ADDRESS REPLY TO:

DEPARTMENT OF RADIATION THERAPY
P. O. BOX 2850

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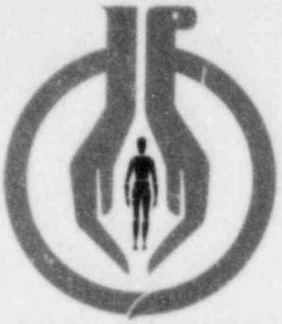

WILMINGTON MEDICAL CENTER
WILMINGTON, DELAWARE 19805

DELAWARE DIVISION
MEMORIAL DIVISION
WILMINGTON GENERAL DIVISION
EUGENE DU PONT MEMORIAL HOSPITAL

EDWARD TORVIK, Sc.D.
JOSEPH A. ROSE, B.S.E.E.

March 18, 1983

Dr. John Glenn
Nuclear Regulatory Commission
631 Park Ave.
King of Prussia, PA 19406

Ref: License #07-12153-02

Dear Dr. Glenn:

Enclosed please find application for amendment to our license #07-12153-02 and check in the amount of $40.00- amendment fee.

The Ionizing Radiation Safety Committee has approved the research proposal of S.Eric Martin and Margaret Johnson subject to NRC amendment to our license for required radioactive material.

I am also enclosing information pertaining to the research. When I talked to receptionist at your office I was informed we do not have to send copy to central repository in Washington.

Yours truly,

Edward Torvik

Edward Torvik, Sc.D.,Physicist

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FORM NRC-313M (8-78) 10 CFR 35	U.S. NUCLEAR REGULATORY COMMISSION APPLICATION FOR MATERIALS LICENSE – MEDICAL	Approved: GAO R0557

INSTRUCTIONS - *Complete Items 1 through 26 if this is an initial application or an application for renewal of a license. Use supplemental sheets where necessary. Item 26 must be completed on all applications and signed. Retain one copy. Submit original and one copy of entire application to : Director, Office of Nuclear Materials Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. Upon approval of this application, the applicant will receive a Materials License. An NRC Materials License is issued in accordance with the general requirements contained in Title 10, Code of Federal Regulations, Part 30, and the Licensee is subject to Title 10, Code of Federal Regulations, Parts 19, 20 and 35 and the license fee provision of Title 10, Code of Federal Regulations, Part 170. The license fee category should be stated in Item 26 and the appropriate fee enclosed.*

1.a. NAME AND MAILING ADDRESS OF APPLICANT *(institution, firm, clinic, physician, etc.)* INCLUDE ZIP CODE

Wilmington Medical Center, Inc.
501 W. 14th St. P.O.Box 1668
Wilmington, DE 19899

TELEPHONE NO.: AREA CODE( ) ____ ____

1.b. STREET ADDRESS(ES) AT WHICH RADIOACTIVE MATERIAL WILL BE USED *(If different from 1.a.)* INCLUDE ZIP CODE

Delaware Division
Nuclear Medicine Dept.
501 W.14th St. P.O.Box 1668
Wilmington, DE 19899
(302)428-2177

2. PERSON TO CONTACT REGARDING THIS APPLICATION

Edward Torvik, Sc.D.,Physicist
Dept.of Radiation Therapy-Physics
Wilmington General Div. 428-4595

TELEPHONE NO.: AREA CODE (302) ____ ____

3. THIS IS AN APPLICATION FOR: *(Check appropriate item)*

a. ☐ NEW LICENSE
b. ☒ AMENDMENT TO LICENSE NO. 07-12153-02
c. ☐ RENEWAL OF LICENSE NO. _____

4. INDIVIDUAL USERS *(Name individuals who will use or directly supervise use of radioactive material. Complete Supplements A and B for each individual.)*

5. RADIATION SAFETY OFFICER (RSO) *(Name of person designated as radiation safety officer. If other than individual user, complete resume of training and experience as in Supplement A.)*

Edward Torvik, Sc.D.,Physicist,RSO

6.a. RADIOACTIVE MATERIAL FOR MEDICAL USE

RADIOACTIVE MATERIAL LISTED IN:	ITEMS DESIRED "X"	MAXIMUM POSSESSION LIMITS *(In millicuries)*
10 CFR 31.11 FOR IN VITRO STUDIES		
10 CFR 35.100, SCHEDULE A, GROUP I		AS NEEDED
10 CFR 35.100, SCHEDULE A, GROUP II		AS NEEDED
10 CFR 35.100, SCHEDULE A, GROUP III		
10 CFR 35.100,SCHEDULE A, GROUP IV		AS NEEDED
10 CFR 35.100, SCHEDULE A, GROUP V		AS NEEDED
10 CFR 35.100, SCHEDULE A, GROUP VI		

