

A 3-week-old boy in the neonatal intensive care unit has increased gastric residual volume and vomiting. He was born at 28 weeks gestation by vaginal delivery due to cervical incompetence. Birth weight was 900 g (2 lb). He initially required mechanical ventilation but extubated to nasal cannula oxygen last week. He has been advancing on continuous nasogastric formula feeds and gaining an average of 30 g each day. His temperature is 35.6 C (96 F), blood pressure is 85/45 mm Hg, pulse is 142/min, and respirations are 34/min. Pulse oximetry is 97% on 2 L oxygen. Examination shows a lethargic neonate with abdominal distension. Laboratory studies show leukocytosis and metabolic acidosis. Imaging would most likely show which of the following?

- ☐ A. Abdominal x-ray with air in the bowel wall and portal veins
- ☐ B. Abdominal x-ray with air in the stomach and duodenum but no distal air
- ☐ C. Abdominal ultrasound with thickened pylorus muscle
- ☐ D. Contrast enema with narrow rectosigmoid and dilation of the rest of the colon
- ☐ E. Head ultrasound with hemorrhage into the lateral ventricles

Submit

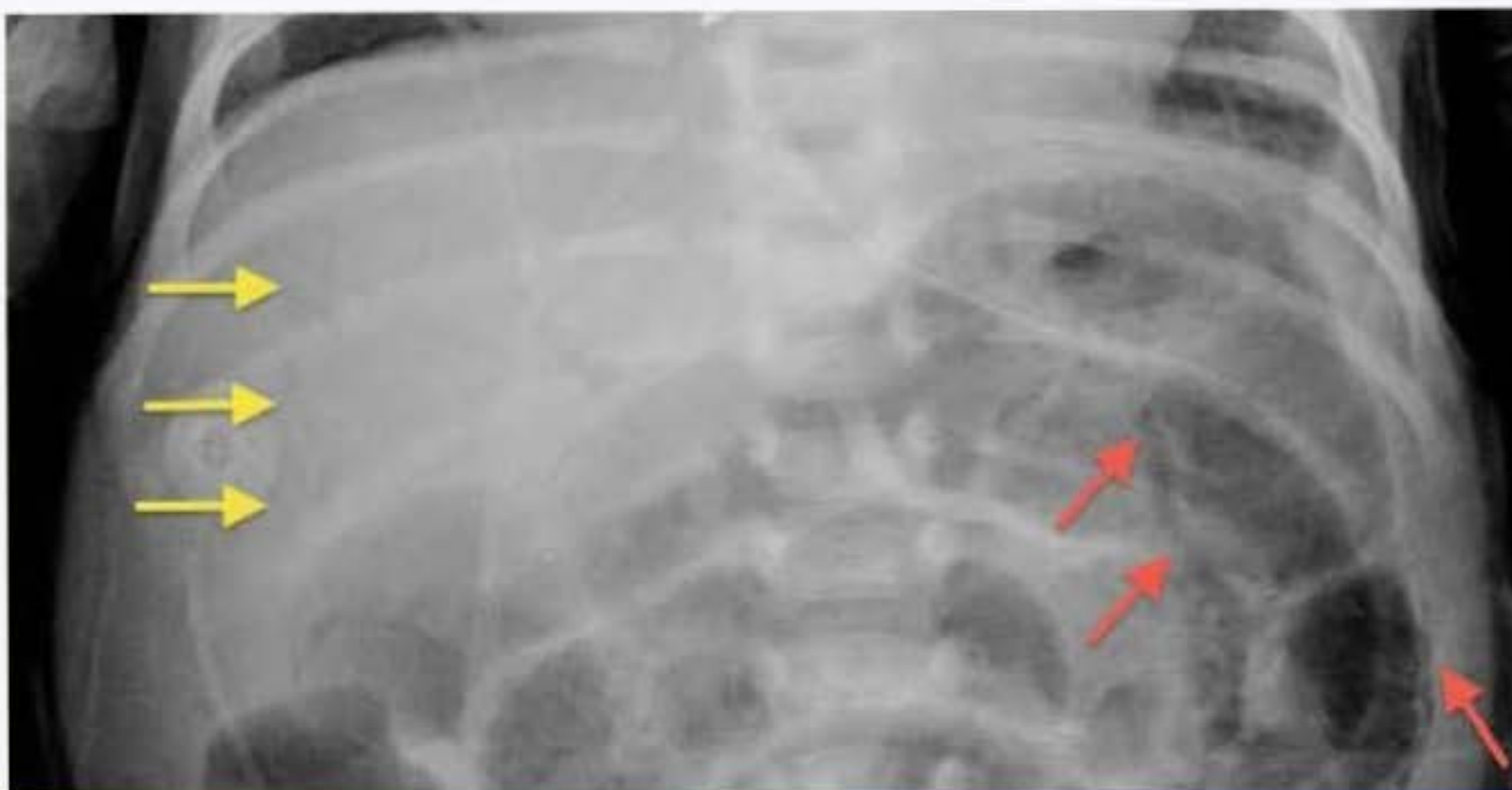
A 3-week-old boy in the neonatal intensive care unit has increased gastric residual volume and vomiting. He was born at 28 weeks gestation by vaginal delivery due to cervical incompetence. Birth weight was 900 g (2 lb). He initially required mechanical ventilation but extubated to nasal cannula oxygen last week. He has been advancing on continuous nasogastric formula feeds and gaining an average of 30 g each day. His temperature is 35.6 C (96 F), blood pressure is 85/45 mm Hg, pulse is 142/min, and respirations are 34/min. Pulse oximetry is 97% on 2 L oxygen. Examination shows a lethargic neonate with abdominal distension. Laboratory studies show leukocytosis and metabolic acidosis. Imaging would most likely show which of the following?

