American Pediatric Surgical Association

Standardized Toolbox of Education for Pediatric Surgery

Necrotizing Enterocolitis

APSA Committee of Education
2012-13
2018-19

STEPS
STANDARDIZED TOOLBOX OF EDUCATION FOR PEDIATRIC SURGERY

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Necrotizing Enterocolitis

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History

- 6 day old premature infant 900gram birthweight
- born at 28 weeks of gestation
- abdominal distension, vomiting
- apneas, bradycardias and desaturations
- had been fed premie formula for past 3 days

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History Discussion Slide

What other points of the history do you want to know?

- **Characterization of Symptoms:**
  Abdominal distention firm/tender
  Appreciate dilated loops of intestine/mass
  Abdominal wall edema
  Abdominal wall cellulitis/erythema
- **Temporal sequence**
  Rapid deterioration of general status feeding well for past days, then increased abdominal distension
- **Associated signs/symptoms:**
  Feeding intolerance
  High residuals
  Bilious output 75%
- **Pertinent PMH**
  Cardiac anomaly? (PDA)
- **ROS**
  What type of feeds? What rate?
- **Meds**
  Is patient on cardiac or respiratory support?
- **Relevant Family Hx**
  Drug use?

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Etiology

- **Unknown**
  - **Immature barrier defense of the premature baby**
    - **Poorly developed mucosa**
    - **Scant goblet cell mucus production**
    - **Low secretory IgA**
  - **Trigger**
    - **Feeds, hypotension**
  - **Aggressive uncontrolled inflammatory response**
    - **Bacteria access the immune system**
    - **TLR mediated**

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Presentation

- **HPI**
  - **Premature infant**
  - **Low birth weight**
  - **Inciting event**
    - **Feedings**
    - **Hypotension**
      - **Cardiac disease**
    - **Medications**

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Physical Exam

- **What specifically would you look for?**
  - **Vital Signs:**
    - Fever not helpful (artificially created in incubator)
    - Temperature instability
    - Lethargy
    - Apnea
    - Bradycardia
    - Desaturation

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Physical Exam

- **What specifically would you look for?**
  - **Appearance:**
    - Sick appearing
    - Abdominal wall appearance
      - Edematous
      - Discolored
      - Erythema
    - Abdominal distension
    - Abdominal Tenderness
    - Requiring increasing support

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Studies (Labs, Imaging)

- **What labs are needed?**
  - CBC with differential
    - High or low WBC with left shift
    - Bandemia
    - Thrombocytopenia
  - Metabolic panel
    - Metabolic acidosis (70-90%)
    - Hyponatremia

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Studies (Labs, Imaging)

- **What imaging is needed?**
  - Supine abdominal X-ray (babygram)
  - Left lateral (right side up) decubitus X-ray or cross-table X-ray
    - Pneumatosis intestinalis
    - Portal venous air
    - Fixed loop
    - Pneumoperitoneum