ADDITIONAL ITEMS:	MARK ITEMS DESIRED "X"	MAXIMUM POSSESSION LIMITS *(In millicuries)*
IODINE-131 AS IODIDE FOR TREATMENT OF HYPERTHYROIDISM		
PHOSPHORUS-32 AS SOLUBLE PHOSPHATE FOR TREATMENT OF POLYCYTHEMIA VERA, LEUKEMIA AND BONE METASTASES		
PHOSPHORUS-32 AS COLLOIDAL CHROMIC PHOSPHATE FOR INTRACAVITARY TREATMENT OF MALIGNANT EFFUSIONS.		
GOLD-198 AS COLLOID FOR INTRA-CAVITARY TREATMENT OF MALIGNANT EFFUSIONS.		
IODINE-131 AS IODIDE FOR TREATMENT OF THYROID CARCINOMA		
XENON-133 AS GAS OR GAS IN SALINE FOR BLOOD FLOW STUDIES AND PULMONARY FUNCTION STUDIES.		

6.b. RADIOACTIVE MATERIAL FOR USES NOT LISTED IN ITEM 6.a. *(Sealed sources up to 3 mCi used for calibration and reference standards are authorized under Section 35.14(d), 10 CFR Part 35 , and NEED NOT BE LISTED.)*

ELEMENT AND MASS NUMBER	CHEMICAL AND/OR PHYSICAL FORM	MAXIMUM NUMBER OF MILLICURIES OF EACH FORM	DESCRIBE PURPOSE OF USE
Iodine 125		10 mCi	Protein labeling
Chromium-51	Na_2CrO_4	10 mCi	Platelet labeling
			See enclosed outline Research Protocol
Technetium-99M	Tech-99M Sulfur Colloid in water	------	Test for Esophageal Dysfunction (See enclosed paper by C.O.Russell,et.al.

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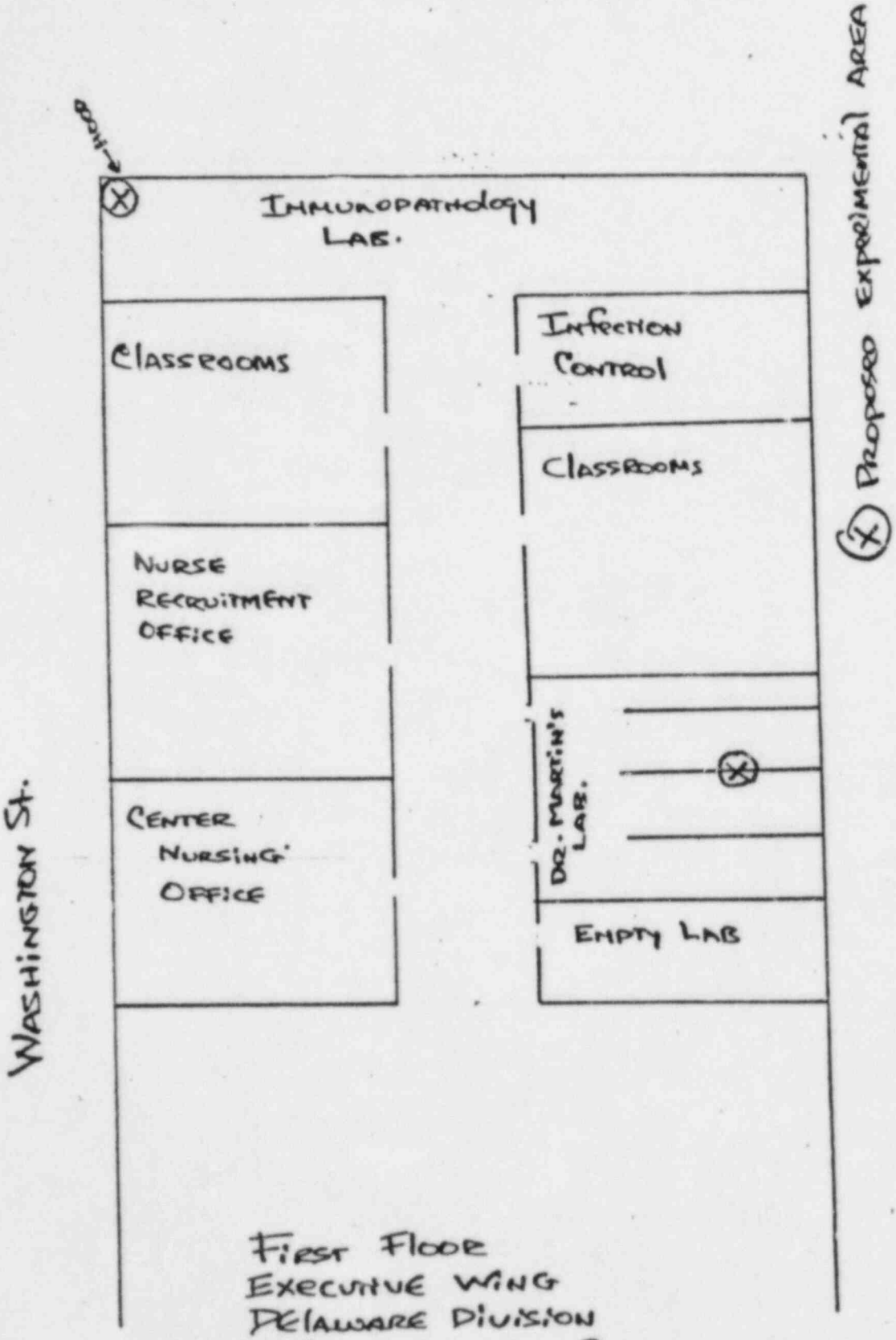