- ☒ A. Abdominal x-ray with air in the bowel wall and portal veins [58%]
- ☐ B. Abdominal x-ray with air in the stomach and duodenum but no distal air [14%]
- ☐ C. Abdominal ultrasound with thickened pylorus muscle [17%]
- ☐ D. Contrast enema with narrow rectosigmoid and dilation of the rest of the colon [7%]
- ☐ E. Head ultrasound with hemorrhage into the lateral ventricles [5%]

[Proceed to Next Item](#)

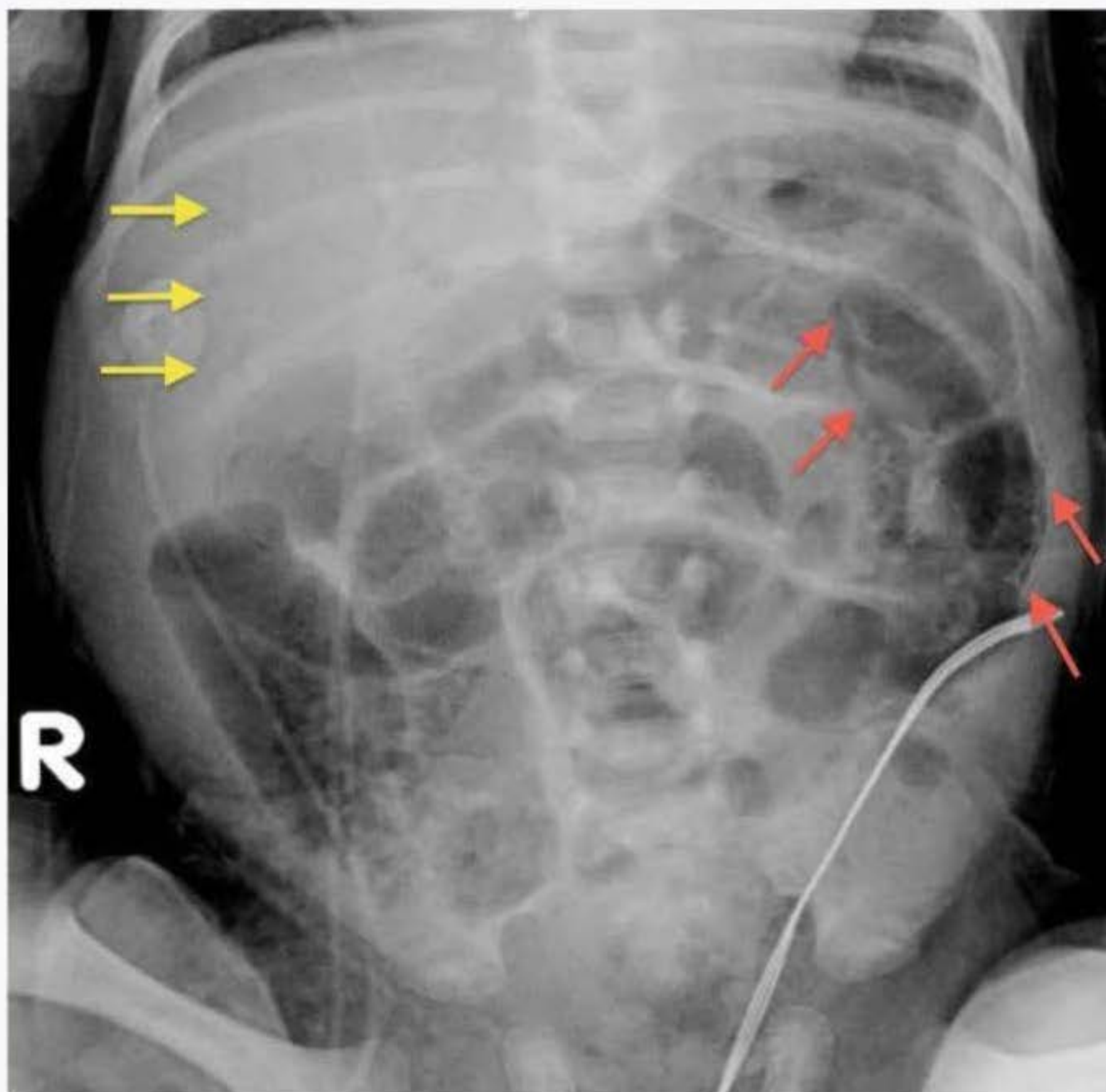
Explanation:

User Id:



Explanation:

User Id: [redacted]



This infant's **prematurity** and **very low birth weight** put him in danger of life-threatening necrotizing enterocolitis (NEC), the most common gastrointestinal emergency in the neonatal intensive care unit. Clinical findings depend on the location and extent of intestinal damage. Initial signs may be nonspecific, such as the hypothermia and lethargy seen in this patient. This patient also has characteristic gastrointestinal symptoms (e.g., vomiting, residual milk in the stomach, abdominal



This infant's **prematurity** and **very low birth weight** put him in danger of life-threatening necrotizing enterocolitis (NEC), the most common gastrointestinal emergency in the neonatal intensive care unit. Clinical findings depend on the location and extent of intestinal damage. Initial signs may be nonspecific, such as the hypothermia and lethargy seen in this patient. This patient also has characteristic gastrointestinal symptoms (eg, vomiting, residual milk in the stomach, abdominal distension).

The pathogenesis involves a combination of **gut immaturity** and **exposure to bacteria from enteral feeds**, leading to a cascade of inflammation and damage to the bowel wall. The premature intestinal mucosa is thought to have increased permeability and bacterial penetration. In addition, immature local host defenses and decreased motility allow for bacterial overgrowth. If possible, premature infants should receive breast milk instead of formula. Multiple studies have demonstrated **decreased rates of NEC in breastfed premature infants** as breast milk may counteract some of the problems associated with gut immaturity. However, the optimal timing of enteral feeding initiation and rate of advancement remains unclear, and premature infants, especially <32 weeks gestation, remain vulnerable to NEC and its complications.

In a normal abdominal x-ray, air is visible only in the lumen of the bowel. However, in NEC, the air is visible in the bowel wall ("double-line" or "train-track" appearance), leading to the hallmark finding of **pneumatosis intestinalis** (red arrows above) on x-ray. Linear, branching areas of lucency over the liver are also abnormal and represent **portal venous air** (yellow arrows above). This results from gas produced by bacteria in the portal veins or by the transmigration of gas from the bowel wall to mesenteric veins and into the portal vein. Severe intestinal necrosis can cause perforation and **pneumoperitoneum**. Laboratory findings of leukocytosis and metabolic acidosis reflect inflammation and intestinal ischemia, respectively.

(Choice B) Duodenal atresia typically presents as bilious vomiting shortly after initiation of feeds. The abdomen is not distended because air cannot pass the duodenum. The classic radiologic finding is the **"double-bubble" sign** (dilated stomach and duodenum), making this diagnosis unlikely.

(Choice C) The typical presentation of pyloric stenosis is post-prandial nonbilious emesis in an otherwise healthy 3-6-week-old infant. There is no abdominal distension due to obstruction in the proximal gut.

(Choice D) Almost all patients with Hirschsprung disease present with abdominal distension, feeding intolerance, and failure to pass meconium within 48 hours of birth.

leading to the hallmark finding of **pneumatosis intestinalis** (red arrows above) on x-ray. Linear, branching areas of lucency over the liver are also abnormal and represent **portal venous air** (yellow arrows above). This results from gas produced by bacteria in the portal veins or by the transmigration of gas from the bowel wall to mesenteric veins and into the portal vein. Severe intestinal necrosis can cause perforation and **pneumoperitoneum**. Laboratory findings of leukocytosis and metabolic acidosis reflect inflammation and intestinal ischemia, respectively.

(Choice B) Duodenal atresia typically presents as bilious vomiting shortly after initiation of feeds. The abdomen is not distended because air cannot pass the duodenum. The classic radiologic finding is the "**double-bubble**" sign (dilated stomach and duodenum), making this diagnosis unlikely.

(Choice C) The typical presentation of pyloric stenosis is post-prandial nonbilious emesis in an otherwise healthy 3-6-week-old infant. There is no abdominal distension due to obstruction in the proximal gut.

(Choice D) Almost all patients with Hirschsprung disease present with abdominal distension, feeding intolerance, and failure to pass meconium within 48 hours of birth. Patients with milder disease may be diagnosed later in life, but they typically have a history of chronic constipation and poor weight gain.