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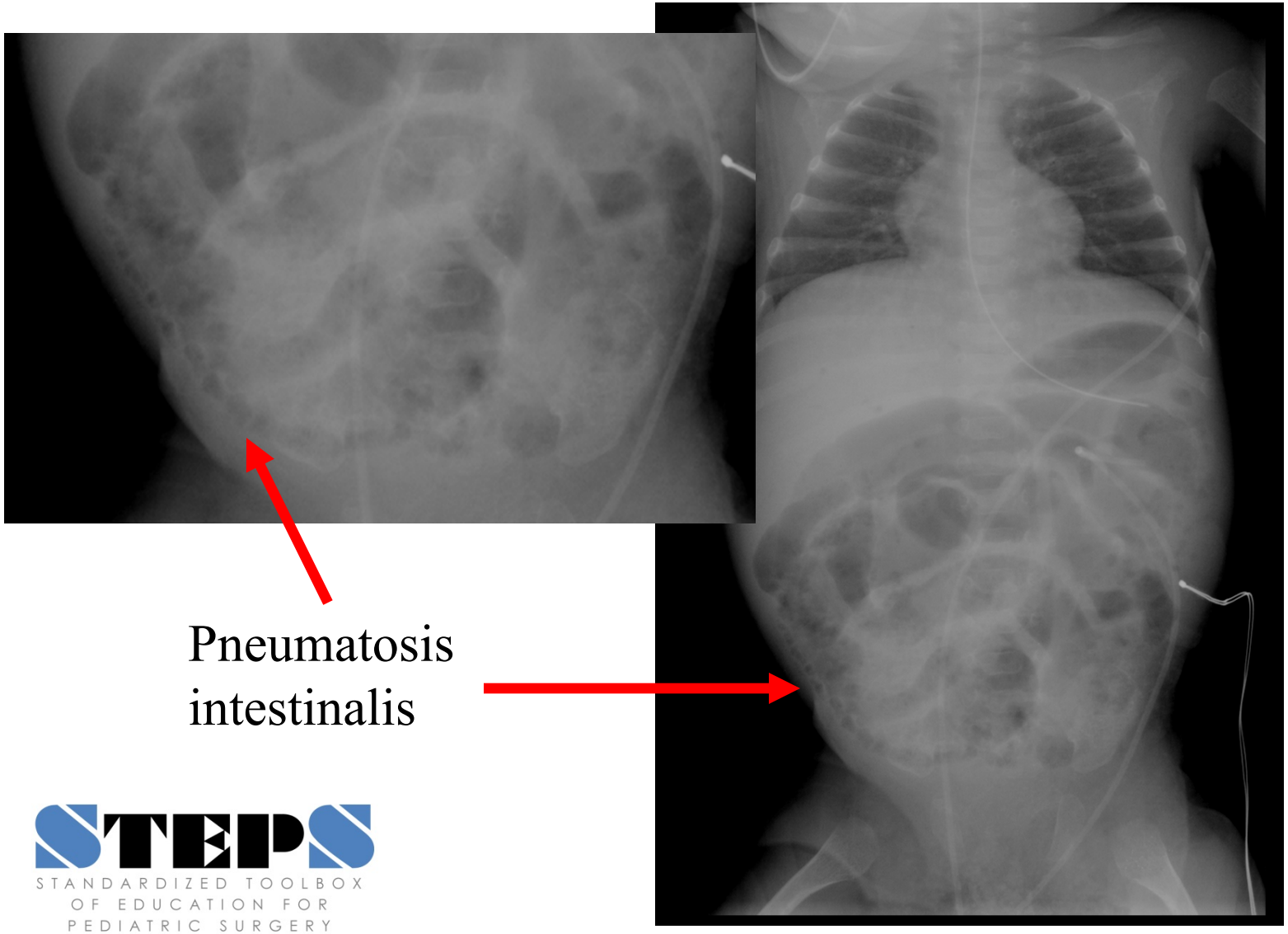
Study Results



Pneumatosis intestinalis

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Study Results

Pneumatosis intestinalis

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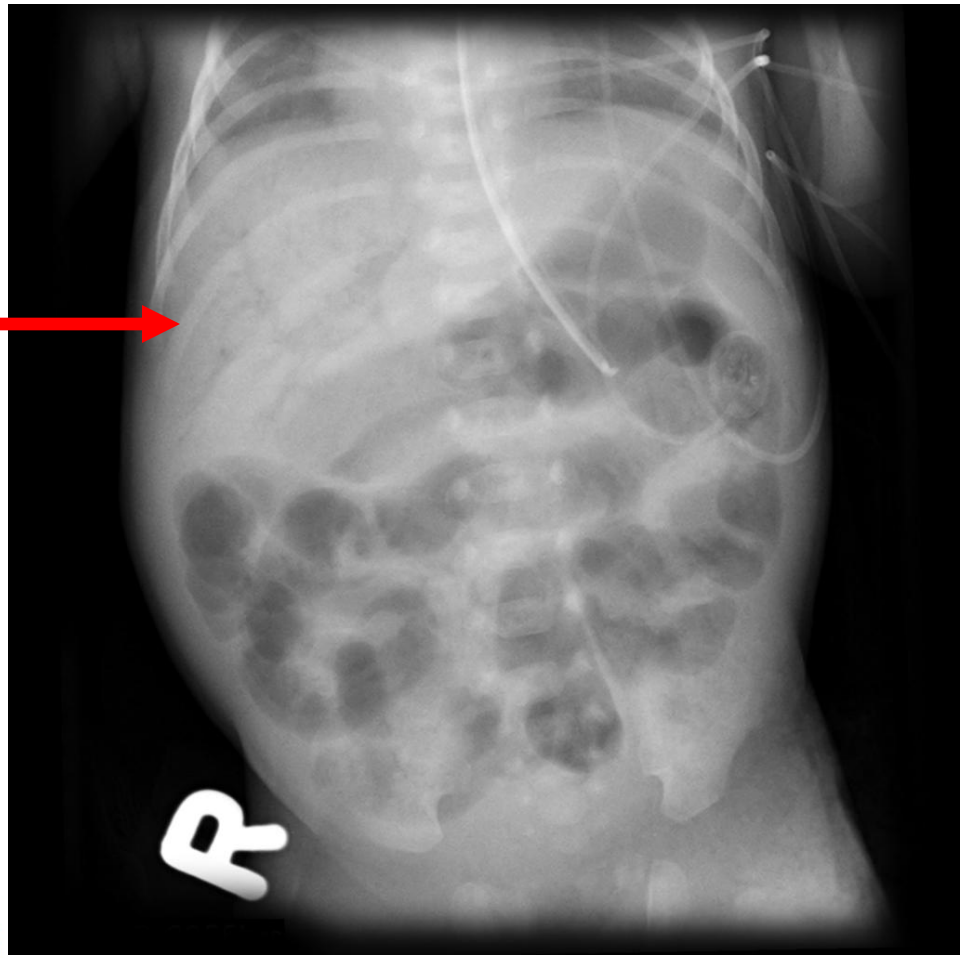
Study Results

