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Fibrocystic disease of the pancreas in adults

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FIBROCYSTIC DISEASE OF THE PANCREAS IN ADULTS

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INTRODUCTION

The name, "fibrocystic disease of the pancreas," is misleading because it gives no hint that the disease is a generalized one involving not only the pancreas but also the intestinal glands, salivary glands, sweat glands, liver and, probably most important of all, the lungs. It is now generally believed that the disease affects all of the mucus-secreting glands and possibly all of the exocrine glands of the body. Farber[1], in 1944, pointed out that this is a generalized disease involving mucus-secreting glands in different parts of the body and in different degrees. There may be extreme variations in the disease, depending on the organs affected, the degree of involvement and the rate of progression of the disease in each organ affected.

Although in the majority of cases both the pancreas and the lungs are involved, it has been pointed out by, Andersen[2], O'Neal[3], Zuelzer and Newton[4], Gibbs et al[5], and di Sant'Agnese[6], that the disease may exist with subclinical pancreatic involvement. It has also been pointed out by Gibbs et al[5], Garrod and Hurtley[7] and di Sant'Agnese[8], that the disease may exist with little or no clinical evidence of pulmonary involvement for many years.

The condition is known by various names such as; Congenital steatorrhea (Garrod and Hurtley[7]), Dysporia entero-broncho-pancreatica Congenita familearis (Glanzman[9]), Mucoviscidosis (Farber[10]), Mucosis (Bodian[11]), Pancreatic fibrosis (May and Lowe[12]), cystic fibrosis of the pancreas (Andersen[2]). di Sant'Agnese[6] suggests the term "generalized exocrinopathy" as more in keeping with the etiology since it is now believed that many, if not all, of the exocrine glands are primarily involved.

Fibrocystic disease of the pancreas is generally considered, and rightly so, as a disease of infancy and early childhood. Clinical manifestations are usually evident very early in life. Andersen[2], in 1938, showed that cases fell into three main groups: (1) those which present within the first week of life with intestinal obstruction as a result of inspissated meconium (meconium ileus). (2) Those presenting between one week and six months of age with respiratory infections and nutritional difficulty (this is the largest group). (3) Those who present later with nutritional difficulty as instances of coliac syndrome or with rectal prolapse or with chronic respiratory infection. Actually there is no sharp separation of distinct clinical types.

Approximately 70% of the cases reported by Andersen[2], in 1938, died before reaching the age of one year. There was one child in her series, however, who reached the age of 14½ years. Kohl[13], Pugsley and Spence[14], and Hendrix and Good[15], have all reported survivals of 17 years. O'Neal[3] reported on 50 patients diagnosed at the Mayo Clinic, 22 of whom were still living on January 1, 1948, the oldest 18 10/12 and the next oldest 14 10/12 years. Schwachman et al[16], in 1955, reported cases with partial pancreatic insufficiency still living at ages 30, 20 and 18 years, and one case who died at 22½ years. di Sant'Agnese[17], in 1956, reported one case still living at age 19. Burnard[18], in 1953, reported a case who died at 23 years. Hellerstein[19], in 1946, reported a negro male who died at age 35 with necropsy findings of: bronchopneumonia, a fatty liver and a fibrous and cystic pancreas.

SIGNS AND SYMPTOMS

Fibrocystic disease of the pancreas may be recognized by the characteristic clinical triad:

(1) Failure to thrive despite an excellent appetite and an adequate diet.

(2) Passage of foul bulky stools which may be frequent, often pale or putty colored, soft and pasty.

(3) Recurring or constant respiratory tract infection with staphylococcus as the predominant microorganism in the nasopharynx.

Some, or all, of these symptoms may be found in a patient with fibrocystic disease of the pancreas. The main symptoms are the result of pulmonary involvement and pancreatic insufficiency.

Pulmonary. It is believed that, in this disease, the mucous glands of the tracheo-bronchial tree secrete an abnormally viscid mucus causing obstruction of the bronchioles, which in turn leads to emphysema and atelectasis with subsequent infection. There may be fever, diminished tidal exchange, distant vesicular breath sounds, resonance and hyperresonance. Rales, coarse and sticky, are common. The atelectasis is not often massive enough to give definite signs such as dullness or bronchial breathing but is usually found on X-ray or at post mortem. At times, wheezing respirations suggestive of asthma may be noted. The chronic and acute infections processes often lead to bronchitis, bronchiectasis or bronchopneumonia, often with otitis media and sometimes with infection of accessary nasal sinuses. As the pulmonary lesion advances the patient develops rapid shallow respirations with use of the accessory muscles of respiration, cyanosis, clubbing of the fingers and toes and rounded emphysematous chest. In most of the large series of cases reported, 80 to 90% have pulmonary symptoms during the first

year of life. In those who die, the pulmonary lesion is constant.

