In this case the associated anomaly, esophageal stenosis, provided for a less than classic presentation of the fistula. In retrospect, the choking episodes with feeding, recurrent wheezing/brochitis and the hospitalization for wheezing probably represented aspiration of esophageal contents through the fistula. The esophageal stenosis probably allowed prestenotic esophageal distention to favor intermittent flow through the fistula.

Potential postoperative complications of the TEF repair include damage to the phrenic nerve, thoracic duct, vagus nerve, carotid artery and internal jugular vein in addition to pneumothorax and cervical infection. Complications of the anastomosis include leak, dysmotility and recurrent stenosis. The patient, fortunately, experienced only mild stenosis at the anastomosis site, responding adequately to dilatation.

Although rare, H-type TEF may accompany congenital esophageal stenosis. Patients with esophageal stenosis should have careful radiographic evaluation for H-type TEF and perhaps intraoperative tracheoesophagoscopy, if TEF is suspected. This is particularly true if there is a previous history of respiratory illness.

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Occupational Asthma Caused by Pectin Inhalation during the Manufacture of Jam*

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We report a case of pectin-induced occupational asthma in a 35-year-old man. His job involved mixing powdered pectin into a fruit puree during the manufacture of jam. Within minutes of adding pectin, he developed coryza, rhinorrhea, coughing, and wheezing. His symptoms cleared during weekends while away from work and improved with the use of a protective face mask at work. Peak flow rates were significantly lower while at work compared with those at home, and a prick skin test with the pectin powder was positive. We conclude that pectin should be added to the list of the substances known to induce occupational asthma.

(Chest 1993; 103:309-11)

Pectin is a carbohydrate found in citrus fruits. It consists of partially methylated polygalactose acid units with molecular weights between 100,000 and 200,000 kd. In the presence of 50 percent sugar and a low pH, it forms a gel in water and is used to thicken jams and jellies commercially. We report a case of skin test-positive occupational asthma induced by pectin inhalation during the manufacture of jam. To our knowledge, this has not been described previously.

CASE REPORT

The patient is a 35-year-old man who is a lifelong nonsmoker. Five years prior to assessment, he immigrated to Canada from Malaysia and was employed in a company that prepared jam and ketchup. His primary responsibility was mixing the ingredients involved in the preparation of jams. This included the pouring of pectin in powdered form from a bucket into a kettle where he manually initiated the mixing of the jam. Exhaust fans were present over the stove. Nine months prior to assessment, he noted the acute onset of coryza, rhinorrhea, wheezing, and cough within minutes of exposure to the pectin powder. His symptoms were improved within hours away from exposure, on weekends, and while on vacation. Wearing a particle face mask decreased the intensity of his symptoms.

His medical history was unremarkable other than periodic coughing during childhood and a week-long episode of wheezing nine years earlier. Three months prior to assessment, he developed status asthmaticus after exposure to soldering fumes that were produced during installation of a boiler at his work place.

During our assessment, results of physical examination and chest roentgenogram were normal. Pulmonary function tests revealed normal lung volumes and diffusion capacity with air-flow limitation at low lung volumes. His FEV1 was 90 percent of predicted and FEF25 was reduced to 25 percent predicted. A 22 percent fall in FEV1 was documented after a methacholine challenge of 4.0 mg/ml indicating mild bronchial hyperresponsiveness. Peak flows were performed during work and at home using a portable peak flow meter (Assess). There was a 15 percent fall in FEV1 while in the work place, as compared with values obtained while away from work (Fig 1).

A skin prick test was performed with a sample of pectin brought from work. The powder was mixed with water immediately prior to testing to form a saturated solution. This resulted in a 5-mm wheal and surrounding flare (Fig 2). A skin prick test with the diluent alone was negative. Skin prick testing of two control volunteers with the same solution was negative. Allergy skin testing to common allergens was positive to dust, grass, and ragweed, confirming this patient's atopic status. The patient then declined further investigation or follow-up. The history and investigations led to a diagnosis of occupational asthma resulting from

**Figure 1.** Peak flows performed during work and at home.

**Figure 2.** Skin prick test shows 5-mm wheal and surrounding flare.
pectin exposure. His claim was accepted by the Ontario Worker’s Compensation Board.