First Floor
Executive Wing
Delaware Division
Wilmington Med Ctr

REQUEST FOR THE USE OF 125-I FOR PROTEIN LABELING AND 51-Cr FOR PLATELETS

Project: Structural-Functional Studies of the Human von Willebrand Protein.

S. Eric Martin M.D., Hematology Section, Principal Investigator

Margaret Johnson Ph.D., Coagulation Laboratory, Research Associate

Under ... of Prussia
Mat I-125 20 mCi/year $40.00
Sect B Cr-51 20 mCi/year

Request for the use of 125-I for protein labeling and 51-Cr for platelet labeling.

Dr. John Glenn.

AIMS:

This study will utilize 125-I to radioiodinate purified Human von Willebrand protein and its degradation products in order to measure their binding to platelets *in vitro*. The second aspect of this request relates to the measurement of platelet binding to collagen-coated surfaces under flow conditions. This latter aspect requires the use of 51-Cr labeled platelets.

Investigators:

S. Eric Martin M.D.- principal investigator, see CV in enclosed research proposal submitted to the American Heart Assoc.
Margaret Johnson Ph.D.- research associate, previous work with rdioisotopes at the Cardeza Foundation, Thomas Jefferson Univ.

Experimental Methods:

Radioiodination- 125-I(protein iodination grade) in 0.1M NaOH will be obtained from New England Nuclear. It is anticipated that in a period of a year a total of 10-20mCi of 125-I will be used. Protein samples will be labeled by using a ratio of 0.1mCi of 125-I per 0.1-0.2mg of protein, utilizing the Chloramine-T method(J. Clin. Invest. 42:346,1963)

51-Cr labeled platelets- this section incorporates the technique of Cazenave, et al(J. Lab. Clin. Med.82:978,1973). Human platelets will be obtained from platelet-rich plasma and washed free of plasma components by three sequential centrifugations in a physiologic buffer(Tyrodes soln.). Platelts will be labeled in the first washing fluid(10 ml) by incubation for 30 minutes at room temperature with 0.2mCi of $Na_2\,^{51}CrO_4$ (100-300mCi per mg of Cr). It is anticipated that in a period of a year approximately 20mCi of 51-Cr will be ordered from New England Nuclear.

Record Keeping

All ordering will be done through the Nuclear Medicine Section of the Wilmington Medical Center. Arecord of receipt of all radioactive materials will be kept there. A logbook will be kept in our laboratory with the following information:

- receipt of the radioactive material from Nuclear Medicine.
- dates, volume of isotope, and units of radiation
- date of removal and volune of isotope removed from the stock solution
- disposal of waste material

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ML10

Methods of handling, storage, and disposal of radioactive material:

Handling: a specific area in our laboratory will be used to work with the radiolabeled products. Labeling experiments will be performed in a certified hood at the Medical Center. The counter tops of these areas will be covered with an absorbent material. Gloves will be used at all times, no mouth pipetting will be performed. Dilutions of labeled products will be identified by substance, date, amounts, and tape with the "radioactive" caution.

Storage: the stock vials will be stored at room temperature in a lead container in the hood area. Labeled proteins will be stored in a cold room.

Waste disposal: all radioactive material will be disposed of in metal containers specific for this purpose, and given to the radiation management entity contracted by the hospital for its radioactive waste disposal.

Monitoring:

Personnel will be monitored by the use of radiation badges. The laboratory work area will be monitored at the end of each work day by counting any wet area on the counter tops, and by sampling with a swab any suspicious site. If contamination is detected, the radiation safety officer will be notified.

GASTROENTEROLOGY 1981;80:887-92

Radionuclide Transit: A Sensitive Screening Test for Esophageal Dysfunction

C. O. H. RUSSELL, L. D. HILL, E. R. HOLMES III, D. A. HULL, R. GANNON, and C. E. POPE II

Mason Clinic; Veterans Administration Hospital; and University of Washington Medical School, Seattle, Washington

The purpose of this study was to extend existing nuclear medicine techniques for the diagnosis of esophageal motor disorders. A standard homogeneous bolus of ^{99m}technetium sulfur colloid in water was swallowed in the supine position under the collimator of a gamma camera linked to a microprocessor. Bolus transit was recorded at 0.4-s intervals, and the movie obtained was used to analyze transit in an objective manner. Ten normal volunteers and 30 subjects with dysphagia not related to mechanical obstruction were studied with this technique. Radionuclide transit studies detected a higher incidence of esophageal motor abnormality than manometry or radiology in the dysphagia group. In addition a definitive description of the functional problem was possible in most cases. Radionuclide transit is a safe noninvasive test and suitable as a screening test for esophageal motor disorders.

