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Otosclerosis
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Staff Meeting Report

Diagnosis of Gastric Malignancy by In Vivo Balloon Radioautography*

Norman B. Ackerman, M.D.; Arthur S. McFee, M.D.; and Owen H. Wangensteen, M.D., Ph.D.

Patients with localized forms of gastric cancer have demonstrated considerably higher rates of survival after surgical treatment than have patients with regional or distant spread of the cancer. At the Fourth National Cancer Conference in September, 1960, the End-Results Group reported on the combined survival figures of patients with malignant gastric lesions representing the experience of 99 hospitals. From the period 1950 to 1956 almost 50 per cent of patients with localized gastric cancer survived for five years, while the corresponding figure for those with regional spread to neighboring tissues and lymph nodes was only 12 per cent. Unfortunately, a comparison of figures showing stage of disease at time of diagnosis before 1950 and after 1950 does not indicate any recent increase in the number of patients with localized lesions at the time of diagnosis.

In an earlier report, the origins of the \( ^{32}P \) balloon technique of diagnosing gastric cancer were sketched. In this presentation we will describe our current practice and our experience with this method.

Since the early 1940's many studies have demonstrated the increased \( ^{32}P \) uptake of malignant tissue. Studies on various types of cancers in man and in experimental animals have shown increased \( ^{32}P \) uptake of 30 to 500 per cent. Shahon and co-

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*This report was presented at the Staff Meeting of the University of Minnesota Hospitals on May 12, 1961.
†Supported by grants from the American Cancer Society and the Atomic Energy Commission
‡Fellow under auspices of the National Cancer Institute
§Medical Fellow, Department of Surgery, University of Minnesota
¶Professor and Chairman, Department of Surgery, University of Minnesota
workers\textsuperscript{5,6} demonstrated the increased avidity for P\textsuperscript{32} of gastric cancers in studies on excised specimens. In \textit{vitro} radioautography on these specimens, as well as on excised colons and esophagi, was found to demonstrate graphically the distribution of P\textsuperscript{32} in benign and malignant tissue (Fig. 1). Foci of cancer were clearly revealed by this technique, and successful results were obtained with gastric lymphosarcomas as well as with adenocarcinomas. The success of this \textit{in vitro} technique in delineating even small areas of malignant tumor prompted us to develop an \textit{in vivo} radioautographic method for use in clinical detection of cancer.

Fig. 1. \textit{In vitro} radioautograph of the resected stomach of a patient with a gastric carcinoma.
In view of the experience with intragastric balloons for local gastric hypothermia, the possibility of using balloons coated with a photosensitive emulsion suggested itself. When our attempts to coat balloons with ordinary photographic emulsions proved unsuccessful, we approached the Eastman Kodak Company with this problem in the spring of 1959; as a result, Eastman Kodak developed a latex base emulsion which adheres closely to the thin-walled rubber balloon. We have used this preparation for detecting gastric cancer during the past 18 months.

**Method**

A dose of 500 microcuries of \(^{32}\)P in the form of sodium phosphate is injected intravenously into the patient 12 to 18 hours before starting the test. If there is any suspicion of even partial gastric outlet obstruction, the patient is placed on gastric suction during the night before the test. Early the next morning, the balloon, attached to a double lumen tube, is passed through the nose into the stomach. This procedure take place in a darkroom to prevent exposure of the film. The patient is returned to bed, and the balloon is inflated with air through the tube. Approximately 700 cc. of air are necessary to inflate the balloon to fullness without causing serious discomfort. The second lumen of the tube is connected to a suction source which helps evacuate collections of fluid. Continuous suction is maintained during the test. The patient is sedated (Seconal® 100 mg. intramuscularly) and given a small dose of Pro-Banthine® (7.5 mg. intramuscularly) to induce dryness. After two to four hours, depending on the speed of the individual film, the test is completed. The balloon is deflated, and the patient is returned to the darkroom for removal of the tube. The balloon is processed by being inverted with the emulsion surface outward on a large glass test tube. The glass tube and balloon are then immersed in the developing and fixing solutions. The presence of a darkened area on the emulsion is caused by contact of that section of the balloon with an area of increased \(^{32}\)P concentration. Thus the presence of a dark spot or area is considered highly suggestive of malignancy.

**Categories of Cases Studied**

Studies have been performed on a total of 346 patients during the past 18 months. The indices of accuracy related in the present experience do not yet have the significance we trust they will reflect presently after greater experience; our assessments are still undergoing changes as we develop the most
promising techniques. However, even our current experience suggests that the method has definite value in the detection of gastric cancer (Table 1).

TABLE 1
RESULTS OF GASTRIC IN VIVO RADIOAUTOGRAPHY
346 Patients

<table>
<thead>
<tr>
<th>Final Clinical Diagnosis</th>
<th>Gastric X-ray Diagnosis</th>
<th>Gastric Balloon Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gastric Adenocarcinoma</td>
<td>Ca 23</td>
<td>Ca 23</td>
</tr>
<tr>
<td></td>
<td>Possible Ca 3</td>
<td>Benign 6</td>
</tr>
<tr>
<td></td>
<td>Benign Ulcer 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal Stomach 1</td>
<td></td>
</tr>
<tr>
<td>Probable Gastric Ca 1</td>
<td>Ca 1</td>
<td>Benign 1</td>
</tr>
<tr>
<td>Gastric Leiomyosarcoma</td>
<td>Possible Ca 1</td>
<td>Benign 1</td>
</tr>
<tr>
<td>2. Benign Ulcer 58</td>
<td>Benign Ulcer 51</td>
<td>Benign 51</td>
</tr>
<tr>
<td></td>
<td>Ca 3</td>
<td>Ca 7</td>
</tr>
<tr>
<td></td>
<td>Possible Ca 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal Stomach 1</td>
<td></td>
</tr>
<tr>
<td>3. Achlorhydria 158</td>
<td>Normal Stomach 158</td>
<td>Benign—158</td>
</tr>
<tr>
<td>4. Pernicious Anemia 43</td>
<td>Normal Stomach 43</td>
<td>Benign—43</td>
</tr>
<tr>
<td>5. Hypertrophic Rugae 14</td>
<td>Hypertrophic Rugae 14</td>
<td>Benign 14</td>
</tr>
<tr>
<td>6. Gastric Polyps 12</td>
<td>Gastric Polyps 12</td>
<td>Benign 12</td>
</tr>
<tr>
<td>7. Gastritis 5</td>
<td>Gastritis 3</td>
<td>Benign—4</td>
</tr>
<tr>
<td></td>
<td>Normal Stomach 2</td>
<td>Ca 1</td>
</tr>
<tr>
<td>8. Postoperative Gastric</td>
<td>Postoperative Gastric</td>
<td>Benign 5</td>
</tr>
<tr>
<td>Deformity 5</td>
<td>Deformity 5</td>
<td></td>
</tr>
<tr>
<td>9. Leiomyoma 1</td>
<td>Leiomyoma 1</td>
<td>Benign—1</td>
</tr>
<tr>
<td>10. Normal Stomach 19</td>
<td>Normal Stomach 17</td>
<td>Benign 19</td>
</tr>
<tr>
<td></td>
<td>Ca 2</td>
<td></td>
</tr>
</tbody>
</table>

In this series 31 patients with cancer of the stomach were tested (Figs. 2 and 3). Some of these patients were studied by balloon radioautography before receiving definitive roentgenographic examinations. Also included in the series are patients who are part of a gastric cancer precursor group which has been followed for many years by this department. The series has included patients with benign ulcers (58), long term achlorhydria from 5 to 15 years (158), pernicious anemia (43), gastric polyps (12), hypertrophic rugations of the stomach (14), gastritis (5), postoperative gastric deformities (5), and leiomyoma (1). In addition, 19 patients with normal stomachs were also studied.
Fig. 2a. Mr. F. S., U.H. No. 821203. *In vivo* balloon radioautograph of stomach positive for cancer. Preoperative roentgenographic diagnosis was benign ulcer.