Cor pulmonale secondary to pulmonary involvement has been reported by di Sant'Agnese[8] and others. Congestive failure with edema and ascites may develope. Pulmonary hypertension has been noted.

Pancreatic. The symptoms of pancreatic insufficiency may occur at birth in the form of meconium ileus. This is an obstruction of the intestine by inspissated neconium as a result of pancreatic insufficiency and an abnormal intestinal secretion.

It is believed that the pancreatic ducts are blocked by an abnormally viscid secretion of the acinar glands. Occlusion of the pancreatic ducts leads to the symptoms of pancreatic insufficiency. The stools are foul-smelling, bulky and quite often frequent, and may be fatty and contain considerable undigested material. The patient fails to gain weight in spite of a good appetite and an adequate diet. The abdomen is usually protuberant with, often, an umbilical hernia. There is usually weakness of the muscles and atrophy of the glutael region. Prolapse of the rectum may occur. Other signs have been noted which may be attributed to poor absorption as a result of the pancreatic insufficiency.

Andersen[2], Lowe et al[20] and Harper[21] all report osteoporosis but rickets has rarely been reported. Anemia, sometimes of the macrocystic type, has also been reported by Harper[21]. Jones[22], in 1949, reported a case of fibrocystic disease of the pancreas with generalized edema associated with severe hypoproteinemia and Robin and Erdman[23], in 1950, reported a case with interstitial edema and ascites which they believed was due to hypoprotenemia or to poor sodium elimination or a disturbance in sodium metabolism. However, most patients, according to May and Lowe[24], have been found to have normal

serum protein and hemoglobin concentrations even when very wasted.

Rarely, a patient may show evidence of liver involvement. Cirrhosis of the liver with portal hypertension and hypersplenism has been reported. Jaundice has also been reported.

Some report excessive sweating, especially about the head while others report no increased perspiration.

INCIDENCE

Fibrocystic disease of the pancreas occurs throughout the United States, Asia and Europe, with equal incidence in both sexes, however it seems to be rare in negroes and orientals.

Lowe et al[20] believe the indicence of affected persons in the general population up to about one year of age to be somewhere between 1 and 100 and 1 and 10,000. They believe that between 2 and 18 persons of every 100 in the general population carry the gene for fibrocystic disease of the pancreas in the concealed heterozygous condition. Bodian[11] believes the incidence is somewhere between 1 in 1,000 and 1 in 10,000. Menten and Middleton[37], in 1944, reported 18 proved cases, 16 white and 2 negroes, from 640 necropsies, giving an incidence of 2.8 percent. Andersen[2], reported and incidence of 3 percent of all necropsies on infants and Bodian[39], found an incidence of 3 or 4 percent in survey of 500 autopsies on children.

Age incidence. In general, the greatest number of patients in most series are under 5 years, with a rare patient surviving to adulthood. Blackfan and May[38], in 1938, reported 35 cases in over 2,800 necropsies in a period of 15 years with average onset of symptoms at 2 months of age. Parmelee[40], in 1935, reported a patient who developed the respiratory

symptoms at 11 years and lived to the age of 14½ years.

With modern treatment, the amount of health and length of life is being increased in these patients and several have been reported who have reached their late teens and early adulthood.

DIAGNOSIS

Fibrocystic disease of the pancreas may be confused with a variety of other diseases, therefore laboratory tests are necessary for the final diagnosis. Tuberculosis and celiac disease are important in the differential diagnosis.

Sweat test. The most consistent and probably the most reliable finding is an abnormally high sodium and chloride content of the sweat in these patients. The problem of recognizing fibrocystic disease of the pancreas in patients with partial or normal pancreatic function, having the lung as the main organ involved, remained unsolved until Darling et al[25], in 1953, reported high sweat electrolytes in a group of patients with proven fibrocystic disease. Subsequent studies by di Sant'Agnese et al[26,27,6] revealed 99% of 180 patients with fibrocystic disease who had an increased concentration of chloride and sodium in the sweat. In one study of 43 patients with fibrocystic disease of the pancreas they found the sodium and chloride concentration in abdominal sweat to be 2 to 4 times as high as in 50 controls with a variety of other diseases. In one of their studies, the range for chlorides in patients with fibrocystic disease of the pancreas was 60 to 160 meq./L. Values in controls ranged from 4 to 80 meq./L with an average of 32 meq./L. Corresponding values for sodium were 80 to 190 meq./L with a mean of 133 meq./L for patients with fibro-

cystic disease of the pancreas and 10 to 120 meq./L with a mean of 59 meq./L for the controls. The potassium values were also elevated in patients with fibrocystic disease.

Schwachman[16] has devised a simple and inexpensive method of collecting the sweat by using a plastic bag thus making the test a practical laboratory procedure which can easily be carried out in any hospital.

