

angiogram on a routine basis as part of gated blood-pool studies in patients with pacemakers.

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Volume-Dependent Pulmonary Aspiration of a Swallowed Radionuclide Bolus

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The radionuclide salivagram was introduced as a simple physiologic technique to document the aspiration of saliva in patients with chronic lung disease. We previously reported positive studies to be prevalent in patients with neuromuscular incoordination, as with cerebral palsy, or after surgery involving the upper airway. Many patients referred for a salivagram, however, have an apparent intact swallowing mechanism and are better challenged with a tagged bolus.

Key Words: aspiration; salivagram; swallowed bolus

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The aspiration of oral secretions is recognized as a source of recurrent lung infections. This is most likely to occur in patients with abnormal laryngeal closure (1). The salivagram was introduced to document the aspiration of saliva in patients with chronic lung infections, many of whom are not receiving oral feeding (2). Additionally, other studies have documented its efficacy (3,4). With the reported success of this study, patients are being referred because of suspected aspiration for causes other than abnormal laryngeal closure, such as with severe gastroesophageal reflux. It appears that patients with apparently intact swallowing mechanisms, in whom the salivagram is negative, may well aspirate when presented with a bolus.

CASE REPORT

A 7-yr-old girl was referred from an outside hospital for respiratory failure. She was a 26-wk premature infant who required assisted ventilation for bronchopulmonary dysplasia. At the time, she suffered severe retinopathy of prematurity and was legally blind. An intraventricular hemorrhage in the neonatal period resulted in a seizure disorder. Previously, she had a Nissen fundoplication for severe gastroesophageal reflux. Her chronic lung disease has been treated with anti-asthma medication, and until about 4 mo before admission she received mechanical ventilation through a tracheostomy tube while at home. During the 5 days before admission, she developed an upper respiratory tract infection associated with increasingly difficult breathing, which

failed to respond to her usual medication. She was admitted to the hospital in respiratory failure and required intubation and mechanical ventilation.

A respiratory syncytial virus infection was diagnosed. A gastrostomy tube was placed for feeding. With medication, she slowly improved. While taking sips of fluid, orally, it was noted that some appeared in the tracheostomy tube. This prompted a workup to document aspiration. A salivagram was ordered. The patient lay supine on the table with a low-energy, all-purpose collimator positioned posteriorly. A drop, approximately 100 μ l in volume containing 11.1 MBq (300 μ Ci) 99m Tc-sulfur colloid, was placed on the tongue. With the mouth, thorax and stomach in the field of view, sequential 30-sec images in 128 \times 128 matrix were acquired for 60 min. There was normal transit into the stomach without evidence of pulmonary aspiration (Fig. 1). Since this patient did not clinically appear to have difficulty handling the normal production of saliva, an aspiration study with a swallowed bolus was sug-

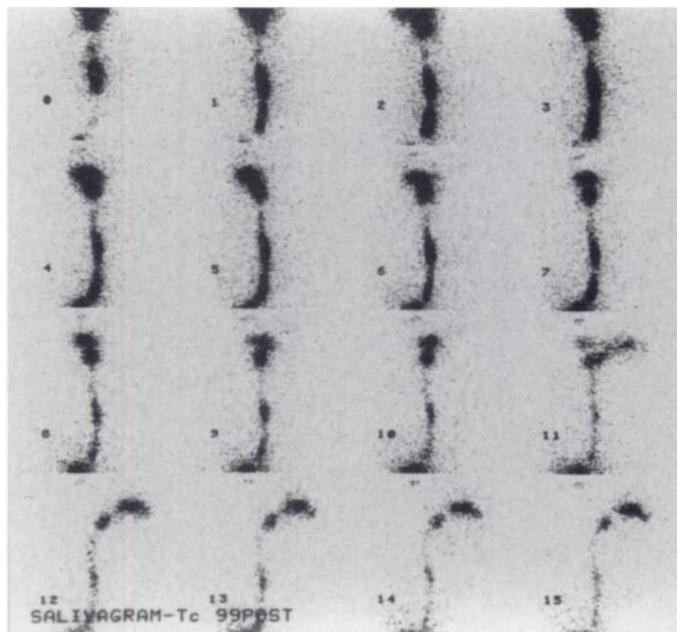


FIGURE 1. Images from the salivagram showing transit of the activity into the stomach without evidence of aspiration.