Fig. 2b. Mr. F.S., U.H. No. 821203. Resected specimen showing carcinoma on lesser curvature.
**THE MEDICAL BULLETIN**

**CORRELATION BETWEEN ROENTGENOGRAPHY AND RADIOAUTOGRAPHY**

**Gastric Cancer:**

Of the 29 cases of proved gastric carcinoma, 23 were correctly diagnosed by both roentgenography and balloon radioautography (Tables 1 and 2). Six patients with cancer had negative balloon tests. An analysis of these errors has been valuable in determining limitations of the technique (Table 3).

**TABLE 2**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Sex</th>
<th>Age</th>
<th>Final Clinical Diagnosis</th>
<th>Gastric X-ray Diagnosis</th>
<th>Gastric Balloon Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>F</td>
<td>50</td>
<td>Ca</td>
<td>Benign Ulcer</td>
<td>Ca</td>
</tr>
<tr>
<td>2.</td>
<td>M</td>
<td>81</td>
<td>Ca</td>
<td>Benign Ulcer</td>
<td>Ca</td>
</tr>
<tr>
<td>3.</td>
<td>M</td>
<td>74</td>
<td>Ca</td>
<td>Normal Stomach</td>
<td>Benign</td>
</tr>
<tr>
<td>4.</td>
<td>M</td>
<td>51</td>
<td>Ca</td>
<td>Possible Ca</td>
<td>Ca</td>
</tr>
<tr>
<td>5.</td>
<td>M</td>
<td>78</td>
<td>Ca</td>
<td>Possible Ca</td>
<td>Ca</td>
</tr>
<tr>
<td>6.</td>
<td>M</td>
<td>77</td>
<td>Ca</td>
<td>Possible Ca, ? Leiomyoma</td>
<td>Ca</td>
</tr>
<tr>
<td>7.</td>
<td>M</td>
<td>69</td>
<td>Ca</td>
<td>Ca</td>
<td>Benign</td>
</tr>
<tr>
<td>8.</td>
<td>M</td>
<td>53</td>
<td>Ca</td>
<td>Ca</td>
<td>Benign</td>
</tr>
<tr>
<td>9.</td>
<td>M</td>
<td>74</td>
<td>Ca</td>
<td>Ca</td>
<td>Benign</td>
</tr>
<tr>
<td>10.</td>
<td>F</td>
<td>50</td>
<td>Ca</td>
<td>Ca</td>
<td>Benign</td>
</tr>
<tr>
<td>11.</td>
<td>M</td>
<td>56</td>
<td>Ca</td>
<td>Ca</td>
<td>Benign</td>
</tr>
<tr>
<td>12.</td>
<td>M</td>
<td>59</td>
<td>Probable Ca</td>
<td>Ca</td>
<td>Benign</td>
</tr>
<tr>
<td>13.</td>
<td>M</td>
<td>73</td>
<td>Leiomyosarcoma</td>
<td>Possible Ca</td>
<td>Benign</td>
</tr>
<tr>
<td>14.</td>
<td>F</td>
<td>64</td>
<td>Benign Ulcer</td>
<td>Ca</td>
<td>Ca</td>
</tr>
<tr>
<td>15.</td>
<td>F</td>
<td>68</td>
<td>Benign Ulcer</td>
<td>Ca</td>
<td>Ca</td>
</tr>
<tr>
<td>16.</td>
<td>M</td>
<td>73</td>
<td>Benign Ulcer</td>
<td>Possible Ca</td>
<td>Ca</td>
</tr>
<tr>
<td>17.</td>
<td>M</td>
<td>54</td>
<td>Benign Ulcer</td>
<td>Ca</td>
<td>Benign</td>
</tr>
<tr>
<td>18.</td>
<td>M</td>
<td>78</td>
<td>Benign Ulcer</td>
<td>Possible Ca</td>
<td>Benign</td>
</tr>
<tr>
<td>19.</td>
<td>M</td>
<td>54</td>
<td>Benign Ulcer</td>
<td>Possible Ca</td>
<td>Benign</td>
</tr>
<tr>
<td>20.</td>
<td>M</td>
<td>49</td>
<td>Benign Ulcer</td>
<td>Benign Ulcer</td>
<td>Ca</td>
</tr>
<tr>
<td>21.</td>
<td>M</td>
<td>56</td>
<td>Benign Ulcer</td>
<td>Benign Ulcer</td>
<td>Ca</td>
</tr>
<tr>
<td>22.</td>
<td>M</td>
<td>38</td>
<td>Benign Ulcer</td>
<td>Benign Ulcer</td>
<td>Ca</td>
</tr>
<tr>
<td>23.</td>
<td>M</td>
<td>59</td>
<td>Benign Ulcer</td>
<td>Normal Stomach</td>
<td>Ca</td>
</tr>
<tr>
<td>24.</td>
<td>F</td>
<td>66</td>
<td>Atrophic Gastritis</td>
<td>Atrophic Gastritis</td>
<td>Ca</td>
</tr>
<tr>
<td>25.</td>
<td>M</td>
<td>63</td>
<td>Normal Stomach</td>
<td>Ca</td>
<td>Benign</td>
</tr>
<tr>
<td>26.</td>
<td>M</td>
<td>78</td>
<td>Normal Stomach</td>
<td>Ca</td>
<td>Benign</td>
</tr>
</tbody>
</table>

Two patients had large obstructing lesions with considerable narrowing of the gastric lumen in this area. The balloon probably did not make sufficient contact with the neoplastic tissue.
in this area to cause an exposure on the photosensitive emulsion. Several positive balloon tests did occur in gastric cancers which exhibited only slight degrees of obstruction. It would appear, however, that success in these patients depends on obtaining apposition of the balloon with at least a “shoulder” or edge of the malignant tissue itself. This type of lesion is usually diagnosed without difficulty by roentgenographic studies.

TABLE 3

<table>
<thead>
<tr>
<th>Patient</th>
<th>Sex</th>
<th>Age</th>
<th>Possible Reason for Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>M</td>
<td>74</td>
<td>Obstructing lesion</td>
</tr>
<tr>
<td>2.</td>
<td>M</td>
<td>76</td>
<td>Obstructing lesion</td>
</tr>
<tr>
<td>3.</td>
<td>F</td>
<td>60</td>
<td>No increased $^{32}P$ uptake</td>
</tr>
<tr>
<td>4.</td>
<td>M</td>
<td>69</td>
<td>Microscopic Ca in stalk of polyp</td>
</tr>
<tr>
<td>5.</td>
<td>M</td>
<td>53</td>
<td>?</td>
</tr>
<tr>
<td>6.</td>
<td>M</td>
<td>74</td>
<td>?</td>
</tr>
<tr>
<td>7.</td>
<td>M</td>
<td>59</td>
<td>? (Possible pancreatic Ca)</td>
</tr>
<tr>
<td>8.</td>
<td>M</td>
<td>73</td>
<td>Extramucosal leiomyosarcoma</td>
</tr>
</tbody>
</table>

A third false negative test occurred in a patient whose cancer showed no greater affinity for $^{32}P$ than did the surrounding normal gastric mucosa. An *in vitro* radioautograph performed on the resected specimen which demonstrated this finding was the first of approximately 70 radioautographs of excised gastric carcinomas that did not show an increased $^{32}P$ uptake. It is not anticipated that this cause of false negative balloon radioautography will be encountered often.