Stool trypsin test. The absense of trypsin may be demonstrated by placing stool emulsions on a piece of unexposed X-ray film. If there is no trypsin in the stool, the X-ray film will be unchanged; if there is trypsin in the stool emulsion, it will digest the gelatin on the film. This is a useful screening test in patients above the age of four weeks. Another useful test is the examination of the stool for fat and starch.

Duodenal intubation. In addition to the reduced volume of duodenal secretion found in pancreatic insufficiency, there is also often an increase in viscosity and a change in ph as well as decrease or absense of pancreatic enzymes. In a child, absence or decrease in any of the pancreatic enzymes with an associated increase in the viscosity of the fluid, may be considered pathognomonic of fibrocystic disease of the pancreas. More recently, however, it has been noted that a few of the children who succumb to this disease have demonstrated none of the changes in pancreatic function during life which are considered characteristic of the disease. This throws some doubt on the validity of the laboratory examination of pancreatic function in making the diagnosis.

Chest X-ray. The earliest pulmonary changes such as emphysema and patchy atelectasis, may appear long before the symptoms are of serious consequence, and before physical signs are present. With repeated respiratory infections there may be marked increase in the density and extent

of the hilar shadows, patchy areas of pneumonia, and finally bronchiectosis. The X-ray findings usually suggest a chronic or subacute process rather than an acute one. In contrast to the usual findings in bronchopneumonia, the changes in the upper lungfields are often quite as marked as those at the bases.

Atwood and Sargent[28] also saw X-ray evidence of disturbed intestinal motility, with definite fluid level and dilated loops of small bowel in one patient and apparent distention of small bowel in another.

Neuhauser[29] reports diagnostic roentgen changes in 40% of the cases studied by him.

Diagnosis can be established by finding any two of the most characteristic manifestations--exocrine pancreatic insufficiency, typical respiratory involvement or increased sweat electrolytes. A positive or suspicious family history of fibrocystic disease of the pancreas lends great diagnostic weight, as does the presence of cirrhosis of the liver with portal hypertension.

ETIOLOGY

The etiology of this disease is not known but it is now generally believed to be a generalized hereditary disease involving many, if not all, of the exocrine glands.

Andersen and Hodges[30], Howard[31], Lowe et al[20], Matheson[32], and others have pointed out the hereditary nature of this disease.

Farber[33], in 1942, was able to produce a pancreatic lesion in kittens, with parasympathomimetic drugs, which was similar in some respects to that found in infants suffering from pancreatic achylia.

Andersen and Hodges[30] suggested that the disease is due to a congenital defect of an enzyme system, causing abnormal acinar secretion.

In 1948, Baggenstoss[34] suggested the possibility of congenital inability of the affected individuals to produce secretin in the duodenum, with resultant inspissation of pancreatic secretion. Farber[1] concluded that the disease affected all mucus-secreting glands, the lesions being caused by inspissation of viscid secretion.

Andersen[30,35] believed the respiratory infection to be the result of nutritional feficiency, and that the lesions observed in the bronchial walls are secondary to infection.

Garrod[36], in 1912, postulated inborn error of fat absorption, probably of Mendilian recessive characteristic. Bodian[11] also suggest an inborn error of mucus secretion throughout the body.

PATHOLOGY

The pathologic lesions most frequently found in fibrocystic disease of the pancreas are those of the lungs, pancreas, liver and intestines, although mucus-secreting glands of the entire body are affected.

Pancreas. In 1905 Landsteiner[41] first described the lesions of the pancreas now associated with this disease. Blackfan and Wolback[42], in 1933, advanced the hypothesis that the pancreatic lesions were caused by inspissation of an abnormally viscid secretion which results in distention and atrophy of the ducts and acini. Farber[33], in 1942, confirmed this by producing similar lesions in kittens with parasympathomimetic drugs.

On gross inspection, the pancreas of patients with fibrocystic disease, is thinner, smaller and more firm than the normal pancreas. The

ducts and acini are dilated and filled with inspissated secretion. The glandular tissue is replaced with fibrous connective tissue. The islands of Langerhans remain normal.

Lungs. The early lesions in the lungs are either emphysema or atelectasis. This is followed by bronchiectosis, scattered areas of bronchopneumonis, and finally chronic interstitial pneumonia. The abnormally viscid mucus diminishes the ciliary action in the bronchi and predisposes to infection. Hemolytic Staphylococcus aurus is the agent of infection in most cases.

Farber[1], in 1944, reported 87 cases of pancreatic insufficiency in whom post mortum examination revealed changes in the lungs, upper respiratory tract, liver, gallbladder and upper alimentary tract similar to those found in the pancreas. He concluded that the disease affected all mucus-secreting glands and that lesions were caused by inspissation of viscid secretion. He believed that it was the loss of normal mucous from the bronchial tree that was responsible for the susceptibility to pulmonary infections.