Portal venous gas



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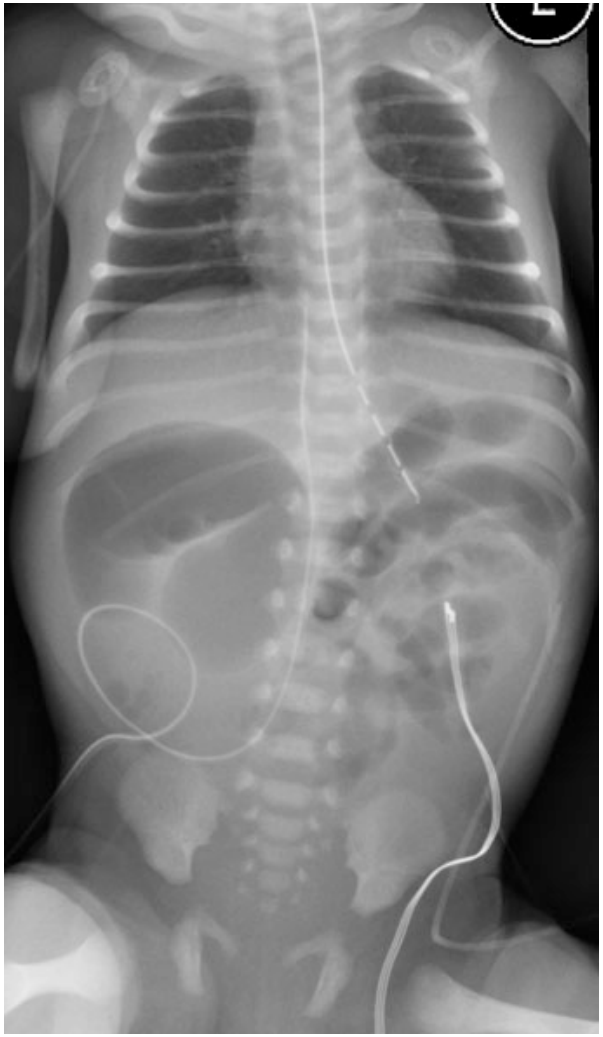

