

TABLE IV. Virus Yield from Hamster Kidney Tissue Cultures Infected with Street Rabies Virus.

HKTC passage No.	Day of harvest	LD ₅₀ titer in mice (log ₁₀)
1	24	1.5
2	14	4.3
3	13	4.3
4	11	4.0

infected salivary gland was used in each case. No virus could be subsequently recovered from the tissue culture fluids which had been inoculated with 2 of the specimens. One of these consisted of dog salivary glands with a titer of $10^{6.5}$ LD₅₀ in mice, the second a suspension of cow salivary glands with a mouse LD₅₀ titer of $10^{5.3}$.

The fluids from tissue cultures inoculated with a third suspension, dog salivary glands having a titer of $10^{6.1}$ LD₅₀ in mice, yielded virus at each change of fluid made every 3-4 days through 39 days after inoculation. This virus was capable of being serially passed at

least 4 times through HK tissue cultures without a drop in infectivity titer for mice (Table IV). Negri bodies could be demonstrated in impression smears from the brains of mice inoculated with tissue culture fluids at each passage level. No cytopathic changes were observed in the tissue cultures.

Summary. Both fixed and street rabies virus strains were propagated serially in hamster kidney tissue cultures but no cytopathic changes were evident in these cultures.

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Detection of Gastro-Esophageal Reflux by Simultaneous Measurement of Intraluminal Pressure and pH. (23998)

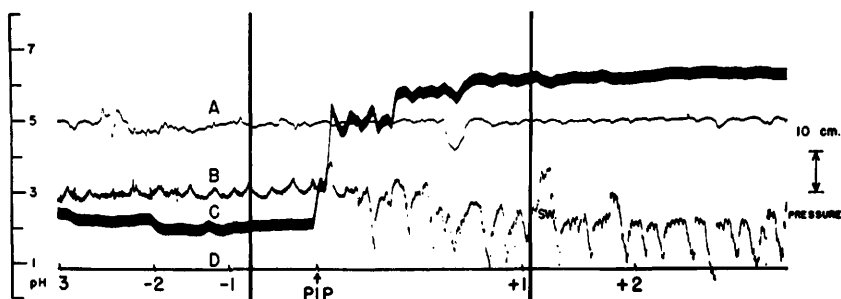
STEWART G. TUTTLE AND MORTON I. GROSSMAN

Wadsworth General Hospital, V. A. Center, and Dept. of Medicine, University of California Medical Center, Los Angeles

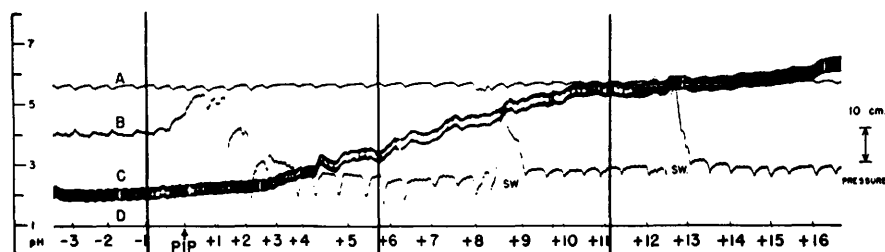
Measurement of pH at various levels within the esophageal lumen provides a direct means for detecting gastro-esophageal acid regurgitation, and simultaneous recording of intraluminal pressure changes permits precise localization of the sensing device at various levels above the diaphragmatic hiatus.

Method. 300 ml of 0.1 N HCl are introduced into the stomach of a fasting subject to assure the presence of pH 1 to 2 for at least 30 minutes. Smaller quantities of acid fail to maintain these pH levels in individuals with rapid gastric emptying. An exploring glass pH electrode on a long flexible lead (Beckman No. 78022V) and small-caliber, water-filled polyvinyl tube are then passed together through the nares into the esophagus. The open end of polyvinyl tube is at the level of

bulb of glass electrode, and this relation is maintained by tying tube to lead wire of electrode with fine silk thread. The polyvinyl tube measures 1.6 mm (internal) and 2.5 mm (external) diameter. Both tubes measure 4.8 mm diameter. The polyvinyl tube is attached to pressure transducer (Statham Model P6a $\pm$ 2D-300) by a 3-way stopcock; a syringe attached to latter permits flushing of tube with water during the test. Direct observations of pressure changes are made on a mirror galvanometer which receives the output of the pressure transducer. The exploring glass pH electrode is attached to a pH meter (Beckman Zeromatic, Model 9600) with circuit established by having subject immerse his unabraded finger into saturated solution of KCl containing the calomel electrode. This



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FIG. 1. Record obtained in patient without gastro-esophageal acid regurgitation. Line A is pneumograph tracing and each downward deflection represents inspiration. Line B shows intraluminal pressure changes, scale on right. PIP is pressure inversion point: to left intraluminal inspiratory deflections are upward or intraabdominal; to right, they are downward or intrathoracic. pH changes are noted in Line C. Line D is signal marker and, reading from left to right, each mark represents removal of sensing device 1 cm upward from stomach toward esophagus. SW designates dry swallows. pH changes rapidly toward neutrality as PIP is passed.