Liver. Lesions of the liver are either fatty infiltration of local areas or cirrhosis with concretions. di Sant'Agnese and Blanc[43] believe the presence of eosinophilic concretions to be diagnostic of hepatic cirrhosis secondary to cystic fibrosis of the pancreas.

The salivary glands, gallbladder, esophagus and other organs show characteristic changes in the mucus glands. The most commonly reported intestinal lesion is obstruction of the lumen by inspissated meconium, meconium ileus.

DISCUSSION

While fibrocystic disease of the pancreas is predominantly a disease of infants and young children, there are several reports of well authenticated cases who have reached adulthood.

Although the name implies that the pancreas is the primary organ affected, the most incapacitating feature of the disease, and the chief cause of death, is chronic pulmonary infection. It is now generally believed that the disease affects all mucous-secreting glands throughout the body and possibly all of the exocrine glands. The disease has been known to exist in patients with partial or even normal pancreatic function[3,4,8,6], and conversely a few patients have been reported who developed only minimal respiratory involvement in spite of the fact that complete pancreatic insufficiency had been present, unrecognized, for years[5,7,63].

The congenital nature of the disease is evident in the cases of meconium ileus.

The disease had been shown by several workers 27, 60, 28, 9, 10 to be hereditary.

di Sant'Agnese[6] found elevated sweat electrolytes in some of the parents and siblings of patients known to have fibrocystic diseas of the pancreas. In addition to abnormal sweat electrolytes, some of the relatives also had the typical pulmonary picture but normal pancreatic function. Some, however, showed only the high sweat electrolytes with neither the pulmonary manisfestation nor low duodenal tryptic activity. He was unable to demonstrate a similar abnormality of sweat electrolytes in normal individuals or in patients with a variety of other conditions.

Sweat tests were done on eleven adult patients suffering from chronic

lung disease in The University of Nebraska Hospital and The Douglas County Hospital. Two patients had moderately elevated sweat chloride and sodium, eight had normal electrolytes and one patient did not perspire enough to collect sufficient sweat for analysis, Table No. I.

The method of collecting the sweat was as follows:

The area of the upper back was washed with distilled water and dried with sterile gauze. Two strips of 4 X 4 gauze were then spread out over the area and covered with a piece of thin plastic material "Saran wrap". The edges of the saran wrap were then taped down with one inch tape. The patient was then wrapped in a plastic sheet and one wool blanket. Two 60 watt heating pads were then placed next to the patients body, one on either side, with one thickness of blanket between the patient and the heating pad. Two more wool blankets were then placed over the patient and the heating pads set at high heat. After the patient had perspired sufficiently the gauze was removed from the patients back, placed in a large centrifuge tube, having a wire mesh platform in the bottom, and the sweat centrifuged out of the gauze and analyzed for chloride, sodium and potassium. The wire mesh platform which was placed in the centrifuge tube was made from hail screen.

In some instances hot water bottles were substituted for heating pads. Six hot water bottles with the water at 150° F are about equivalent to two 60 watt heating pads turned to high heat.

Patient No. 5, who had sweat electrolytes of borderline significance also showed low or borderline tryptic activity on duodenal drainage. No bile was returned in duodenal fluid. X-rays of this patient revealed gas in the biliary ducts, marked pulmonary fibrosis, large lung cysts and numerous calcific areas in the pancreas.

Patient No. 11, who failed to produce sufficient sweat for analysis, also had foul, liquid stools which showed no proteolytic activity on X-ray film in one and one half hours at room temperature. This is probably significant since the stool was fresh and liquid, although negative trypsin tests are ordinarily not important in adults with firm stools. Microscopic examination of this patients stool by the Sudan III method revealed an excessive amount of fat. A cyst had been removed from this patient's lung.

A second attempt to obtain sweat from this patient by local injection of 0.1 cc of 1:100 acetylcholine (micro sweat test) also failed. This patient, a diabetic, went into insulin shock at a later date and was reported to have perspired profusely.

Subsequent to the above studies the patient was treated with pancreatin and immediately began to show improvement. He gained weight at the rate of one pound per week, seemed more relaxed and less irritable, had fewer physical complaints and complained less of diarrhea. This response to pancreatin is very good evidence of pancreatic insufficiency. However, it is impossible, without tissue studies, to say whether this insufficiency is a result of inflammatory changes or fibrocystic disease of the pancreas.

It may be noted, Tables I and II, that patients No. 5 and 11 perspire rather poorly, which raises the question of whether or not the function of the sweat glands may be altered in patients with fibrocystic disease of the pancreas who live to adulthood.

CASE HISTORIES

Case No. 1 (Patient No. 5 in Table I). This patient, a 41 year old

negro female, was admitted to The Douglas County Hospital on November 16, 1956 with complaints of cough and chest pain of ten days duration. She gave a history of cholecystostomy in 1953, cholecystectomy in 1954, repair of ventral hernia in 1954, carcinoma of the cervex in 1953, treated with radium implants. Other things for which no definite data could be obtained were: gastric ulcer with resection, colostomy, cirrhosis of the liver, pancreatitis, lues, gonorrhea and hemorrhoidectomy. She also had a history of alcoholism.