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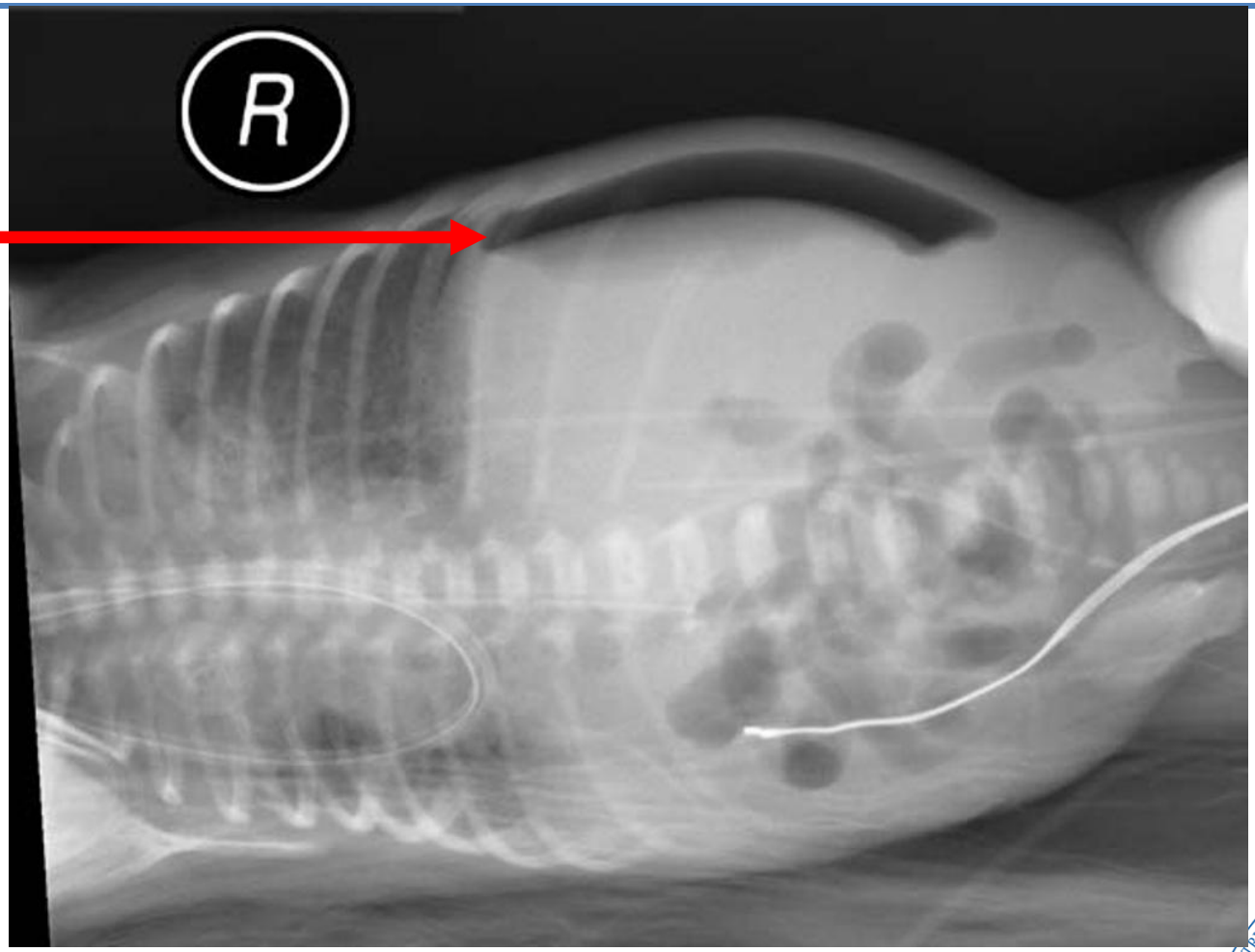
Study Results

Free air



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Case Discussion

- **Diagnosis**
  - Necrotizing enterocolitis (NEC)
    - Pneumatosis Intestinalis (pathognomonic, 98% NEC)
  - Sepsis can look very similar (UTI/Respiratory/Intracranial hemorrhage)

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Case Discussion

- **Treatment Plans**
  - NPO
  - Gastric decompression with NG/OG tube
  - Antibiotics (e.g. Amp/Gent/Clinda)
  - Resuscitation
  - Respiratory support (ventilator)
  - Serial examination
    - Physical exam
    - Labs
    - X-rays

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Staging

STAGE	SYSTEMIC SIGNS	INTESTINAL SIGNS	RADIOLOGIC SIGNS	TREATMENT
I. Suspected				
A	Temperature instability, apnoea, bradycardia	Elevated pregavage residuals, mild abdominal distension, occult blood in stool	Normal or mild ileus	NPO, antibiotics x 3 days
B	Same as IA	Same as IA, plus gross blood in stool	Same as IA	Same as IA
II. Definite				
A: Mildly ill	Same as IA	Same as I, plus absent bowel sounds, abdominal tenderness	Ileus, pneumatosis intestinalis	NPO, antibiotics x 7 to 10 days
B: Moderately ill	Same as I, plus mild metabolic acidosis, mild thrombocytopenia	Same as I, plus absent bowel sounds, definite abdominal tenderness, abdominal cellulitis, right lower quadrant mass	Same as IIA, plus portal vein gas, with or without ascites	NPO, antibiotics x 14 days
III Advanced				
A: Severely ill, bowel intact	Same as IIB, plus hypotension, bradycardia, respiratory acidosis, metabolic acidosis, disseminated intravascular coagulation, neutropenia	Same as I and II, plus signs of generalised peritonitis, marked tenderness and distension of abdomen.	Same as IIB, plus definite ascites	NPO, antibiotics x 14 days, fluid resuscitation, inotropic support, ventilator therapy, paracentesis