A fourth false negative balloon test was obtained for a patient whose roentgenographic studies showed “a large ulcerating polypoid carcinoma on the greater curvature.” A large nonulcerated pedunculated gastric polyp was resected at operation. Only after multiple microscopic sections were made was the diagnosis of cancer established. The cancer was microscopic and noninvasive.

The fifth and sixth false negative balloon radioautographs occurred in patients with cancers of moderate size, and the reasons for failure in these tests are not known. One of these lesions was also incorrectly diagnosed by roentgenography. Radioautography of the excised specimens showed increased $^{32}P$ concentration in the malignant tissue. We assume that contact between the balloon and the tumor was unsatisfactory, and we hope that with improved technique, errors of this type will be very infrequent.
One additional patient whose balloon test was negative, had, at operation a large cancer involving most of the pancreas as well as the antrum and duodenum. Frozen section of the tumor revealed adenocarcinoma, but the site of origin as between the antrum or the pancreas was not definitely established. The cancer, unfortunately, was, unresectable.

One patient with a large gastric leiomyosarcoma was found to have a negative balloon radioautograph. Roentgenographic studies were inconclusive. The excised tumor was observed to have greater growth outside the stomach than in the stomach interior, where it penetrated the mucosa in one area marked by a necrotic ulcer. Because of the limited penetration of $\text{P}^{32}$ beta particles, lesions not involving the mucosa are difficult to detect.

In three of the 29 patients with proven gastric carcinoma the diagnosis was missed entirely by roentgenographic studies. Two of these patients had ulcers which were considered benign by radiologic criteria. Balloon studies of both patients were positive, and ulcerating carcinomas were found at operation (Fig. 2). Roentgenographic studies failed to demonstrate any abnormality in a third patient, who had had a previous gastroenterostomy. Although the balloon radioautographic study also was negative, the patient was subjected to surgical exploration, and a polypoid carcinoma was found. Roentgenographic studies of three other patients suggested the presence of gastric abnormalities but did not indicate whether the lesions were benign or malignant. Positive balloon radioautographs in vivo were obtained on all three patients, and these diagnoses were substantiated upon surgical intervention (Fig. 3).

**Benign Gastric Ulcers**

Fifty-eight patients with benign gastric ulcers have been studied both by balloon radioautography and x-ray (Tables 1 and 2). Errors in diagnosis were made with both diagnostic techniques. In 48 of these patients the absence of malignant disease was correctly reported by in vivo radioautography and by roentgenography. Seven patients had false positive balloon radioautographs, three of these occurring among the first ten ulcer patients who were studied. Of the seven patients with false positive tests, five had tests of six hours in duration. For the past 10 months as a result of the availability of better and faster photosensitive emulsions, almost all of the studies have been two to four hours long. Among 28 patients with benign ulcers tested for from two to four hours, only two false positives were seen. We expect that with improved balloons and a better
processing technique, false positive results with benign ulcers will be uncommon.

Fig. 3a. Mr. H.I., U.H. No. 955456. *In vivo* balloon radioautograph of stomach positive for cancer. Preoperative roentgenographic diagnosis was inconclusive.

Fig. 3b. Resected specimen showing carcinoma in antrum.
Roentgenographic studies failed to demonstrate any gastric abnormality in one patient with benign ulcer. This patient had one of the false positive balloon tests noted above. At operation he was observed to have a healing benign pre-pyloric ulcer. The diagnosis of gastric cancer was made by x-ray in three other patients with benign ulcer; unfortunately, two of these patients also had false positive balloon tests. The third patient had a negative balloon study. All three patients had benign ulcers at operation. In three additional patients whose benign ulcerations were proved at the time of surgical exploration, roentgenographic studies had suggested the possibility of cancer; the balloon radioautograph of one of these patients had also been positive.

Other Conditions

The remaining patients in this series included those with other nonmalignant conditions as well as a small number of patients with normal stomachs (Table 1). In general, in vivo radioautography and roentgenographic studies were in agreement as to the absence of malignant lesions in almost all these patients. In 158 patients with long term achlorhydria, balloon radioautography yielded negative results. Forty-three patients with pernicious anemia of long standing had negative tests, as did 14 patients with hypertrophic gastric rugations, 12 with gastric polyps, 5 with postoperative gastric deformities, and 1 patient with a large leiomyoma. Of five patients believed to have had gastritis on the basis of either roentgenographic or endoscopic studies, one showed a positive balloon radioautograph; at surgical exploration no gross carcinoma was observed, but a severely atrophic gastritis was noted.

Negative balloon radioautographs were obtained on 19 patients with normal stomachs. Most of these patients had symptoms referred to the upper abdomen caused by nongastric conditions, including pancreatic carcinoma, benign biliary tract disease, and so on. Several patients had no demonstrable abdominal abnormality. Two of these patients observed at operation to have normal stomachs had preoperative roentgenographic diagnoses of gastric cancer. One of these patients at laparotomy was found to have a huge liver largely replaced by cancer; the stomach was entirely normal, and the primary site of malignant tumor was believed to be the pancreas. The second patient was observed at surgical intervention to have a chronic abscess in the omentum resulting from an old gallbladder perforation which deformed the stomach extrinsically. Both these patients had negative balloon radioautographs.
Considerable experience has been gained in the past 18 months with the technique of *in vivo* balloon radioautography. During this developmental stage of the test, results have been encouraging in spite of the introduction of variations in the procedure. The coating of the balloons themselves has varied in speed and in thickness, and only recently has an estimate of the speed of the film been available. Several logical modifications of the technique have been employed successfully, and additional modifications are under study.

One of the most trying problems at one period was the presence of artifactual markings on the developed balloons. Most of these were easily distinguished from true exposures because of their unique form (symmetry, linearity, a "wrinkled" appearance, etc.). This problem was solved in part by improving the quality of the balloons themselves. Since the original processing method itself appeared to be a prime cause of these artifacts, the new method described above has recently been introduced. The last 68 balloons, all of which were processed by the new method, have failed to show the presence of artifacts. It is felt in retrospect that several of the results reported as false positives probably represented artifacts rather than true exposures.

Several other modifications have been made part of the routine procedure. These include use of the intravenous route of administration of $^{32}$P, a shortened exposure time of the balloon in the patient, and the use of a double lumen tube. This tube, a modified Miller-Abbott tube, permits continuous suction of the contents of the stomach and esophagus, as well as inflation of the balloon with air. The use of this tube has substantially increased the comfort of the patient. Experimental studies are presently being conducted to determine the ideal interval between $^{32}$P administration and onset of testing, that is, the time when uptake of $^{32}$P by malignant tissue is highest and differentiation between cancer and normal or inflammatory tissue is greatest. In addition, studies are in progress using several types of balloons preshaped in the form of the stomach.

In view of the results of this test during the past 18 months, we believe that continued work with this technique is warranted. The possibility that *in vivo* balloon radioautography will be successful in the earlier diagnosis of occult gastric cancer is a real one; further experience is needed to confirm or disprove its value. In addition, the test will probably be helpful in implementing roentgenographic studies in presence of gastric ulceration, and in patients for whom roentgenographic studies are inconclusive.
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MULTIPLE ORGAN SCREENING

The application of an in vivo radioautographic technique in diagnosing gastric cancer has stimulated interest in the use of radioautography for the diagnosis of other cancers, especially in organs in which the incidence of malignant disease is high. Each of these organs presents individual problems to be solved before in vivo radioautography can be used successfully.

Fig. 4. Mrs. U.H. No. breast radioautographs showing positive test on right and negative test on left. An infiltrating duct carcinoma of the right breast was removed at operation.