Physical examination revealed a thin, poorly nourished colored female who appeared chronically ill. Chest expansion appeared to be equal and adequate bilaterally. The lungs were clear to percussion and anscultation. The heart tones were regular and normal but the heart sounds were distant in spite of the thin chest wall. The liver was palpable 4 cm. below the right costal margin and the spleen was palpable 4 cm. below the left costal margin.

Chest X-rays showed large cystic lesions and diagnosis of "Vanishing lung" was made. Laboratory findings on November 19, 1956 were:

Prothrombin time - 100% normal
B.S.P. - no dye retention
T.S.P. - 6.80 grams %
alb - 3.10 grams %
glob - 3.75 grams %
Direct bilirubin @ 10 min. 0.20 mgm %
Direct bilirubin @ 30 min. 0.20 mgm %
Total bilirubin @ 30 min o.45 mgm %
Thymal turbidity 3 units
Inorganic phosphorus 1.1 mgm %
Alkaline phosphatise 5.6 units
Cholesterol 2 29 mgm %
Thymal flocculation 8 hrs. neg.
Cephalin flocculation - 24 hrs. 1 -.

Sweat test done on November 23, 1956 showed sweat electrolytes of borderline significance, see Table I. Duodenal drainage on December 12,

1956 also gave results of borderline significance, see Table III. X-rays at the time of the duodenal drainage revealed fibrosis of the lungs, air in the biliary ducts and numerous calcified areas of the body of the pancreas, see Figures I and II, pages 23 and 24. Upper G. I. studies on January 17, 1957 revealed a duodenal diverticulum but no other abnormalities and there was normal passage of burium through the bowel in 24 hours.

The patient complained frequently, during her hospital stay, of severe sharp pain in the right chest.

Case No. 2 (Patient No. 6 in Table I). This sixty year old white male patient entered The University of Nebraska Hospital on November 21, 1956 with chief complaints of weakness and shortness of breath for many years. He gave a history of asthma since age 13 and of allergy to dust, feathers, animals, weeds, eggs, pork, and many other substances. At the age of 30 the patient began to have acute episodes of dyspnea precipitated by exertion. He gave a history of yellow jaundice 30 years ago.

On physical examination there was good expansion of the thorax and lungs. There was some supraclavicular and intercostal retraction and some increase in the A.P. diameter of the chest. Some inspiratory and expiratory wheezes were present but no moist rales were noted. The rest of the physical examination was essentially negative.

Laboratory and X-ray data: C B C, U A and serology were within normal limits, sed red 22, sweat chloride 70 meq./L, sweat sodium 70 meq./L, sweat potassium 5.8 meq./L, see Table No. I. T.S.P. 6.6% with alb 3.9 and glob 2.7. B.S.P. 22% dye retention. Chest X-ray showed marked bilateral pulmonary emphysema. E. K. G. revealed a right axis tendency, vertical position and

clockwise rotation consistant with chronic emphysema. Pulmonary function tests revealed a total capacity of 1.4 liters with a one minute 2/10 of a liter and a two minute vital capacity of 25/100 of a liter.

Clinical Course. Upon admission the patient was treated with I. V. glucose and H_2O with aminophillin. He was also given sublinqual isoprel, aminophjllin suppositories and saturated solution of potassium iodide; procaine penicillin 1,200,000 U. per day for chronic bronchitis. He also received phenobarbital, Chlortrimeton and Amesec tablets as well as sulfadiazine therapy with some response. As routine asthmatic preparations were not helping the patient greatly, he was placed on prednisone 10 mgms tid on November 26, 1956. This was gradually reduced to 5 mgm tid by December 4, 1956. The patient was discharged on co-deltra 5 mgm bid, potassium iddide drops 10 bid, bland diet, aminophillin and phenobarbital P R N and sulfadiazine grams $\frac{1}{2}$ qid.

Case No. 3 (Patient No 11 in Table No. I). This 45 year old white male patient, who is being treated at The University of Nebraska Psychiatric Institute for toxic pychosis, failed to produce enough sweat for analysis. Wrapped in a plastic sheet and three woolen blankets with two heating pads turned to high heat for two hours, the patient failed to perspire enough to dampen the gauze patches placed on his back. A later attempt to obtain sweat by local injection of acetyl choline (micro sweat test) also failed.

Five years prior to admission to the Psychiatric Institute, the patient began having severe coughing spells with blood-tinged sputum. This condition became much more marked $2\frac{1}{2}$ years before admission. About 3 years prior to admission the patient had chronic laryngitis. He also developed a red spot

on one leg, dermatosis of the penis and peeling of the skin around the eyes; edema, aching and tenderness of the feet and ankles. For this condition he received cortisone therapy. He continued to drink heavily and smoke heavily. He developed nausea and vomiting and lost considerable weight. Chest films at that time showed pathology in the left lung. He has continued to have intermittant episodes of diarrhea for the past three years.