Dysphagia is the clinical manifestation of mechanical obstruction or motor dysfunction of the esophagus. Mechanical obstruction is relatively easily demonstrated with careful radiographic and endoscopic techniques. Intermittent motor dysfunction remains more difficult to demonstrate. Barium swallows, even with cineradiography, can only observe the esophagus for a very short time because of radiation considerations. Interpretation of barium studies is also a highly subjective process at best. Manometry allows an assessment of peristaltic activity and will offer an explanation for dysphagia in many cases. However, it is an invasive procedure with low patient acceptance. More importantly, there are a significant number of patients with intermittent dysphagia in whom manometry is found to be within normal limits.

Stimulated by previous reports on the use of radionuclides as an alternative method of assessing esophageal motor function we sought to further develop this concept. It was hoped that this method would provide a safe, sensitive, objective screening test for esophageal motor abnormality and that its noninvasive nature would result in a high level of patient acceptance.

Materials and Methods

Three groups were studied:

Group I: 10 normal volunteers (5 males, 5 females) with no symptoms or past history suggestive of any upper GI disorder. Mean age 34 ± 9 yr (SD).

Group II: 15 patients with a primary complaint of dysphagia and obvious manometric abnormality but no radiologic evidence of obstruction (3 males, 12 females). Mean age 47 ± 16 yr (SD).

Group III: 14 patients with a primary complaint of dysphagia but normal manometry and no radiologic evidence of obstruction (7 males, 7 females). Mean age 54 ± 11 yr (SD).

Techniques

Radionuclide transit (RT). Studies were performed in the supine position under a low-energy all-purpose collimator of a gamma camera linked to a microprocessor (Union Carbide Corp., New York, N.Y.). Subjects were positioned so that events in the mouth, entire esophagus, and stomach could be recorded. A radioactive marker was placed alongside the cricoid cartilage, then a 10-ml homogeneous bolus of water and 250 μCi ^{99m}technetium sulfur colloid was introduced to the mouth and ingested on de-

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Address requests for reprints to: C. E. Pope, II, M.D., Veterans Administration Hospital, 4435 Beacon Avenue S, Seattle, Washington 98108.

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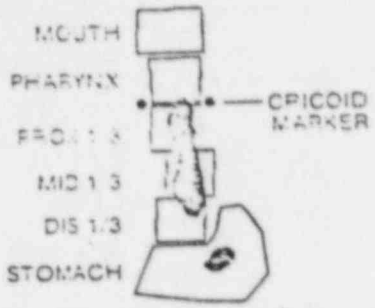

Figure 1. Single scintigraphic image taken from normal swallowing sequence demonstrating areas of interest.

mand with a single swallow. A further "dry" swallow ensued 30 s later. The study was then repeated with another identical radionuclide bolus. All subjects were studied in the fasting state (>4 h). When none of the bolus entered the stomach, the second study was performed in the erect position.

The swallowing sequences were recorded by the microprocessor at 0.4 s intervals for a total of 50 s and stored on a computer disc. This record could then be replayed, and the cricoid region and gastroesophageal junction could be identified. With a light pen, areas of interest representing the mouth, pharynx, and stomach were delineated. The microprocessor then divided the esophageal zone into three equal areas of interest (Figure 1).

Actual passage of the bolus through each area was plotted graphically using radioactivity (representing volume) on the vertical axis and time in seconds on the horizontal axis. These graphs are rapidly created by the microprocessor and provide descriptive and temporal information on bolus transit. In the dysphagia patients the temporal aspects of bolus transit were assessed by measuring the esophageal transit time, i.e., the time from initial entry of the bolus into the esophagus to total clearance from the esophagus. Normal controls were similarly assessed, but in addition the regional (i.e., proximal, middle, and distal) transit times were assessed. The manner in which bolus transit occurred was indicated by the graphic patterns obtained (see Results).

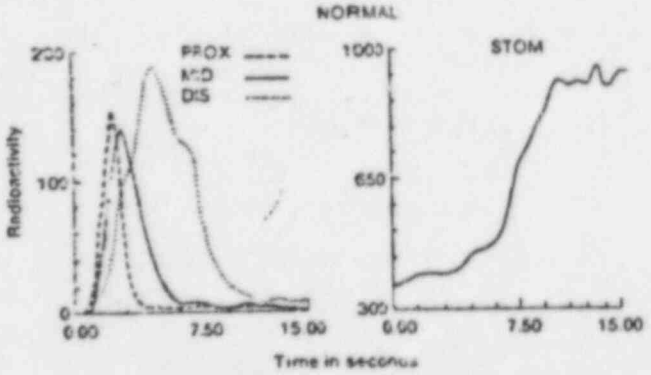

Figure 2. Radionuclide transit graph from normal volunteer. *Vertical axes* represent the radioactivity in each area and the *horizontal axes* the time in seconds. Note sequential peaks in proximal, middle, and distal esophagus indicating smooth passage of the bolus in an aboral direction with early complete entry into the stomach.