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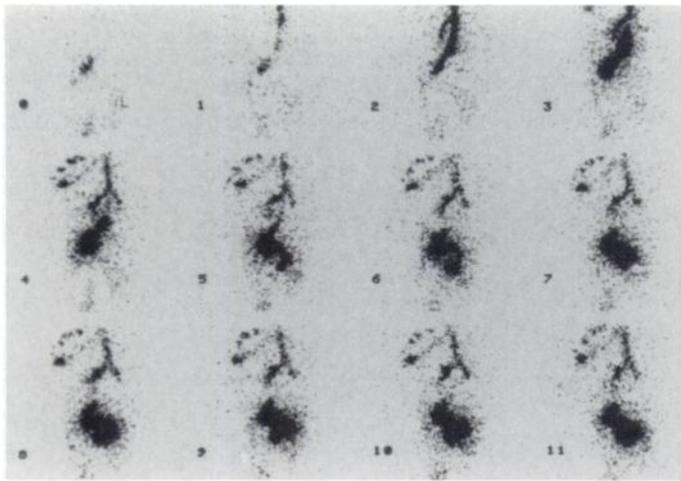


FIGURE 2. There is bilateral pulmonary aspiration after swallowing the bolus. Activity is also present in the tracheostomy.

gested. She returned the following day. She was seated with her back to the collimator, reclining slightly. As before, the mouth, thorax and stomach were in the field of view. On this occasion she was given 10-ml bolus of water tagged with 18.5 MBq (500 μ Ci) 99m Tc-sulfur colloid. This was sucked into the mouth through a straw and swallowed when directed. Sequential frames were acquired at 3-sec intervals in 128 \times 128 matrix and continued for 1 min. There was now clearly aspiration bilaterally into both lungs. The path of the tracheostomy tube was also clearly outlined (Fig. 2). The aspirated material was not readily cleared from the lungs.

At this time, she was started on antireflux medication. The chest radiograph showed hyperinflation with possible obliterative bronchiolitis in the left upper lobe as well as interstitial markings and peribronchial thickening, probably due to chronic lung changes. Chest CT revealed abnormal aeration and multiple blebs in addition to small areas of tubular bronchiectasis, although bronchoscopy did not reveal any evidence of chronic aspiration. The vocal cords appeared to function normally after stimulation. A small vocal cord nodule was noted, which was removed.

DISCUSSION

In children, the aspiration of oral contents into the lungs can be detrimental and may even prove fatal. Swallowing dysfunction with aspiration may be due to cricopharyngeal dysfunction, which is frequently present in neurological diseases (5). While neurological disorders can cause inadequate glottic closure resulting in aspiration, it has been shown that even patients with full glottic closure may aspirate in the pre- and postdeglutition stages of swallowing (6). The patient described in this report is believed to be such a case. She can handle the small volume of

saliva produced. This is demonstrated by the prompt swallowing of the drop of radiopharmaceutical when placed on the tongue without oral retention. When presented with a larger bolus, however, the swallowing mechanism is stimulated and found to be abnormal. It is likely that the tracheostomy in this patient predisposes her to aspiration. It has been shown that although the vocal cords close completely during swallowing in patients with tracheostomy, their duration of closure is significantly shorter than of normal volunteers. Furthermore, in contrast to normal controls, the duration of deglutitive closure in patients with tracheostomy is modified by a liquid bolus. In these patients with tracheostomy, 5 ml water swallows significantly increases the duration of vocal cord adduction/abduction compared with that of dry swallows, but the duration of closure is still significantly shorter than the controls (7). Deglutitive aspiration has been attributed to impaired laryngeal movement, loss of protective laryngeal reflexes and uncoordinated laryngeal closure.

It is not likely that the discordance between the salivagram and the swallowed bolus is due to the difference in positioning. If anything, the supine position used with the salivagram should have facilitated aspiration. It seems, therefore, that a small drop (100 μ l) placed on the tongue does not tax the swallowing mechanism when the mouth is dry. For patients unable to handle their oral secretions, the drop mixes with a larger volume in the mouth. Thus, the salivagram is likely to be abnormal in patients with neuromuscular problems who clinically have difficulty dealing with their saliva. The indication in patients who do not tend to retain oral secretions may be questioned. If the salivagram is negative in patients believed to be experiencing recurrent episodes of aspiration, then a follow-up study with a labeled bolus may be appropriate. While this is a single case report, it suggests that further evaluation of the discordance reported here is merited.

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