On August 7, 1956 the left upper and ½ of the left lower lung lobes were removed. The lesions were not malignant and were not tuberculous. They were thought to be of fungus etiology but no fungus could be cultured. from them. The patient developed toxic psychosis postoperatively. He continued to drink heavily, coughed up blood again and complained of pain in the legs and shoulders. In October 1956 he was thought to have pellagra and was treated unsuccessfully for this condition.

He gives a history of heavy drinking since age 16 or 17, yellow jaundice in early life and mild diabetes melitus. He claims to have lost 100 pounds during the past year and a half.

The patient gives a history of 2 or 3 stools per day all his life and states that he had always been a "big eater".

X-rays on November 1, 1956 showed the remaining portion of the lung to be well expanded. There was some thickening of the apical pleura on the left, slight bilateral pulmonary emphysema and moderate elevation of the left diaphragm with several pleuro-disphragmatic adhesions and loculation of a small amount of fluid.

Upper G. I. studies on January 7, 1957 showed atrophic gastritis with polypoid thickening of the mucosa.

On October 29, 1956 the patients serum Cl was 95 meq./L; serum Na 130

meq./L serum K 3.9 meq./L. On November 7, 1956 the serum CL was 91 meq./L; Serum Na 134 meq./L and serum K 5.6 meq./L.

Stool examination on February 9, 1957 revealed a foul liquid stool containing a large amount of undigested material. There was an excessive amount of fat on microscopic examination with Sudan III and acetic acid. No proteolytic activity was noted on X-ray film in 1½ hours at room temperature.

Following this stool examination the patient was palaced on pancreatin and immediately began to gain weight at the rate of 1 lb. per week. He complained less of diarrhea, was more relaxed and less irritable and had fewer complaints. There was no noticable change in the appetite, however.

SUMMARY

Fibrocystic disease of the pancreas is a hereditary disease of the exocrine glands, particularly those glands which secrete mucus. The pancreas, respiratory systems and sweat glands are most characteristically affected. The disease is typified by malnutrition, pancreatic insufficiency and respiratory infection. It is predomently a disease of infants and young children, however, a few cases have been reported to have survived to their late teens and early adulthood.

Diagnosis can be established by finding any two of the most characteristic manifestations - exocrine pancreatic infufficiency, typical respiratory involvement, or elevated sweat electrolytes.

Out of eleven patients at The University of Nebraska Hospital and The Douglas County Hospital, having chronic lung disease, who were sweat tested, two had sweat electrolytes of borderline significance, one failed to produce sufficient sweat for anaysis and the rest had normal sweat electrolytes.

The patient who failed to perspire also had definite pancreatic insufficiency. One of those with elevated sweat electrolytes had pancreatic function tests of borderline significance and the other apparently had normal pancreatic function. This is in line with what one would expect to find in patients with a mild form of the disease who lived to adulthood since the most severe cases are quite likely to succumb at an earlier age. It is impossible to say definitely without further studies, whether or not these three patients have fibrocystic disease of the pancreas or whether their difficulty is on an inflammatory or some other basis.

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Patient	Race	Sex	Age	Complaint or Diagnosis	Sweat Chloride in meq./L	Sweat Sodium in meq./L	Sweat Potassium in meq./L
1	White	M	21	Chronic cough	20.9	20.0	5.5
2	White	F	77	Chronic cough	14.0	13.6	8.5
3	White	M	73	Chronic cough	22.0	26.0	5.3
4	White	F	74	Bronchiectasis - 5 years duration.	36.0	37.0	4.7
5	Negro	F	41	Chronic cough, pain in chest. Lung cyst.	62.6	72.0	5.3
6	White	M	60	Bronchiectasis and asthma	70.0	70.0	5.8
7	White	M	64	Chronic bronchitis	21.0	25.0	5.7
8	White	F.	48	Bronchiectasis and asthma	14.0	16.0	5.1
9	White	M	61	Chronic cough-10 years duration	35.0	33.0	4.2
10	White	F	31	Chronic cough-4 years duration	24.0	22.0	8.3
11	White	M	45	Toxic psychosis, diabetes m. emphysema, lung cyst.	--	--	--

Table No. I

Time in Min.	Oral temp. of Patient Number 5	Oral temp. of Patient Number 6	Oral temp. of Patient Number 7	Oral temp. of Patient Number 8	Oral temp. of Patient Number 11
0	98.4	98.2	100.2	99.2	97.0
5	98.4	98.6	100.2*	99.2	97.0
10	98.6	98.7	100.4	99.2*	97.0
15	98.6	98.9*	100.5	99.3	97.2
20	98.7	99.0	100.5	99.3	97.3
25	98.9	99.1	100.5	99.3	97.3
30	99.0*	99.3	100.6	99.3	97.3
35	99.2	99.4	100.8	99.5	97.3
40	99.3	99.5		99.7	97.3
45	99.3	99.6			97.3
50	99.4				97.3
55	99.5				97.3
60	99.6				97.4
80					98.2
100					99.4
120					99.7
#	104°		126°	130°	118°
S	1.2°	1.4°	0.6°	0.6°	2.7°

Table No. II

S - Total increase in oral temperature.
* - First evidence of perspiration.
# - Temperature next to patient, directly under heating pad, at end of tes.