Some progress has been made in the area of breast cancer. For diagnosing cancer of the breast the Eastman Kodak Company has developed a plastic shield coated with a photosensitive emulsion. Although various types of plastics and emulsions have been tried, an entirely satisfactory preparation is not yet available. Initial studies with the materials at hand, however, have been quite successful on a small, preliminary series of patients. Thus far, 28 successful breast studies have been performed. Five patients in this group have had positive test results; in four of them the diagnosis of breast cancer was confirmed at surgical exploration (Fig. 4). The fifth patient had had an excisional biopsy of a breast cancer several days before the in vivo radioautograph was made. When the rest of the breast was removed
subsequently, no residual cancer was found. The false positive result was probably due to the healing incision from the initial biopsy. Twenty-three other radioautographic studies on the breast were negative. All these patients were thought to have benign conditions.

For detection of cancer of the uterine cervix, a soft, plastic, cuplike form has been developed by Dr. Edgar Makowski, Instructor in Obstetrics and Gynecology, with the help of Mr. George Harrison of the Minnesota Mining and Manufacturing Company. These molds of varying sizes produced by the Minnesota Mining and Manufacturing Company will subsequently be coated by the Eastman Kodak Company. In a joint study with Dr. Makowski, discussed during the past ten months, we propose to position such cups against the cervix for the localization of cervical cancers as well as in the search for cancers in situ.

For detecting cancers of the rectum and colon a long, narrow, thin-walled balloon coated with the photosensitive emulsion has been prepared. We are now in the process of screening reaches of the colon that are proximal to the reach of the sigmoidoscope. We plan to insert these balloons into the rectum through the proctoscope, in the hope that we may propel them as far forward as the splenic flexure of the colon. We have experimented too with passing a deflated long sausage-like balloon into the colon from above. The difficulty of ascertaining the exact position of the tube must, of course, be resolved.

At present, the techniques of diagnosing cancer in the cervix, breast, and colon are in the exploratory stage. Thus we do not feel justified in endorsing them until we have had adequate experience with them. We hope it will not be long before simultaneous screening of several organs by in vivo radioautography can be used in detecting both asymptomatic and symptomatic malignant lesions.

In vivo balloon radioautography of the stomach, on the contrary, we believe from this experience, is a procedure which merits study in the hands of other groups. Only when other interested members of the profession have had the opportunity to assess its worth will it be possible to evaluate the usefulness of in vivo radioautography employing $^{32}$P in the detection of gastric cancer. We shall continue to explore the promise of the method in the detection of early, asymptomatic lesions.

**Summary**

An in vivo radioautographic method for the detection of gastric cancer has been developed which utilizes the selective
uptake of radioactive phosphorus (P^32) by malignant tissues. Studies on 346 patients (with and without symptoms) have been described. Various improvements in the technique have been made over the past 18 months, and more are anticipated.

*In vivo* radioautography is currently being adapted for use in cancer of the breast, uterine cervix, and colon. When further developed, multiple simultaneous organ screening could have real importance for the early detection of some cancers.

**Acknowledgments:** We would like to acknowledge with gratitude the technical assistance of Mr. Alvin Shemesh and Mrs. Jean Kreykes at the University of Minnesota College of Medical Sciences. We are beholden too to many individuals, including professional people and officers of the Eastman Kodak Company, the National Hygienic Products Company, the Minnesota Mining and Manufacturing Company, and the Perry Rubber Company. We are collaborating with Dr. Edward Makowski, Instructor in the Department of Obstetrics and Gynecology, on the problem of detecting uterine cervical cancer. The cooperation of Dr. VictorGilbertsen, Director of the Cancer Detection Center, also is gratefully appreciated.

Gastric balloons have been generously supplied by the National Hygienic Products Company, Akron, Ohio. The balloons have been coated with photosensitive emulsion by the Eastman Kodak Company, which has made the preparations available as Kodak Autoradiographic Elastic Base Film, Type I.

**References**

Research Studies Related to the Surgical Treatment of Clinical Otosclerosis*

L. R. Boies, M.D.,† Albert Hohmann, M.D.,‡ and Melvin Sigel, M.D.§

The April 15, 1958, issue of the University of Minnesota Medical Bulletin contained a staff meeting report of surgical therapy of conductive hearing loss under the title "Microsurgery in Otology." This report commented on experience at this hospital with: 1) 404 fenestration operations performed for clinical otosclerosis in the University Hospitals in a 12½-year period, prior to January 1, 1958; and 2) 300 stapes mobilization operations performed for clinical otosclerosis in the University Hospitals in a two-year period prior to February 13, 1958.

This report indicated that during a 20-year period the fenestration technique had probably reached the peak of its perfection, and that as of 1958 an ideal candidate for this operation was generally regarded as having at least a 90 per cent chance of a successful result, i.e., restoration of hearing to a level that is: 1) practical for ordinary social and economic contacts and 2) permanent until impairment occurs due to aging or to the further effect of otosclerosis on the labyrinth.

The revival of a direct attack on the stapes via the external auditory canal, however, was believed by some otologists to be the surgical procedure of choice.

The advantages of the stapes mobilization operation were described as:

*This report was presented at the Staff Meeting of the University of Minnesota Hospitals on May 5, 1961.
†Professor and Head, Department of Otolaryngology
‡Clinical Instructor in Otolaryngology
§Medical Fellow in Otolaryngology
The Medical Bulletin

1) The possibility of higher hearing levels and more natural hearing than can be obtained through fenestration surgery.

2) Very limited morbidity associated with a maximum of two days of hospitalization and a return to normal activity thereafter;

3) No postoperative care beyond the removal of a small amount of packing.

Our experience indicated that in approximately one-third of the patients treated surgically, the stapes could be successfully mobilized by pressure techniques; moreover in a direct attack on the footplate with the use of picks and chisels, mobility was obtained in approximately 50 per cent of patients. (Others had reported a considerably higher percentage of successes.)

Failure to mobilize the stapes successfully invariably results from too solid a fixation of the footplate due to the extent of otosclerotic bone. Alternative techniques suggested were: 1) fenestration of the footplate with a drill and covering of the opening thus made with a vein graft, after which a plastic "stapes" is attached to the lenticular process of the incus (Shea); 2) the use of tantalum wire for a columella effect, attached to the incus and inserted through a comminuted portion of the stapes footplate (Schuknecht); 3) simple "fenestration" of the footplate with a sharp perforator as advocated by Rosen, although his findings had not been corroborated.

Stapedectomy and Artificial Prosthesis

The limited success with stapes mobilization techniques in 573 cases, and the eventual regression of hearing to its preoperative level in these patients led us to attempt stapedectomy with the insertion of an artificial prosthesis in contact with or attached to a graft placed over the oval window. Our current practice is to attempt mobilization and then to perform a stapedectomy in all cases in which the stapes does not appear adequately mobilized and in which there is a reasonable chance of lasting mobility.

Hazards of this Procedure

The greatest hazard in this form of surgical intervention is the possibility of hearing loss. If the stapes can be extricated easily, the oval window promptly covered with a suitable membrane, a prosthesis easily attached to the end of the incus, and contact made with the new covering of the oval window, the possible hazards are minimized. But it commonly happens that while the superstructure of the stapes (head and crura) may be removed more or less intact, the footplate is shattered.
and must be removed piecemeal. Prior to this an attempt is made to remove the membrane overlying the footplate and the margins of the fossa ovalis. This membrane may be hyperplastic and exceedingly vascular. If the fossa ovalis has been narrowed by otosclerotic bone, the approach may have to be enlarged by drilling away some bone. If the footplate is thickened as a result of otosclerotic involvement, this may require reduction with a drill. Conclusive information on the potential hazard of this form of trauma is not yet available, but some evidence suggests that it may contribute to impairment of hearing of high tones.