DISCUSSION

Pectin is a food additive that is found in the lenticels of unripe fruit. Lemons, orange peel, and apple pomace are the sources commonly used for the commercial extractions. In the presence of 50 percent sugar and a low pH, pectin forms a gel in water solution and it is used as a thickening agent in the commercial production of jams and jellies. It is a hydrophilic celluloidal carbohydrate consisting chiefly of partially methylated polygalacturonic acid units. The molecular weights of the pectin vary between 100,000 and 200,000 kD.

Breakdown of the pectins into components yields galacturonic acid, methyl alcohol, and galactose. There has been only one previous report, to our knowledge, suggesting occupational asthma to pectin and in that case report, the skin test response was negative, unlike this patient.

We conclude that pectin should be added to the high molecular weight allergens that cause occupational asthma. Treatment includes avoidance of such products if possible in sensitive individuals. The recognition of pectin as an allergen raises the possibility of allergic responses to pectin secondary to ingested fruits, jams, or jellies. To date, this has not been reported and our patient did not report food-related allergic symptoms. The heating of pectin during preparation of jams and jellies may alter its integrity in these products. Assessment of pectin in patients with documented allergic responses to fruits containing pectin may merit further investigation.

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Delayed Pulmonary Perforation*

A Rare Complication of Tube Thoracostomy

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Tube thoracostomy is a standard therapy for a number of pulmonary disorders. The procedure is associated with a certain incidence of morbidity related to the technique of insertion, the patient population selected, and the length of time the tube remains in place. Complications of tube placement previously described include empyema, residual pneumothorax, lung perforation, placement of the tube in the chest wall, diaphragmatic perforation, perforation of intraabdominal organs (such as spleen, liver and stomach), unilateral pulmonary edema, bronchopleural fistula, hemithorax, cardiogenic shock and Horner syndrome. A case of a delayed pulmonary perforation developing several days after placement of a chest tube is described with a discussion of the clinical and radiographic findings associated with this complication. A possible pathophysiologic mechanism by which this complication may have occurred is proposed. (Chest 1993; 103:311-13)

Insertion of a chest tube into the pleural space is an accepted treatment for a variety of pulmonary disorders. Indications include but are not limited to pneumothorax, penetrating chest injuries, hemothorax, empyema, chylothorax, bronchopleural fistula and pleurodesis. The most common complications of chest tube insertion are empyema and residual pneumothorax after chest tube removal. The technique of chest tube insertion has been shown to influence the incidence of certain complications, with the trocar insertion method being associated with a much higher incidence of perforation of the lung, diaphragm and intra-abdominal viscera. Other complications appear to occur without regard to method of tube placement but are directly related to tube location after placement, such as cardiogenic shock secondary to right atrial compression or Horner syndrome secondary to pressure on the inferior cervical ganglion. The following case report describes the development of a pulmonary lesion and the apparent migration of a chest tube from the pleural space into the lung parenchyma over a three-day period following chest tube insertion using the blunt dissection method for a spontaneous pneumothorax. A literature search has failed to locate a previous account of this rare complication.

CASE REPORT

A 68-year-old man with a history of three episodes of right-sided spontaneous pneumothorax requiring chest tube drainage at several institutions over the six months prior to presentation. His past medical history also was notable for the development of re-inflation pulmonary edema in the past following chest tube thoracotomy. One week after discharge from an outside institution where he had undergone his third chest tube evacuation of a pneumothorax, he presented to his internist complaining of general malaise and shortness of breath. Physical examination by the internist disclosed decreased breath sounds on the right side. The patient was sent to the emergency room at our institution for evaluation and treatment. Physical examination in the emergency room indicated the absence of breath sounds in the right lower lung fields and a marked decrease in breath sounds in the right upper lung fields. There were several right-sided scars from past chest tube thoracostomies, including a recently healed wound in the fourth interspace in the mid axillary line. The remainder of the physical examination was normal with the exception of guaiac-positive stool test. A chest radiograph obtained in the emergency room demonstrated a moderate pneumothorax on the right side. A No. 28 French straight thoracic catheter was placed via the fifth interspace in the anterior axillary line using the blunt dissection technique previously described. The patient tolerated the procedure well and there were no complications noted at insertion. The chest tube was connected to the Pleur-evac suction device and suction was applied at 20 cm H2O. There was no immediate fluid drainage from the chest tube, although a large air leak was noted. The patient reported a subjective decrease in his shortness of breath, and a chest radiograph obtained

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