	Volume obtained in 20 minutes	Trypsin concentration in Anson units
Without secretin stimulation	?	8
Following stimulation with old frozen secretin	10 cc	16
Following stimulation with new secretin	20 cc	48

Table No. III

In children, the normal trypsin concentration is 20 to 150 Anson units with average of 65 Anson units.

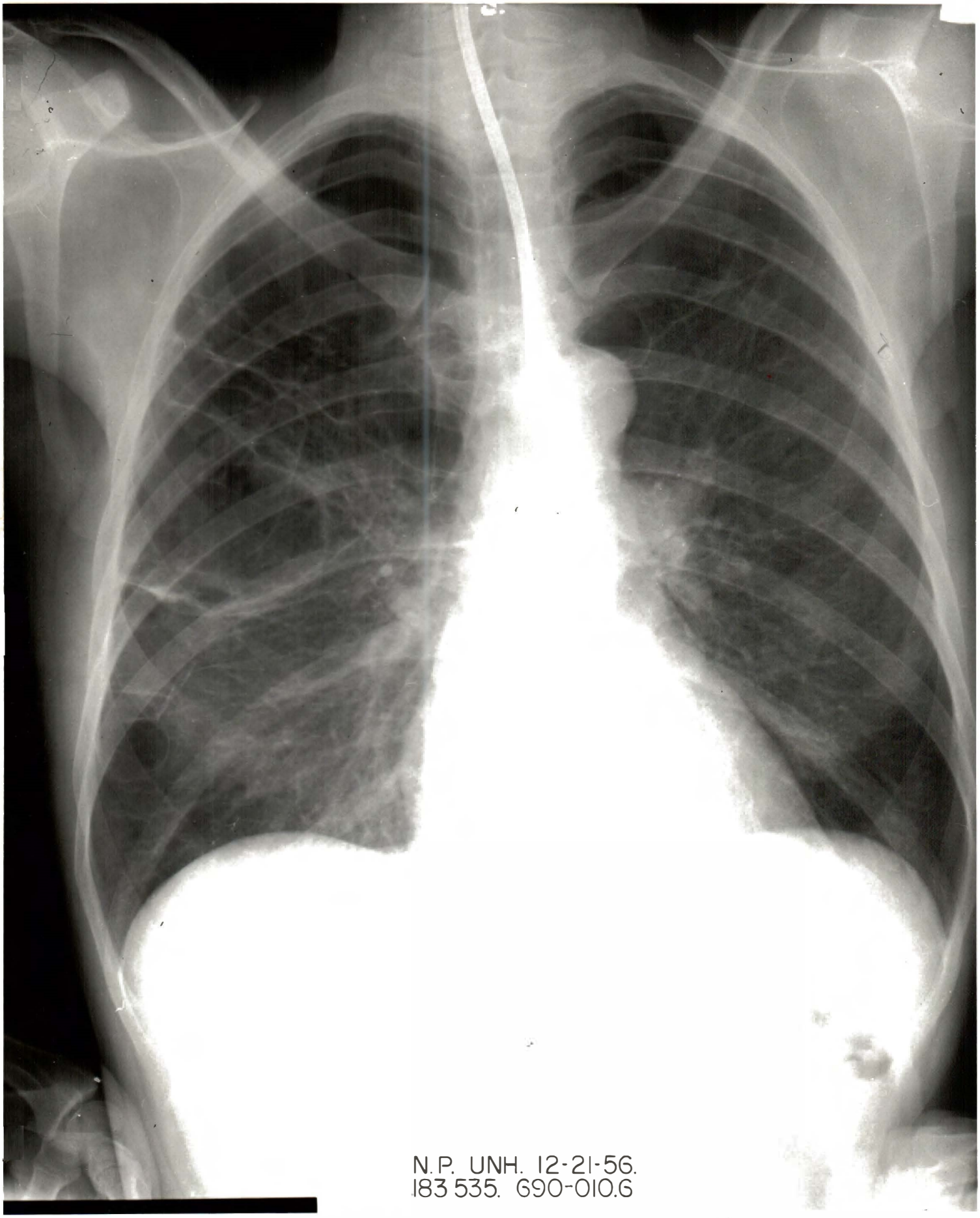

Figure No. I (Explanation on Page 25).