When the footplate has to be removed piecemeal by "fishing out" fragments, trauma may occur through fracturing of marginal bone or loss of fragments into the vestibule. In some cases we have observed bleeding into the vestibule in varying amounts. Another potential hazard is the accidental aspiration of perilymph. In addition, if much instrumentation is carried out, the saccule or utricle may be injured.

A variety of oval window grafts have been tried clinically. We have used vein, mucous membrane, connective tissue, fat, and a simple covering of gelfoam; these have all been effective in replacing the footplate and acting as a barrier under which a layer of mobile mucoendosteal membrane rapidly forms.

Polyethylene tubing, and tantalum or stainless steel wire provide the contact to transmit the sound pressure stimulus from the incus to this new mobile membrane, which is a substitute for the stapedial footplate.

Animal Research

The cat is well suited anatomically to ear research; Figure 1 depicts the anatomy of the cat middle ear and the approaches used.

Behavioral conditioning of the cat so that the hearing can be tested can be performed with special equipment shown in Figure 2. This conditioning is accomplished by presenting a loud tone for two or three seconds followed immediately by an electrical shock, forcing the animal to move forward in the rotating cage. The cross-bars of this cage serve as electrodes through which the shock is administered. The training requires a number of practice sessions 30 to 60 minutes in length. After three to four hours of such conditioning, most cats have learned to move forward upon the presentation of the tone. Pre- and postoperative auditory thresholds can then be determined according to the design of the experiment.
Fig. 1
Anatomical relationships of the middle ear structures of the cat to the oval window area, and to the two stapedectomy approaches that are possible without damage to drum or facial nerve. In the oval window graft experiments, the atticotomy approach is used, while in the cats subject to behavioral conditioning, the mastoid approach with preservation of the ossicular chain is utilized.

Experimentally induced lesions of the inner ear are studied histologically after special preparation of the temporal bones followed by serial sectioning and microscopic examination. Graphic reconstruction of the cochlea and spiral ganglion is made by the method of Guild\(^2\) (Fig. 3).

The reaction of the labyrinth to bleeding into the perilymph of the vestibule, to certain grafts used to cover the oval window, and to trauma related to the removal of the footplate has been studied by one of us (A.H.) working in the Otological Research Laboratory of the Henry Ford Hospital in Detroit.\(^3\) These studies are now being continued here in a new laboratory at St. Joseph's Hospital in St. Paul.
The Effect of Hemorrhage into the Vestibule

A controlled experiment was performed in a series of 11 cats to determine the effect of injecting blood into the vestibule. After the perilymphatic pressure had been reduced by the removal of cerebrospinal fluid from the cisterna magna, stapedectomy was performed first on one side and then on the other, with blood injected into the vestibule on one side and cerebrospinal fluid on the other, followed by identical oval window plugs of either gelfoam or fat. The position of the fat graft or gelfoam plug was maintained by a polyethylene strut.

The animals were killed after postoperative survival times ranging from 11 days to 5 months. All temporal bones were sectioned serially. The animals that were killed 11 days after surgical intervention showed a conglomeration of erythrocytes in both the scala vestibuli and tympani of the upper middle and upper apical turn.

Two animals surviving two and one-half and three months, respectively, showed only small clusters of erythrocytes distrib-
uated throughout the perilymphatic space, and phagocytes adjacent to the erythrocytes displaying intracellular hemosiderin pigment deposits (Fig. 4).

Fig. 3
Graphic reconstruction of the cochlea and spiral ganglion of a cat killed three months after a complicated stapedectomy with blood instillation into the vestibule. A large dot represents a normal hair cell and a small dot an abnormal hair cell. The numbers along the right side of the diagram show the consecutive numbers of the slides containing the organ of Corti. The numbers along the spiral represent the length of the organ of Corti starting at the basal end. The letters A,B,C,D,E,F, designate the six points plotted first and then connected by semicircles. Each semicircle represents a half turn of the cochlea.

Note the almost complete absence of hair cells in the first 7 mm. of the organ of Corti, abnormal appearance of hair cells in the following 11 mm. and prevalence of normal ones in the upper middle and apical turn.

The black filling in the channel representing the spiral ganglion indicates the estimated percentage of missing spiral ganglion cells of the same cochlea.

The inner ears of the remaining eight animals sacrificed three, four, and five and one-half months after the blood instillation contained no red blood corpuscles in the peri- and endolymphatic spaces. Occasional phagocytes with hemosiderin
were observed in these ears. No permanent significant changes were detected in the inner ear as a result of the blood injection, except for mild hydrops of the labyrinth.

![Fig. 4](image)

High power view of scala media of upper turn of a cat killed two and one-half months after blood instillation into the vestibule. Small clusters of erythrocytes are still present in the perilymphatic spaces. Lysis and phagocytosis takes place. Mild hydrops of scala media present, external and internal hair cells appear normal.

These findings concur with previous findings of Schuknecht, who showed in an experiment on cochlear injuries from head blows that intralabyrinthine hemorrhages did not cause either degenerative changes or fibrosis in the inner ear.

Thus, no serious damage appears to arise from the presence of normal blood in the cochlea. The increased phagocytic activity stimulated by the oval window operation might be responsible for faster absorption of blood than occurs following labyrinthine concussion.

**Reaction to Oval Window Grafts**

Several investigators have recently reported the results of animal experiments establishing the reaction of the oval window to a variety of materials used for grafts. Each of these materi-
A. The thin mucoendosteal oval window membrane formed in a cat after a compressed alloplastic gelfoam cover had been placed over the window four months earlier.

B. In an identical procedure a No. 50 polyethylene strut 3 mm. long was placed on top of the gelfoam. Four months later, there was protrusion of the strut and gelfoam flakes into the vestibule, causing a serous labyrinthitis.
als has seemed effective in providing a cover under which a layer of mucocartilaginous membrane rapidly forms.

Figure 5 shows an experiment by A. H. on the oval window of a cat using a) gelfoam alone, and b) gelfoam in contact with a polyethylene strut.

Figure 6 shows a similar experiment using a fat graft.

![Image](image.png)

**Fig. 6**

Oval window area and vestibule of animal killed five months after stapedectomy followed by introduction of a fat graft and polyethylene tube (identical to the one in 5B). Note the well-preserved fat graft, the endosteal membrane covering the vestibular surface of the graft, and the normal vestibule.

**Reaction of the Cochlea to Grafts and to the Trauma of Stapedectomy**

As clinical experience with the operation of stapedectomy has accumulated, delayed cochlear degeneration has been observed in a small percentage of cases.\(^3,4\) As this problem continues to be investigated, the two most commonly noted abnormalities appear to be mild hydrops of the cochlear duct and hypotonic atrophy of the organ of Corti\(^6\) (see Fig. 7).
Fig. 7

A. High power view of the scala media of a cat killed four months after stapedectomy during which some blood was instilled. Mild hydrops is evident in an out-bulging of Reissner's membrane and unfolding of the tectorial membrane.

B. A similar view in which hypotonic atrophy occurred after the instillation of spinal fluid into the vestibule.

These are the two most common consequences of such treatment in the cat.
Clinical Experience with Stapedectomy and: (1) A Polyethylene Strut over Gelfoam and (2) A Stainless Steel Prosthesis Attached to A Fat Graft

In a 17-month period prior to February 21, 1961, stapes surgery performed by one of us (L.R.B.) has been characterized by:

1. An initial attempt to mobilize the stapes satisfactorily. In all instances in which lasting mobility has seemed uncertain, a stapedectomy has been performed.

2. Avoidance of the trauma that can be induced by retrieving pieces of fractured footplate difficult to "fish" out, or a markedly depressed position of the footplate. The use of a drill to "saucerize" an approach to the footplate or on the footplate itself has been avoided whenever possible; the drill has been employed only when the growth of otosclerotic bone has markedly narrowed the approach to the footplate, or when the footplate has been thickened and removal could not be accomplished by ordinary means.