All studies were read by one of the authors (E. Holmes) with no prior knowledge of clinical data or results of other tests.

Manometry. On a separate occasion esophageal peristalsis was recorded by fused polyvinyl catheter assemblies (OD 1.2 mm, ID 0.8 mm) with side holes circumferentially placed 5 cm apart. Each catheter was perfused with water (0.5 ml/min) from a hydropneumatic infusion system (Arndorfer). Esophageal intraluminal pressure was transmitted from the catheter assembly to either Hewlett-Packard (HP) or Sanborn transducers and recorded on 6 channels of a HP or Sanborn recorder. Each system gave a rise time greater than 150 mmHg/s. All swallows were recorded using a belt pneumograph placed over the larynx. The peristaltic response to 5-10 wet swallows (10 ml of water) was assessed.

Criteria for manometric abnormalities were as follows: achalasia—elevated or normal lower esophageal sphincter pressure (LESP) with failure to develop complete relaxation and aperistalsis throughout the entire esophagus; diffuse esophageal spasm (DES)—normal LES function, periods of baseline pressure elevation within the esophageal lumen, and repetitive nonprogressive contractions interspersed among normal peristaltic contractions; and scleroderma—decreased LESP and nonprogressive reduced amplitude esophageal contraction waves. Nonspecific motor disorder (NSMD) was the term used to describe patients who exhibited an abnormality in 1 or more of the parameters of peristalsis, i.e., velocity, duration, and amplitude, but could not be classified according to the above definitions. Normal peristaltic ranges for wet swallows (10 ml) in our labs are: amplitude, 75 mmHg ± 40 (SD); duration, <7 s, velocity, 3 cm/s ± 1.5 (SD); and peristaltic sequences following at least 90% of swallows. All records were coded and read independently by two observers.

Barium esophagogram. A minimum of four barium swallows (15 → 25 ml) were observed fluoroscopically

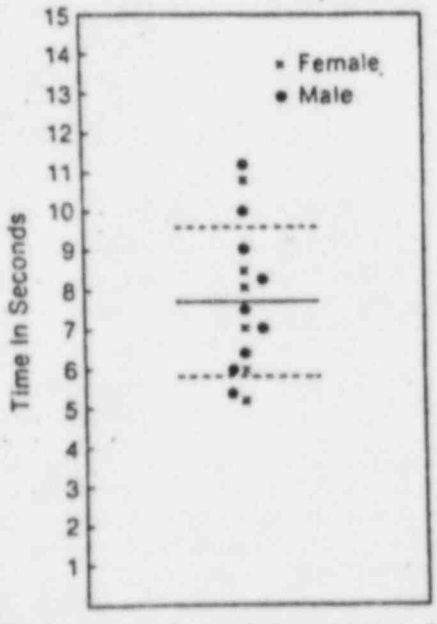

Figure 3. Total esophageal transit times in normal volunteers. These represent 15 swallows from 9 subjects. *Solid bar* is mean and *dotted line* is 1 SD.

in the supine position. If esophageal emptying did not occur, additional studies were made in the upright position. This was the basic technique of all radiologists involved.

These studies were approved by the Human Research Committee of the University of Washington on October 9, 1979, and were carried out with the informed consent of study subjects.

Results

Group I (Control Group) (n = 10)

A total of 17 radioactive swallows was recorded. Analysis of RT through the three esophageal areas revealed a graphic pattern characterized by three distinct sequential peaks of activity representing proximal, middle, and distal esophageal regions, respectively (Figure 2). This indicates smooth coordinated bolus transit in an aboral direction and will subsequently be termed a "normal" RT pattern. Esophageal transit time was <15 s in all cases.

The mean esophageal transit time for the 17 swallows was 7.7 s ± 1.7 (SD) (Figure 3). Mean transit times for the individual areas were: proximal, 2 s ± 0.8 (SD); middle, 4.4 s ± 1.7 (SD); and distal, 7.2 s ± 1.7 (SD) (Figure 4). Note the increasing times with distal progression. When the studies were repeated 2 mo later in 5 of the volunteers the "normal" patterns and transit times were virtually identical. Manometry was normal in all cases.