(Choice E) Premature infants are at risk for intraventricular hemorrhage. Although severe hemorrhage can cause obstructive hydrocephalus and symptoms of increased intracranial pressure (eg, vomiting), it is typically preceded by other abnormalities such as expanding head circumference, hypotonia, irregular breathing, apnea, and/or seizures. This patient's abdominal distension and increased gastric residuals also point to a gastrointestinal rather than neurologic problem.

Educational objective:

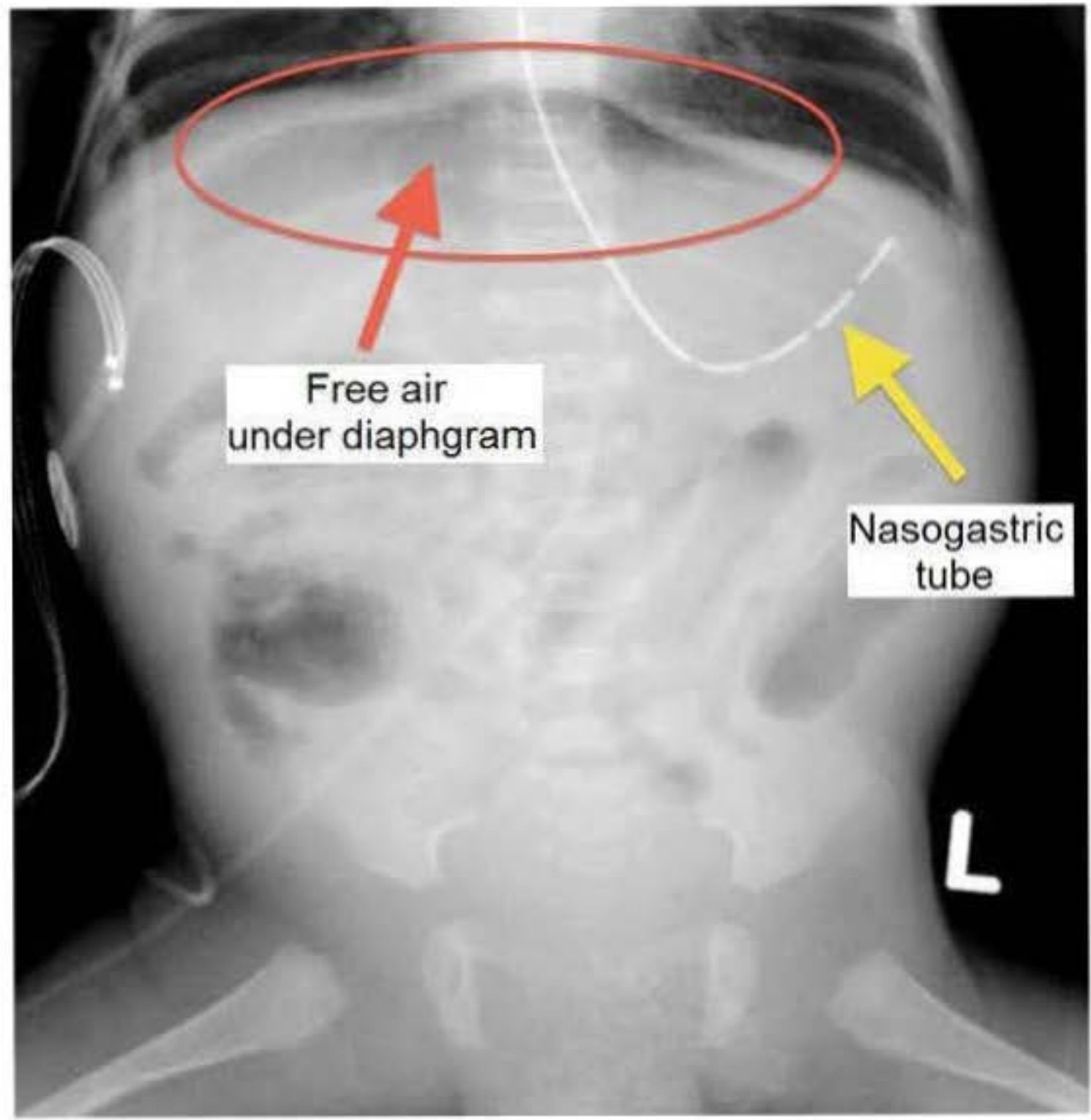
Increased gastric residual volume, vomiting, and abdominal distension in a preterm neonate are highly suspicious for necrotizing enterocolitis. Hallmark findings on x-ray include pneumatosis intestinalis (intramural air) and portal venous air.

References:

1. **Feeding practices and necrotizing enterocolitis.**
2. **A clinical perspective of necrotizing enterocolitis: past, present, and future.**
3. **Necrotizing enterocolitis.**

Media Exhibit

ing enterocolitis



Media Exhibit

al atresia