In this period the following number of stapes operations have been performed:

- Stapes mobilization ........................................... 19
- Stapedectomy and polyethylene-gelfoam prosthesis ........................................... 128
- Stapedectomy and stainless steel pin-fat graft prosthesis ........................................... 64

Ideal follow-up hearing evaluation consists of air, bone, and speech audiometry. To date, we have been able to perform this type of evaluation on less than half these patients because most of them live in distant communities in which the apparatus for carrying out these studies is not readily available. In such cases, our evaluation at this time is based on the referring physician's report or a statement from the patient as to his or her subjective evaluation of rehabilitation. This type of analysis follows.

The Polyethylene Strut over Gelfoam

A cover of compressed gelfoam over the oval window would seem to be a rather flimsy contact for a projecting polyethylene strut, and reports have been made of hearing loss apparently following protrusion of the strut into the vestibule. This occurred in one of our patients who, although temporarily improved, experienced while exercising two months after the operation a sudden attack of vertigo followed by complete hearing loss in
the treated ear. At a subsequent exploration, the polyethylene tube was found to have penetrated the vestibule.

An adequate attachment of the polyethylene strut (Fig. 8) to the end of the incus may be difficult to obtain because of variations in the contours of this end.

In seven of the 128 cases, (including the one just described) a sudden or gradually developing intermittent loss of the hearing that had been gained, led to the suspicion that adequate contact of the strut with the incus was lost. When these patients were subjected to exploration, the suspicion was confirmed. In all except the patient with the complete hearing loss mentioned previously, a semitransparent mobile membrane was found closing the oval window. After removal of the polyethylene, a pin prosthesis over a fat graft was placed. To date, three of the six patients have had a satisfactory gain in hearing.

Another five of the 128 patients had no change in hearing, making a total of twelve patients known to have been unimproved. Our followup on the other 118 cases (approximately 90 per cent) indicates a substantial and satisfying hearing gain.

Stainless Steel Wire Attached to Fat Graft

Stainless steel wire (No. 36 gauge) is tied to a suitable fat graft that will cover the oval window and then is looped at the other end to be hooked over the incus and crimped at the proper position. The steel wire seems preferable because it is
stiffer and less brittle than tantalum. Fat, which is easily obtained from the lobe of the ear and has a uniform consistency, seems to be the tissue of choice.

One of the 64 patients in which this form of prosthesis was used experienced a postoperative hearing loss without any accompanying vertigo or other morbidity. She was 64 years of age, had undergone a previous stapes mobilization elsewhere and had a large sensorineural component to her preoperative hearing loss. In 60 patients a substantial hearing improvement has at least been temporarily achieved. Follow-up reports on the three remaining patients have not been obtained to date.

**Summary**

At present successful surgical treatment of most cases of clinical otosclerosis requires stapedectomy followed by the insertion of an oval window cover or graft in contact with an artificial prosthesis connected to the incus.

Short-term results to date indicate that this surgical treatment can provide a very substantial improvement in hearing to eliminate the conductive component of the hearing loss.

Animal experiments on cats have provided information on the labyrinthine reaction to oval window grafts, the effect of the trauma occurring in a stapedectomy, the presence of blood in the labyrinth, and the possibilities of cochlear degeneration. These studies are continuing.

**References**

FIRST GIFTS TO MEDICAL STUDENT CENTER PROJECT RECEIVED

The first gifts to the newly-announced Medical Student Center Project have been received by the Minnesota Medical Alumni Association, sponsoring body. Several contributions of $100.00 from individual alumni have helped lift the $70,000 campaign off the ground, said Dr. V. J. P. Lundquist, (Med. '42), general chairman. He also announced the 16 members of the Board of Directors of M.M.A.A. have pledged $100.00 each to help build the study, rest, lunching, and on-call station for the Medical School's 500-member student body.

The first group contribution came from the Nu Sigma Nu Medical Fraternity, Epsilon Chapter, Minneapolis, which gave a $250.00 gift from its Stewart Graves fund. G. Nicholas Rognine, chapter president, said the fraternity was "happy to en-
Dr. Lundquist said the early stages of the campaign have been devoted largely to organization. He announced the appointment of the following regional members of the Campaign Committee:

Dr. Paul C. Leck, Austin; Dr. Carl E. Christensen, Clinton; Dr. Rudolph B. Skogerboe, Karlstad; Dr. Charles G. Sheppard, Hutchinson; Dr. Henry A. Korda, Pelican Rapids; and Dr. Ben P. Owens, Hibbing.

The wives' auxiliary of the Minnesota Chapter, Student American Medical Association, has offered support and assisted with the Medical Student Center Project booth exhibited at the Minnesota State Medical Association meeting May 22-24 in St. Paul. S.A.M.A. wives are also cooperating in preparing a series of campaign appeals to be mailed soon from project headquarters in the Northwestern National Bank Building, Minneapolis. Office space for the entire 18-month campaign was donated by the Bank.

Architectural plans for the Medical Student Center are nearing completion. The facility, consisting of 3,500 square feet of floor space, will be located on the first floor of the Mayo Memorial Building, at the Medical School. Doors are expected to open in September, 1962, or earlier, based on results of the fund drive.

Gifts to the Medical Student Center Project are tax-deductible, Dr. Lundquist said. He urged medical alumni everywhere to join with the 1,700 members of the Minnesota Medical Alumni Association in contributing funds. He expressed hope that the entire project can be financed by gifts from medical alumni of the University of Minnesota, but said other donations will be welcome.

(Donor may use the pledge form on the following page to make gifts. Fill out, detach, and return with your check).
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Minneapolis 2, Minn.

The Medical Student Center Project is a special account of the Minnesota Medical Alumni Association, Inc. Gifts to the project are designated wholly to use by the University of Minnesota and are deductible for tax purposes.
Three prominent members of the Medical School faculty have accepted positions as heads of departments in other Universities and will leave Minnesota before the 1961-62 academic year commences.

They are Dr. E. B. Brown, Professor of Physiology; Dr. Herman C. Lichstein, Professor of Bacteriology; and Dr. Alan P. Thal, Associate Professor of Surgery.

Dr. Brown leaves Minnesota after 15 years to become Head of the Department of Physiology at the University of Kansas Medical School, in Kansas City, Kansas, under the deanship of Dr. Arden Miller, a 1943 graduate of the University of Minnesota Medical School. Dr. Brown has been prominent in the Korean medical teaching exchange program, and for the past two years has been membership chairman for the Minnesota Medical Foundation. He came to Minnesota in 1946 as a teaching assistant and rose to full professor in 1955.

Dr. Lichstein will leave on August 15th to assume the position of Professor and Head of the Department of Microbiology at the University of Cincinnati School of Medicine. He has been on the Minnesota staff since 1950, and has been active on many departmental, medical school and university committees. Since Feb. 1, 1961, he has been in charge of academic affairs in the Department of Bacteriology.

Dr. Thal, a native of South Africa and graduate of Cornell University Medical School, will leave in July to become Professor and Head of the Department of Surgery at Wayne State University Medical School in Detroit, Mich. The 35-year-old surgeon has been at Minnesota for nine years. In his new position he will also serve as surgeon-in-chief at Detroit Receiving hospital.
1961 INTERNSHIP ASSIGNMENTS ANNOUNCED

Internship assignments for the 114 members of the 1961 graduating class, University of Minnesota Medical School, were announced this month.

Forty-seven graduates accepted intern positions in seven different Minnesota hospitals. Twenty-nine others went to hospitals in California, which was the second most popular state for internship training. One graduate—Neva M. Wieseke—took an internship overseas and will spend the next twelve months at Gorgas Hospital in the Panama Canal Zone.