Group II (Dysphagia + Abnormal Manometry) (n = 15) (Table 1)

Five patients had a manometric diagnosis of achalasia. These patients demonstrated an "adynamic" RT pattern characterized by complete loss of the normal distinct sequential peaks of activity (Figure 5). The esophageal transit time exceeded the period of study in all cases (i.e., >50 s) with very little radioactivity reaching the stomach. When the study was repeated in the standing position, the bolus still failed to enter the stomach. The 2 patients with scleroderma and the 1 patient with diabetes had a similar "adynamic" RT pattern. Esophageal transit time was prolonged; however, a significant portion of the bolus entered the stomach in the first 30 s even in the supine position (Figure 6). Three patients with DES demonstrated another RT pattern—"incoordination" characterized by multiple peaks of activity (Figure 7) showing the disorganized bolus transit with periods of retrograde movement. Esophageal transit time was >50 s in all cases. This pattern of incoordination was also seen in the 4 patients with NSMD, and transit times were also >50 s in 3 of

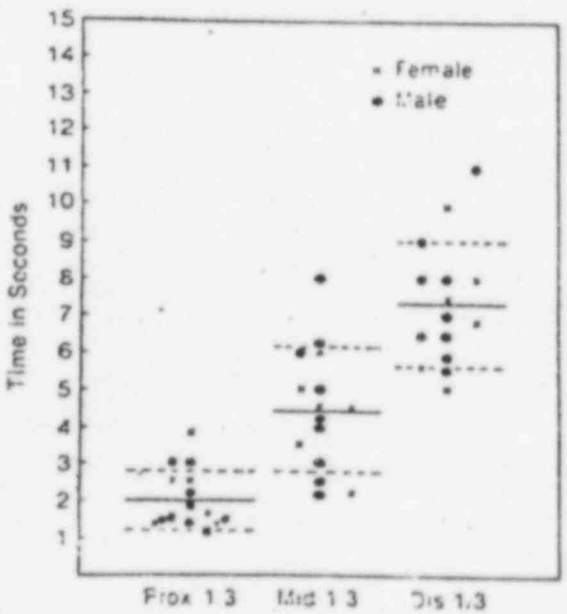

Figure 4. Transit times for the individual esophageal areas in 9 normal volunteers. *Solid bar* is mean and *dotted line* 1 SD.

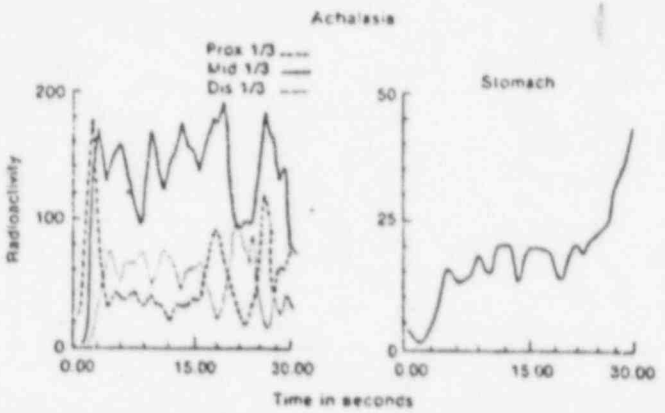

Figure 5. Radionuclide transit graph from patient with achalasia. The *vertical axes* and *horizontal axes* are radioactivity and time in seconds, respectively. Note nonprogression of bolus beyond the midsegment at 30 s. This is an adynamic pattern. Note relative lack of radioactivity entering stomach (cf. Figures 2, 6, and 7).

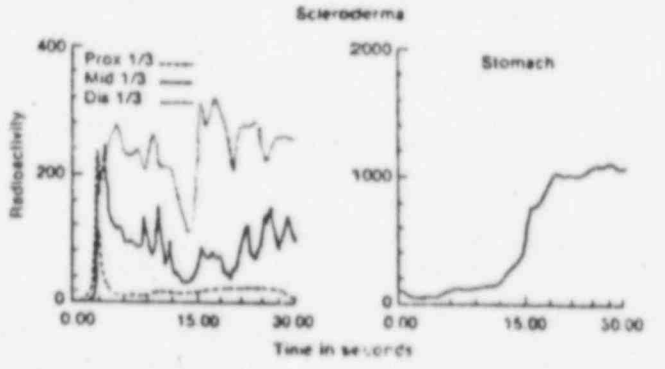

Figure 6. Radionuclide transit graph from patient with scleroderma (in supine position). The *vertical axes* and *horizontal axes* are radioactivity and time in seconds, respectively. Note loss of proper bolus progression at 30 s. Note entry of substantial portion of bolus to stomach in 30 s.