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Surgery

- **Indications for surgical intervention**
  - Absolute indication
    - Free air (pneumoperitoneum)
    - Peritonitis
  - Relative indication
    - Ongoing decompensation (failure of medical management)
      - Worsening examination
      - Persistent thrombocytopenia, leukocytosis/penia or acidosis
      - Fixed intestinal loop
    - Failure to improve over several days

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Surgery

- **Goals of surgical intervention**
  - "clean up" contamination (stool/abscess)
  - divert fecal stream
  - remove dead bowel
  - decompress abdominal compartment syndrome

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Surgery

- **Operative Options**
  - **Laparotomy**
    - Resection of dead bowel
    - Drainage of stool/abscess
    - Diversion (ostomy)
    - Temporary closure and re-exploration
  - **Placement of peritoneal drain**
    - Neonates under 1kg
    - Decompression and drainage of stool/abscess
      - Temporizing or therapeutic

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Complications

- **Peri-operative**
  - Loss of intestinal length
  - Liver bleeding
  - Abdominal compartment syndrome
  - Death
- **Post-operative**
  - Intestinal strictures
  - Wound and ostomy complications
  - Short-gut syndrome (intestinal failure)

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Post-operative Management

- Antibiotics
- Nutritional support (parenteral nutrition)
- Await return of bowel function
  - Reintroduction of enteral feeds
- Reoperation for intestinal continuity
  - Stoma closure
    - 4-6 weeks after NEC and over 2kg

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SIP

- Spontaneous intestinal perforation
  - A form of NEC or a distinct entity
  - Low birth weight and premature
  - Usually have not been fed
  - First week of life

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Final Discussion/Review

- Risk factors: Prematurity and very low birth weight
- Breast milk decreases risk vs formula
- Pneumoperitoneum is an absolute indication for surgery / intervention
- Antibiotic treatment, bowel rest and supportive care
- Short gut and parenteral nutrition associated liver disease are common potential negative outcomes

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Questions

3 weeks after non-operative treatment of an episode of NEC, 1200gr baby has persistent abdominal distension, high NG output and is not passing stool. What are possible causes?

A. inguinal hernia

B. unrecognized abscess

C. Hirschsprung's disease

D. intestinal stricture

E. intestinal obstruction

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Answers: D and E most likely, A and B possible

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Questions

1100gr infant has newly diagnosed pneumatosis intestinalis, and gas in the liver parenchyma. No signs of pneumoperitoneum. What is the treatment?

A. Emergent liver and small bowel transplant

B. Antibiotics for NEC

C. Laparotomy to remove the affected intestine

D. Placement of penrose drain at bedside

E. Changes in ventilator settings

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Questions

After 2 days of antibiotic treatment, 15 day old former 26 week GA infant (700gr) with NEC has decreased abdominal distension and now pneumoperitoneum on today's x-ray. What is the treatment?

A. Change antibiotic regimen to include antifungal therapy
B. Laparotomy, resection of perforation and ileostomy
C. Placement of abdominal drain at the bedside
D. Continue current care as abdominal distension is improving
E. Repeat x-ray to follow the pneumoperitoneum

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Answers: B or C

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Questions

What are risk factors for NEC?

a. Trisomy 21
b. Congenital diaphragmatic hernia
c. Twin gestation
d. Preterm delivery

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Questions

What is an indication for surgical intervention in NEC?

A. Portal venous gas

B. Pneumatosis Intestinalis

C. Intractable acidosis with known NEC

D. Bloody stool

E. Abdominal distention

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Final Discussion/Review

- **Top 5 take home points for NEC**
  - 1: Risk factors: Prematurity and very low birth weight
  - 2: Breastmilk decreases risk vs formula feeds
  - 3: Pneumoperitoneum is indication for surgery
  - 4: Antibiotic treatment, bowel rest and supportive care
  - 5: Short gut and parenteral nutrition associated liver disease are common sequelae

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