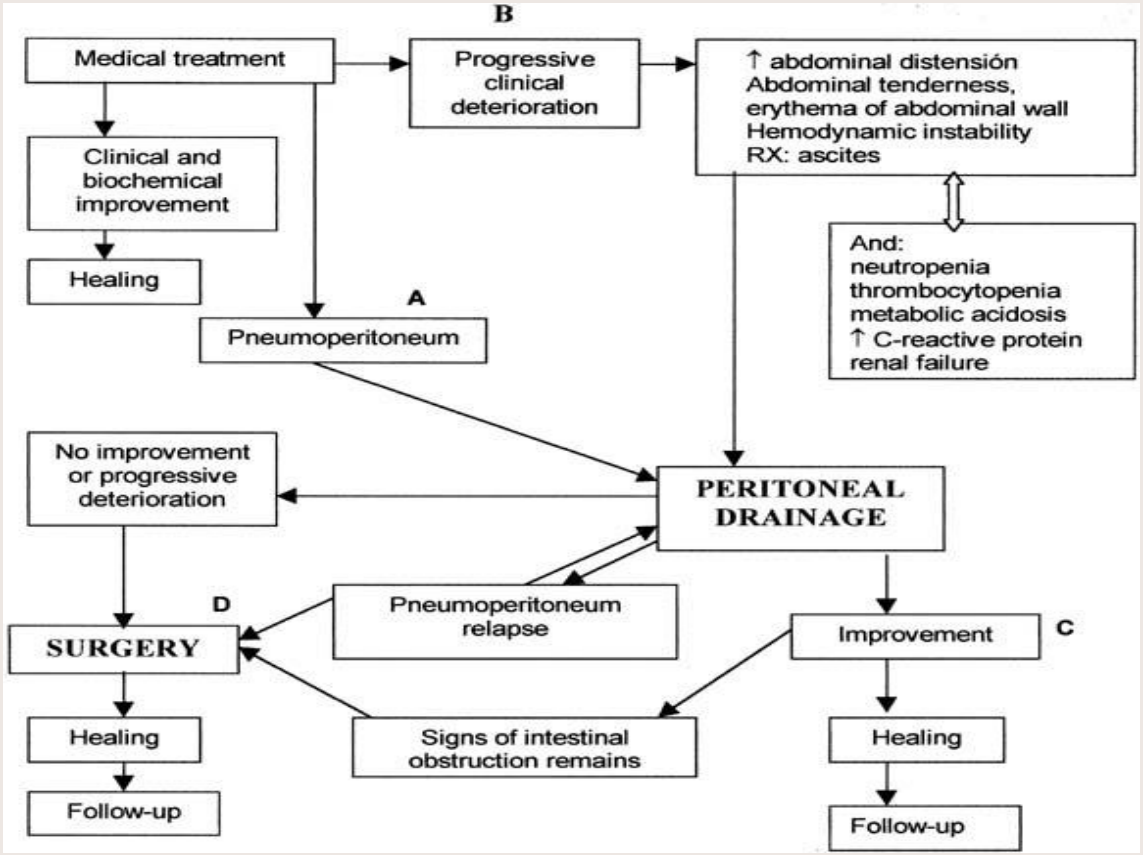
[36] *Singh m et al. Surgery for intestinal perforation in preterm neonates: anastomosis vs stoma. J Pediatr Surg. 2006 Apr;41(4):725-9.*

MANAGEMENT, SURGICAL

Peritoneal drainage:

- More conservative approach, Started in 1977
- Insertion of a peritoneal draine local anaesthesia
- Initially, used for very sick premature babies, with weight ≤ 1000 g
- Now, it is used more commonly with larger and more stable babies
- It is used as a definite treatment in some centers

MANAGEMENT, SURGICAL



Algorithm for the treatment of necrotizing enterocolitis

[37] *Xavier Demestre et al Peritoneal drainage as primary management in necrotizing enterocolitis: A prospective study, J Pediatr Surg. 2002 Nov • Volume 37 • Number 11 • p1534 to p1539.*

MANAGEMENT, SURGICAL

Laparoscopy:

- **Clarck and Mackinaly** reported the use of laparoscopy on day 30 of life in the treatment of a VLBW infant (900 g) with perforated NEC.[38]
- **Tan et al.:** 4 babies (500-1000 g)

Needlescopic diagnosis is feasible and appears to be safe, even in critically ill micropremmies less than 1000 g. The technique can provide useful information for surgical decision-making and allows for precise placement of a microlaparotomy incision over the site of perforation, thus minimizing the trauma from open surgery in this special group of patients. [39]

[38] *Clark C, Mackinlay GA. Laparoscopy as an adjunct to peritoneal drainage in perforated necrotizing enterocolitis. J Laparoendosc Adv Surg Tech A. 2006 Aug;16(4):411-3.*

[39] *Tan HL et al. The role of diagnostic laparoscopy in micropremmies with suspected necrotizing enterocolitis. Surg Endosc. 2007 Mar;21(3):485-7.*

PROGNOSIS AND OUTCOME

- NEC with perforation: mortality 20-40 %
- Recurrent NEC : rare complication, 4%
- Subacute or intermittent symptoms of bowel obstruction: strictures, 10-35 %
- Short-gut syndrome: FTT, high mortality.
- The type of operation (peritoneal drain vs. laparotomy) performed for perforated NEC does not influence survival or other clinically important early outcomes in preterm infants. [40]

[40] *Moss RL et al. Laparotomy versus Peritoneal Drainage for Necrotizing Enterocolitis and Perforation. N Engl J Med. 2006 May 25;354(21):2225-34.*


Thank
you