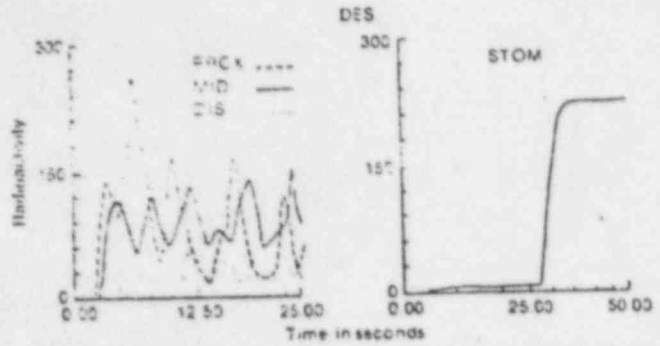

Figure 7. Radionuclide transit graph from patient with DES. Vertical axes and horizontal axes are radioactivity and time in seconds, respectively. Note multiple peaks of activity representing disorganized bolus transit. Some of the bolus however reached the stomach within the 30-s time period.

these patients. In these patients and the DES patients a significant portion of the bolus entered the stomach during the study period as can be seen from Table 1. Radionuclide transit studies detected abnormality and gave information on the transit abnormality involved (e.g., adynamic, incoordination) in all cases.

Group III (Dysphagia but Normal Manometry) (n = 14)

Radionuclide transit studies detected abnormality in 9 cases (64%). The abnormalities were incoordinated transit in all 9 cases. Gastroesophageal reflux (GER) was seen in 2 patients and was indicated by a drop in gastric radioactivity corresponding with a rise in counts in any of the esophageal areas of interest (Figure 8). One patient failed to ingest the bolus with a single swallow, and this was detected by a failure of radioactivity to drop rapidly in the mouth region (Figure 9) and a double "normal pattern."

Discussion

Passage of a bolus through the esophagus is influenced by several factors acting on that bolus during its transit. Factors promoting transit are the force developed during pharyngeal ejection (1), gravity, and the effect of peristalsis on the bolus. Retarding factors are luminal resistance and in pathological states failure of LES relaxation and intrinsic or extrinsic encroachment on the lumen by tumors, strictures, etc. In this study we use a fluid bolus and exclude patients with organic narrowing to minimize resistance. The effect of gravity is eliminated by use of the supine position. Initially the pharyngeal ejection force is the prime factor, but, as the bolus progresses distally, the peristaltic force becomes the major transport force. Thus, studying bolus transit through progressively caudad areas allows assessment of this important esophageal muscular function.

Radiology has traditionally been the method of choice for studying bolus transit. It is true that careful fluoroscopy of barium swallows by a skilled radiologist will detect a large percentage of abnormalities, but this is achieved at the expense of a not insignificant dose of radiation to the patient. In 1972 Kazem (2) introduced the use of radionuclides for studying bolus transit. Since then there have been a number of applications of this concept (3–5). The first definitive study of nuclear medicine techniques in esophageal motor disorders was performed by Tolin et al. (6). Tolin's study examined percentage clearance of an ingested standard volume (15 ml) radionuclide bolus from the esophagus. After the initial swallow to ingest the bolus, "dry" swallows occurred every 15 s for a total of 10 min. A temporal analysis of esophageal emptying was performed. This demonstrated normal individuals who emptied the esophagus in <15 s (i.e., with one swallow), whereas patients with scleroderma, achalasia, and DES required more time (i.e., more swallows). The emptying rate of patients with DES appeared significantly different from that of achalasia and scleroderma. However, separation of the last two was not possible on this basis. They also demonstrated abnormalities of emptying in patients with esophagitis and abnormal manometric tracings using this quan-

Table 1.

Manometric diagnosis	Radiologic diagnosis	Radionuclide transit: Motor function	Radionuclide transit: Total transit time (s)
DES	Not done	Incoordination	>50
DES	Normal	Incoordination	>50
DES	Diffuse spasm	Incoordination	>50
Achalasia	Achalasia	Adynamic	>50
Achalasia	Achalasia	Adynamic	>50
Achalasia	Achalasia	Adynamic	>50
Achalasia	Achalasia	Adynamic	>50
Achalasia	Achalasia	Adynamic	>50
Scleroderma	Aperistalsis	Adynamic	>50
Scleroderma	Normal	Adynamic	>25
Aperistalsis (diabetic)	Poor peristalsis	Adynamic	>25
NSMD	Normal	Incoordination	>25
NSMD	3° Waves	Incoordination	>15
NSMD	3° Waves	Incoordination	>50
NSMD	3° Waves	Incoordination	>50

NSMD = nonspecific motor disorder. Manometric, radiologic, a scintigraphic diagnosis in 15 patients with dysphagia and abnormal manometry (Group II).

titative test of esophageal emptying in response to deglutition.

Our modification of this method measures not only the esophageal retention time of Tolin et al., but also the actual dynamics of bolus progression. This assessment is achieved by analysis of radioactivity in these three individual areas—proximal, middle, and distal—of identical size at frequent time intervals (0.4 s). When radioactivity (equivalent to volume because of the homogeneity of the bolus) is plotted against time for each area the resulting graph describes bolus transit through each area. Combining these three graphs on the same axes describes the mode of transit through the esophagus in an objective manner. With the aid of a microprocessor—increasingly available in nuclear medicine departments—these graphs are rapidly developed. To prevent potential artefacts resulting from delayed entry of the bolus into the esophagus as a result of an incomplete initial swallow, we monitor radioactivity in the mouth and pharynx. Performing studies in the fasting state and monitoring radioactivity in the gastric area minimizes and detects artefacts due to GER.