Eighteen members of the graduating class will intern at Ancker Hospital, St. Paul, and eleven will be at Minneapolis General Hospital.

The 1961 graduates and their appointments:

| Anderson, John T. | Ancker Hospital, St. Paul, Minnesota |
| Anderson, David W. | Ancker Hospital, St. Paul, Minnesota |
| Avian, David B. | St. Elizabeth's Hospital, Washington, D.C. |
| Bandt, Calvin M. | Minneapolis General Hospital, Minneapolis, Minnesota |
| Barnett, Michael B. | Harbor General Hospital, Torrance, California |
| Bart, Bruce J. | General Hospital of Riverside, Arlington, California |
| Bealke, Neil M. | Ancker Hospital, St. Paul, Minnesota |
| Belden, Allan D., Jr. | Strong Memorial Hospital, Rochester, New York |
| Berland, Robert H. | Long Island Jewish Hospital, New York, New York |
| Birkebak, Roland C. | Bethesda Hospital, St. Paul, Minnesota |
| Birksmeyer, Eugene J. | Minneapolis General Hospital, Minneapolis, Minnesota |
| Birkey, Thomas G. | Minneapolis General Hospital, Minneapolis, Minnesota |
| Bruhl, Martin G. | King County Hospital, Seattle, Washington |
| Bundt, Robert E. | Ancker Hospital, St. Paul, Minnesota |
| Bursan, David W. | Win. Beaumont General Hospital, El Paso, Texas |
| Carlyle, Richard R. | Ancker Hospital, St. Paul, Minnesota |
| Carlson, Clifford A. | Win. Beaumont General Hospital, El Paso, Texas |
| Cich, John A. | Ancker Hospital, St. Paul, Minnesota |
| Conrad, William C. | King County Hospital, Seattle, Washington |
| Cich, Donald C. | Minneapolis General Hospital, Minneapolis, Minnesota |
| Cumming, Robert J. | Ancker Hospital, St. Paul, Minnesota |
| Cunningham, Walter D. | St. Luke's Methodist Hospital, Cedar Rapids, Iowa |
| Diehl, James J. | Charles T. Miller Hospital, St. Paul, Minnesota |
| Dilhord, Herman V. | Ancker Hospital, St. Paul, Minnesota |
AOA OFFICERS, INITIATES CHOSEN

The Minnesota chapter of Alpha Omega Alpha, national honor medical fraternity, has elected Charles W. Drage, a medical school junior, as its president for the 1961-62 year. He succeeds Patrick J. Scanlan, a member of the 1961 graduating class.

Other new officers elected for the coming year include G. Nicholas Rogentine, vice president; Leon W. Hoyer, secretary, and Margaret Grunnet, treasurer. AOA members also elected Dr. A. Sigrid Gilbertsen to the position of faculty secretary-treasurer for a three year term, and named Dr. Richard M. Magraw, assistant dean and director of the Comprehensive Clinic program, as a new faculty member-elect. Dr. Magraw is the first faculty member so elected into AOA since the group’s charter was recently amended.

Sixteen other students, all graduating seniors, were initiated into AOA. They include Calvin M. Bandt, Allan D. Belden, Martin G. Bruhl, David M. Burgan, Clifford A. Carlson, William C. Conrad, Nancy Jo Engeset, Richard T. Foreman, H. Irving Katz, John B. Leary, Malcolm I. Lindsay, Jr., Robert E. Olson, Gerald R. Onstad, James R. Schimshock, Joseph J. Westermeyer, and David M. Worthen.

The chapter also renewed its AOA Scholarship, which is awarded annually to an outstanding senior medical student through the scholarship program of the Minnesota Medical Foundation.
SURGERY

Dr. Owen Wangensteen, Chief of the Department of Surgery and Distinguished Service Professor, was named 1961 recipient of the Passano Award. The $5,000.00 prize has been made available annually since 1943 by the Passano Foundation of the Williams & Wilkins Co. to encourage medical science and research. Dr. Wangensteen will receive the award June 28 in New York City in honor of his many contributions to surgical techniques, post-operative care of the patient, and for his teaching.

PATHOLOGY

Dr. Jesse E. Edwards, Clinical Professor of Pathology and director of laboratories and a pathologist at Charles T. Miller Hospital, St. Paul, is the author of a three-volume book, *An Atlas of Acquired Diseases of the Heart and Great Vessels*, just published by the W. B. Saunders Company. Dr. Edwards came to St. Paul in 1960 after fourteen years on the staff of the Mayo Clinic, Rochester. He is also secretary of the Minnesota Heart Association.

MEDICINE

Dr. Cecil J. Watson, Professor and Head of the Department of Medicine, was installed as president of the Association of American Physicians on May 2, 1961 in Atlantic City, New Jersey, and was elected president of the Association of Professors of Medicine. On May 10, he "received the hood" of the American College of Physicians, being one of four American doctors designated "Masters in the College" by the A.C.P.
MINNESOTA MEDICAL FOUNDATION PLANS LARGER SCHOLARSHIP PROGRAM

The Minnesota Medical Foundation this month launched a major effort to increase the number and size of scholarships available to students at the University of Minnesota Medical School.

Since 1949 the chief source of scholarship funds for the Medical School, the Foundation has announced an objective of gradual enlargement of its student aid program until it is possible to issue 100 Foundation scholarships each year in amounts ranging from $500.00 to $1,000.00. The need for such a scholarship program is described in a new brochure just published by the Foundation. Titled "The Key to Medical Education," the brochure is being widely distributed to prospective donors by trustees of the Foundation.

The proposed expansion program is among the most ambitious undertaken in support of the Medical School since the Foundation was established in 1939. In the past twelve years, the Foundation has awarded 215 scholarships worth $110,000 to University medical students. A peak was reached in 1960 when 32 awards totalling $16,500 were distributed. The Foundation hopes to make up to 50 scholarships available for the 1961-62 school year if additional donors can be found, according to M. E. Herz, Foundation trustee and chairman of the fund raising committee.

Including M.M.F. awards, the Medical School currently has fewer than 75 scholarships available annually to its 500 medical students. The average award is less than $500.00.

M.M.F. awards are given on the basis of scholastic achievement (55%) and financial need (45%). Approximately 160 medical students have applied for the M.M.F. awards which will be distributed on Minnesota Medical Foundation Day, September 25, 1961, as the school year commences.

The expansion program will proceed as rapidly as donors can be located, Mr. Herz announced. Individuals, corporations,
alumni, businessmen, foundations or others interested in the program can get details by contacting Mr. Eivind Hoff, Jr., Executive Secretary, Minnesota Medical Foundation, 1342 Mayo Memorial Bldg., University of Minnesota, Minneapolis 14, Minn., or by telephoning FEderal 9-7311, Ext. 2748.

Trustees of the Foundation have complete information. They are:

Medical School: Dr. Arnold Lazarow, Dr. John A. Anderson, Dr. L. R. Boies, Mr. Ray Amberg, Dr. Harold O. Peterson, Dr. Robert B. Howard, Dr. H. Mead Cavert, Dr. William Fleeson, Dr. Wesley W. Spink, and Dr. C. Donald Creevy.

St. Paul: Mr. A. A. Heckman, Dr. Charles E. Rea, and Dr. Milton M. Hurwitz.

Minneapolis: Mr. Malcolm McDonald, Dr. R. S. Ylvisaker, Dr. Donald Couling, Dr. V. J. P. Lundquist, Mr. Samuel Maslon, Dr. Sheldon M. Lagaard, Mr. M. E. Herz, Mr. Gerald T. Mullin, Dr. Arthur C. Kerkhof, and Mrs. Frank W. Bowman.