FIG. 2. Record obtained on subject with gastro-esophageal acid regurgitation. pH remains low over area of several cm above PIP. See Fig. 1 for key.

method of making intraluminal pH measurements is comparable to that described by Rovestad *et al.*(1,2) who discussed its limitations and advantages. For photokymographic recording, pressure transducer, pH meter, and pneumograph are attached to a Heiland multichannel oscillograph. This recording system is similar to that described by Bachrach *et al.*(3). Initially the tube is passed with subject sitting. Since inspiratory intrathoracic and intraabdominal pressures are, respectively, negative and positive, the location of diaphragmatic hiatus is readily determined by observing the level at which this reversal of deflections occurs. This point, as measured by distance of tips of tubes from nares, is reproducible to within 1 cm when tube is passed repeatedly both upward and downward. Fluoroscopic and X-ray examina-

tions have confirmed that this point of pressure inversion is at the diaphragmatic hiatus. Subsequently, permanent photokymographic records are obtained by placing open tip of polyvinyl tube and the pH electrode in the stomach and withdrawing them 1 cm at a time or by passing them downward into the stomach in the same manner. Some patients manifest acid regurgitation when upright or supine; others, only when supine. Recordings, therefore, are made with subjects in the latter position. Acid regurgitation is diagnosed only when a pH of 3 or less is encountered over an area of at least 2 cm above the diaphragmatic hiatus, and when these observations can be reproduced by passing the sensing device in both directions several times. In practice this has not been a major problem, since the average length of acid regurgitation

above the pressure inversion point among patients studied to date has been over 9 cm. However, it should be emphasized that variations in height of reflux in the same individual, tested at different times, are great.

Results. Fig. 1 illustrates a normal record. The tracing was started with sensing elements placed 3 cm below the hiatus. Thereafter, the tube was withdrawn one cm at a time. So long as it remained in the stomach, pH remained low and intraluminal inspiratory deflections were upward or positive. However, as pressure inversion point was passed, deflections became negative and pH changed rapidly toward neutrality. It is also apparent that intraesophageal pressures are lower than intragastric pressures, a finding that has been noted by all workers.

Fig. 2 illustrates acid reflux. The pH remained strongly acid for several cm above pressure inversion point, and only as the sensing device was removed far above the hiatus did it return to neutrality. A dry swallow had little effect on pH. In contrast, swallowing water (not shown) usually induced a rapid but transitory rise in pH which persisted for 5 to 30 seconds. On the recording, to right of pressure inversion point, there is a distinct increase in intraluminal pressure. Fyke, Code, and Schlegel(4) have recently described this phenomenon which they believe represents an intrinsic gastroesophageal sphincter. Similar zones have been noted in over half of our tracings, but no correlation between their existence and the presence or absence of acid regurgitation could be found.

To date, 90 subjects have been tested for

evidence of gastroesophageal reflux, and acid regurgitation has been demonstrated in 54. Of this latter group, all but 2 had clinical, endoscopic, or radiographic evidence of esophageal inflammation. In contrast, no subject with normal records had either symptoms or findings referable to the esophagus. These findings lend support to the concept that regurgitation of gastric contents plays a dominant role in pathogenesis of esophagitis. In addition, it is felt that this new method will provide further information about the mechanisms whereby gastric contents are normally prevented from entering the esophagus, and the nature of the defect which permits such regurgitation.

Summary. Simultaneous intraluminal pressure and pH recordings at various levels within the esophagus and stomach were performed in 90 subjects. Evidence of esophageal inflammation was present in 52 of 54 individuals manifesting gastroesophageal acid regurgitation but was absent in all of those with normal records. A zone of increased pressure at the diaphragmatic hiatus could not be correlated with presence or absence of acid reflux. The evidence suggests that reflux of gastric contents is important in pathogenesis of esophagitis.

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Metabolic Inhibition Test for Determination of Antibodies to Group B Coxsackie Viruses.* (23999)

N. G. ROGERS, A. S. BANKHEAD, I. P. CRAWFORD, AND H. M. MEYER, JR.
(Introduced by M. R. Hilleman)

Department of Virus Diseases, Walter Reed Army Institute of Research, Washington, D. C.

The metabolic inhibition test of Salk,

* Technical assistance was rendered by H. D. Huff and O. W. Dandridge.

Youngner and Ward(1) has found extensive use in assay of poliovirus neutralizing antibodies. Several changes in technic of this