We applied this technique to 15 patients with obvious motility disorders. Radionuclide transit abnormality was present in all cases. The mode of transit in patients with achalasia and scleroderma—adynamic—was similar; however, these two conditions could be separated on the basis of entry of a major portion of the bolus into the stomach in scleroderma patients during the 50-s study period either in the supine position or when the study was repeated in the erect position. Diffuse esophageal spasm patients had an RT pattern—incoordination—different from patients with nonspecific manometric abnormalities. All normal controls studied had a typical "normal" RT pattern with transit times <15 s. The mean age of

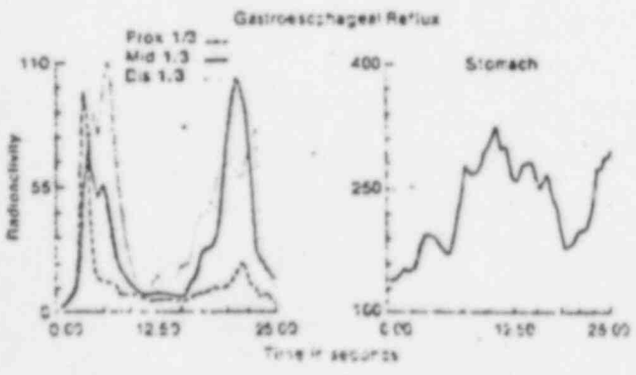

Figure 8. Radionuclide transit graph from patient with known GER. *Vertical axes* and *horizontal axes* are radioactivity and time in seconds, respectively. Note initial "normal" transit and then second activity peaks in esophagus coinciding with marked fall in gastric radioactivity.

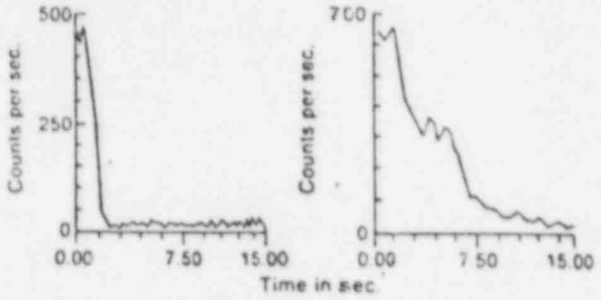

Figure 9. Graphs of radioactivity in the mouth area of a patient with dysphagia. The *graph on the left* indicates the bolus was ingested cleanly with a single swallow; that on the *right* shows two swallows, the first having cleared approximately half of the activity.

this group was not significantly different from that of groups I and III. We feel, as do Hollis and Castell, (7) that age per se is not an important factor in predicting peristaltic abnormality.

The most significant part of this study is the incidence (64%) of RT abnormality detected in group III—the normal manometry group. Why does this method detect these abnormalities? Esophageal manometry examines only some aspects of the cascade of events termed peristalisis. In particular, it does not measure the actual force acting in an aboral direction on a bolus. Studies performed earlier (8) suggest pressure waves recorded by manometry do not always correlate with the force applied in an aboral direction to a solid bolus at that level. It is of note we have seen no patients with abnormal manometry but normal RT.

We therefore present a technique capable of detecting esophageal motor disorders where conventional methods—manometry and radiology—fail. In addition to defining the presence of abnormality, RT studies also provide some description of the functional abnormality. This technique is safe, noninvasive, and simple to perform with the appropriate equipment (microprocessor). Due to the high velocities involved, this technique is unsuitable for studying cricopharyngeal disorders. In our institution RT is less expensive and less time-consuming than manometry.

Do we need another test of esophageal function? We suggest the investigation of dsyphagia still commence with radiology, particularly to exclude mechanical obstruction (and especially of malignant etiology). If no abnormality is detected, RT studies might next be used as a screening test for esophageal motor disorders and thus save some patients from the unpleasant experience of manometry. If RT is normal, our present experience suggests that manometry provides no useful additional information. If RT is abnormal, manometry might provide further information on and classification of

the abnormality present. It is hoped that this noninvasive objective test will allow a rapid inexpensive assessment of esophageal function.

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∴ Achalasia ⇒ Failure of GES to relax during swallowing

Scleroderma ⇒ Chronic hardening + shrinking of the connective tissue of Esophagus. Skin may be thickened, hardened, and rigid.

APERISTALSIS ⇒ lack of PERISTALTIC movement (Diabetic)

DES ⇒ Diffuse esophageal spasm

NSMD ⇒ NON SPECIFIC MOTOR ~~DISEASE~~ DISORDER.

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