Rochester: Dr. Corrin H. Hodgson

Duluth: Dr. Anderson C. Hilding

Hibbing: Dr. Bernard Halper

Hopkins: Dr. Herman E. Drill

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**DR. BOIES INSTALLED**

Dr. Lawrence R. Boies was installed May 26, 1961 as president of the American Otological Society at the group's 94th annual meeting in Lake Placid, New York. He is professor and head of the Medical School's department of otolaryngology. The Society was founded in 1868 as a scientific and educational organization to investigate and report upon diseases of the ear.
A VITAL SUBSTANCE

The search for substitutes for insulin in the treatment of diabetes goes forward at the University of Minnesota Medical Center with assistance from the Minnesota Medical Foundation.

Dr. Frederick C. Goetz and a research team in the Department of Medicine are nearing completion of a two-year study assisted by a $13,716 grant from the Foundation. The funds had been willed to the Foundation by the late Eva Rhodes Freeman of Minneapolis, who requested that an attempt be made to find a less painful method of treating the diabetic.

The grant was the first made for medical research under the reorganized program of the Foundation.
Subjects of the insulin assay are six weeks old mice, several hundred of which were purchased for the project. Junior scientists Beryl Greenberg and Joyce Ells, working in Dr. Goetz' laboratory, inject an inbred mouse of a special strain with a plasma sample as part of the procedure for measuring insulin. The injection dosage is $\frac{1}{10}$ of 1 cc. Laboratory environment of the mice is kept as constant as possible. One hour later, (below) technicians carefully draw blood sample from the tail of the mouse for glucose estimation.
The measurement of the mouse's blood sugar (left) provides an indication of the amount of insulin in plasma sample previously injected into the animal.

Project director Dr. Goetz (below) calculates an assay result. Using mice, his research team has investigated factors regulating secretion of insulin by the islet cells of the pancreas, with special emphasis on the effects of tolbutamide and other synthetic substitutes for insulin. A second major effort has been the qualitative and quantitative estimation of individual fatty acids in the serum of diabetic patients by liquid-gas chromatography, with special reference to changes produced by oral hypoglycemic agents.

The Minnesota Medical Foundation this year added more support for the diabetes research project by awarding a $1,284.00 grant to Dr. Donald A. Duncan, Fellow in the Department of Medicine, to finance an immunochemical method of insulin assay. The grant complements Dr. Goetz' project and was made possible by the original Eva Rhodes Freeman bequest to the Foundation.
Alumni Notes

♦ 1928

Herman E. "Tiny" Drill was elected to a three year term on the Board of Directors, American Academy of General Practice. He has been a Minnesota delegate to the AAGP for six years, and served two years as president of the Minnesota Medical Foundation. He is in general practice in Hopkins, Minnesota.

♦ 1929

Kenneth R. Nelson retired May 1, 1961 as a Rear Admiral, United States Public Health Service. His last duty assignment was as Chief Medical Officer with the U.S. Coast Guard, Washington, D.C. Dr. Nelson has been appointed Commissioner of Hospitals for the city of St. Louis, Mo., heading the five public hospitals operated by that city. He is a native of Minneapolis.

♦ 1937

James H. Aldes, Director of Rehabilitation at Cedars of Lebanon Hospital, Los Angeles, Calif., received the Physicians Award of the President's Committee on Employment of the Physically Handicapped. He was chosen for his "outstanding contribution to the Committee's year 'round program."

♦ 1937

Hendrik J. Svien, consultant in neurosurgery at the Mayo Clinic, Rochester, Minn., was reelected secretary of the Harvey Cushing Society at its 29th annual meeting this year in Mexico City, Mex. The Society is the largest neurosurgical group in the world.

♦ 1956

Kenneth Bredesen will begin the practice of psychiatry on July 1, 1961 in Minneapolis with offices in the Southdale Medical building. He is completing a residency in psychiatry at the University of Colorado Medical Center, Denver, Colo. after two years as a U.S. Navy medical officer. His family now includes his wife, two sons, and one daughter. Dr. Bredesen will also hold a part time teaching position in the Medical School's Department of Psychiatry.
THE MEDICAL BULLETIN

♦ 1956
John A. Gronvall has accepted an appointment as an instructor in the department of pathology at the University of Mississippi Medical School.

Lt. John M. Sheehan has returned home after receiving his discharge from the U.S. Navy. He was a medical officer at the Naval Hospital in San Diego, Calif.

♦ 1957
Lt. Jerome H. Modell, U.S. Navy Medical Corps, has been transferred from the Naval Hospital, St. Albans, New York, to the Naval Hospital, Pensacola, Fla.

♦ 1958
Lt. Lowell K. Kleven has completed two years' service in the U.S. Navy and has returned home. His final duty station was at the Naval Hospital, Bremerton, Washington.

♦ 1958
Lt. Loren R. Leslie has received his discharge from the U.S. Navy and returned home. His last duty station was with the U.S. Marines at Camp LeJeune, N.C.

ALUMNI DEATHS

♦ 1900
Dr. Frederick R. Huxley, a physician and surgeon in Faribault, Minn. for 60 years, died May 28, 1961 after a long illness. He was 86 years old.

Dr. Huxley was born in Winona, Minn. His first medical assignment was as head physician for the state school and hospital at Faribault. He was a member of Phi Delta Theta, Nu Sigma Nu and Sigma Xi fraternities, and was a Mason. He was former president of the Southern Minnesota Medical Association, and an officer of the Minnesota State Medical Association. Dr. Huxley is survived by two sons, both of whom reside in California.

♦ 1950
Dr. H. A. Gull of Chino, Calif., died February 10, 1961 at the age of 48 years. He had been engaged in the general practice of medicine in association with his brother, Dr. Reuben Gull, in Chino since 1951. Death was caused by lung cancer. Dr. H. A. Gull was a chemical engineer prior to his medical career, and was a veteran of World War II. In California he was on the medical staff at Pomona Valley Hospital and San Antonio Community Hospital. He was a member of the American Medical Association. Dr. Gull is survived by his wife, Katherine, and two young sons.

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Coming Events

University of Minnesota Medical School

List of Continuation Courses for Physicians
1960-1961

University of Minnesota
Center for Continuation Study

May 1-3 . . . . Ophthalmology for Specialists

May 8-10 . . . . Gynecology for General Physicians and Gynecologists

May 11-13 . . . . Surgery for Surgeons

May 15-19 . . . . Proctology for General Physicians

June 1-2 . . . . Psychiatric Emergencies in Medical Practice

1960-61 all year . . Cancer Detection for General Physicians

The University of Minnesota reserves the right to change this schedule without notification.

Courses are held at the Center for Continuation Study or the Mayo Memorial Auditorium on the campus of the University of Minnesota. Usual tuition fees are $30 for a two-day course, $50 for a three-day course, and $75 for a one-week course. These are subject to change under certain circumstances.

Specific announcements are sent out for each course to all members of the Minnesota State Medical Association and to any physicians who request information for a specific course, about six weeks to two months before the date of the course. For further information write to:

DIRECTOR
DEPT. OF CONTINUATION MEDICAL EDUCATION
1342 MAYO MEMORIAL
UNIVERSITY OF MINNESOTA
MINNEAPOLIS 14, MINNESOTA
A Word About

Memorial Gifts

The Minnesota Medical Foundation welcomes your memorial contributions when an appropriate occasion arises. Memorial gifts serve the living and pay thoughtful tribute to the memory of a friend or relative.

The Foundation will promptly acknowledge your gifts to both the donor and the family of the deceased. The gift will help finance the Foundation’s program for the advancement of medical education and research. The Medical School at the University of Minnesota will be the direct benefactor.

Gifts should be sent to the Minnesota Medical Foundation, 1342 Mayo Memorial, University of Minnesota, Minneapolis 14, Minn.