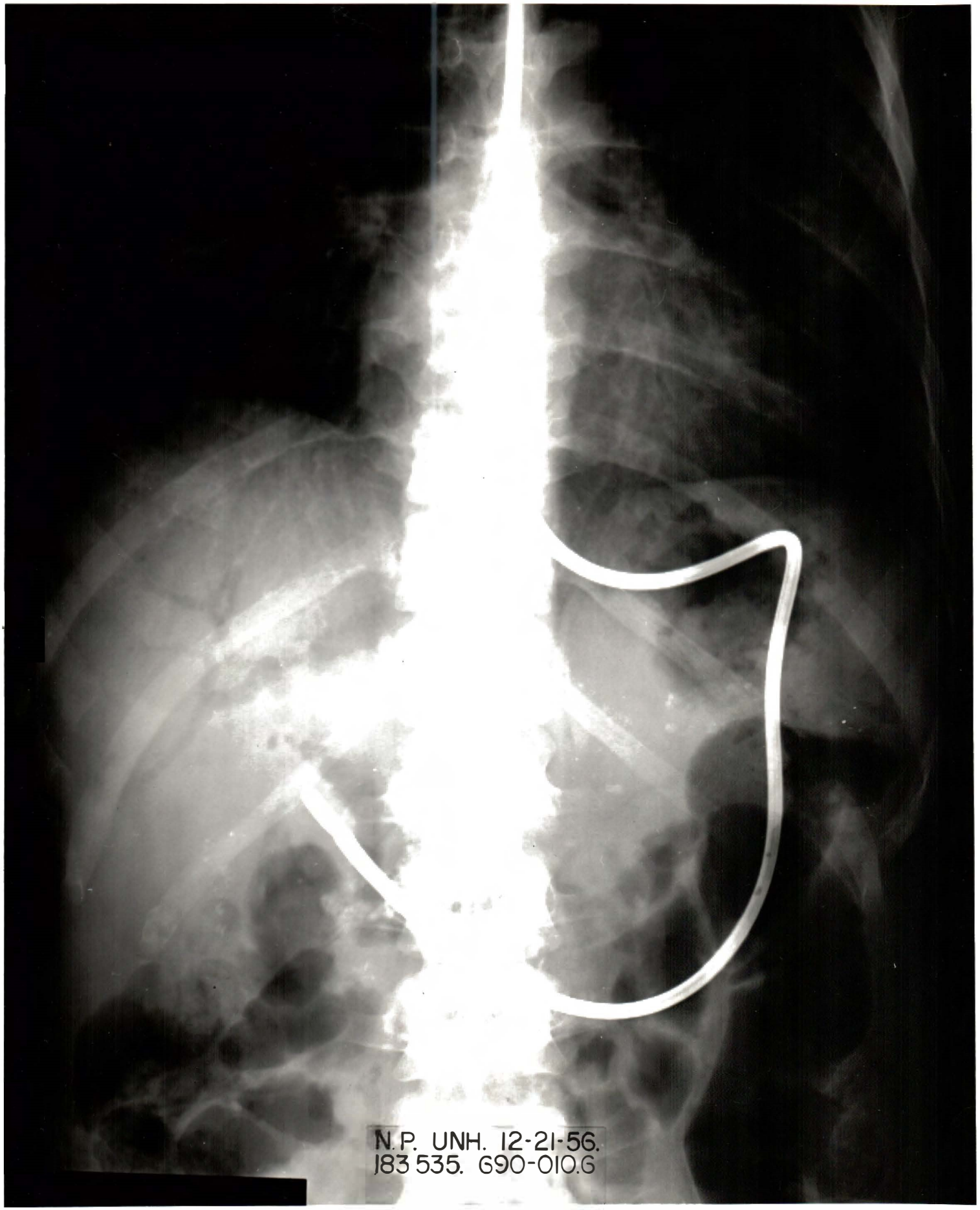

Figure No. II (Explanation Page 25).

Figure No. I: Chest X-ray of patient in Case No. 1, taken during the process of duodenal drainage. The enteric tube may be visualized traversing the esophagus and passing through the stomach. Note the extensive fibrosis and segmental atelectosis of both lungs, particularly marked in the right lung.

Figure No. II: X-ray of abdomen of patient in Case No. 1, taken during the process of duodenal drainage. The distal end of the enteric tube appears to be within the region of the duodenum. Note the numerous small, mottled, calcific densities in the region of the pancreas. Note, also, the air in the biliary ducts suggesting abnormal connection between the G. I. tract and the biliary system. No bile was found in the fluid obtained from the tube, which appears to be well placed within the duodenum, suggesting that the abnormal connection between the bowel and the biliary duct system may be the jejunum or the colon. The patients stools were reported to be normal in color.

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