Preclinical Training in Bronchoscopic Diagnosis of Cancer*

John E. Rayl, M.D., F.C.C.P.; Jan M. Pittman, M.Ed.; § and Jonathan J. Shuster, Ph.D. §

This study evaluated educational effectiveness of preclinical training of residents in diagnostic bronchoscopic techniques which used videotaped programs. Sixty-five residents in eleven medical centers were randomized. Experimental subjects viewed five videotaped programs dealing with bronchoscopic anatomy and pathology. Following their tenth clinical experience in bronchoscopic diagnosis, performance of both experimental and control subjects was objectively evaluated using a Visual Discrimination Test (VDT) that contained six videotaped sequences in suspected cancer patients. Clinical performance was subjectively evaluated by teachers who used a list of Minimum Competency Requirements (MCRs). Experimental subjects provided a significantly greater number of correct answers in the VDT and achieved higher scores for the MCRs that were specifically related to recognition of bronchoscopic anatomy and pathology. This study demonstrated that preclinical training using videotaped programs could improve visual perception and discrimination skills of residents in their bronchoscopic examination of patients with suspected cases of cancer.

During the past two decades, several medical and surgical specialties have added clinical experience in endoscopy to their residency training requirements. This additional experience has increased the number of residents for whom endoscopic training must be provided. On the other hand, it has reduced the number of hands-on clinical experiences available for each resident during his or her training period.

In an attempt to help compensate for this reduction of clinical experience, our residents in bronchoscopy were provided preclinical training. This training was completed prior to their first clinical experience and utilized edited segments of bronchoscopic examinations previously recorded on videotape to simulate visual experiences in the recognition of endoscopic anatomy and pathology. Our observations have suggested that this type of preclinical training enhanced the performance of residents during their early clinical experiences.

The purpose of this investigation was to evaluate objectively the effectiveness of preclinical training in bronchoscopy with a larger group of residents.

METHODS

Videotape Programs Evaluated

The method used to evaluate the effectiveness of preclinical training was to determine the difference in the performance of two groups of residents (experimental and control subjects). One group had seen and the other group had not seen five videotape programs in bronchoscopic anatomy and pathology. The five videotape programs used in this evaluation were (1) bronchoscopic checkpoints, (2) endoscopic examination of the upper airway using the flexible bronchoscope, (3) bronchoscopic features of acute inflammation, (4) bronchoscopic features of chronic inflammation, and (5) bronchoscopic features of carcinoma.

Content

The content of each program and distribution sources follow:

Bronchoscopic Checkpoints

This demonstrates a systematic method for a flexible bronchoscopic examination and describes the endoscopic anatomy of the 18 bronchopulmonary segments. It also describes eight anatomic checkpoints that can be used to maintain constant orientation or rapid reorientation when required (length, 19 min; 1981).

Endoscopic Examination of the Upper Airway Using the Flexible Bronchoscope

This demonstrates a method for a systematic examination of the upper airway using a flexible bronchoscope to visualize as many as 49 anatomic structures in ruling out the presence of carcinoma. The use of a visual checkpoint in each of seven anatomic areas is described to assist the physician in endoscopic orientation and localization of lesions (length, 11 min; 1981).

Bronchoscopic Features of Acute Inflammation

Presented are 22 selected bronchoscopic sequences that illustrate the four endoscopic features associated with acute inflammation, including purulent exudate, erythema, edema and intermittent
Bronchoscopic Features of Chronic Inflammation

Twenty selected bronchoscopic sequences that illustrate the four bronchoscopic features associated with chronic inflammation, including mucus, longitudinal light bands, transverse mucosal ridges and dilated ducts of mucous glands are presented. Changes in these endoscopic features that indicate the need for biopsy to rule out carcinoma are described (length, 15 min; 1980).

Bronchoscopic Features of Carcinoma

This videotape presents 44 selected bronchoscopic sequences that illustrate 18 pathologic features that may be associated with intraluminal, bronchial wall or extrabronchial carcinoma. A method for classifying these features is suggested. The indications for biopsy to establish a precise diagnosis are emphasized (length, 30 min; 1981).

Distribution Sources

Videotape programs in this report (and additional programs in endoscopy) are available by purchase from (1) National Audovisual Center (NAC), Customer Service Section, 8700 Edgeworth Drive, Capitol Heights, MD 20743-3701 (telephone: 301-783-1896); and (2) Health Sciences Consortium (HSC), 103 Laurel Avenue, Carrbor, NC 27510 (telephone: 919-942-8731). Instructional Guides are available with each program purchased from HSC.

The same videotape programs are available by loan from (1) Veterans Administration Library Network (VALNET), contact Library Service in any VA Medical Center or telephone 202-389-5130; (2) National Library of Medicine (NLM), Collection Access Section, Public Services Division, 8600 Rockville Pike, Bethesda, MD 20894 (telephone: 301-496-5511); (3) American College of Chest Physicians (ACCP), Order Fulfillment Department, 911 Bussey Highway, Park Ridge, IL 60068-2375 (telephone: 312-698-2200); and, (4) Health Sciences Consortium (HSC), 201 Silver Cedar Court, Chapel Hill, NC 27514 (telephone: 919-942-8731).

Bronchoscopic Training Sites

Training sites were recruited in numbers sufficient to access a sample of 60 or more trainees. Eleven bronchoscopy training sites at various medical centers throughout the United States were selected where the physician-supervisors had agreed to evaluate the effectiveness of their endoscopy training with and without the use of preclincial videotape training programs. Those physician-supervisors included Drs. A. Jay Block at the University of Florida in Gainesville; Dick D. Briggs, Jr., at the University of Alabama in Birmingham; Robert W. Cantrell of the University of Virginia Medical Center in Charlottesville; L. Penfield Faber at the Rush Medical College in Chicago; Willard Fry at the Northwestern School of Medicine in Evanston, IL; James H. Harrell at the University of California in San Diego; Bernard R. Marsh of the Johns Hopkins Hospital in Baltimore; Charles M. Norris at the Temple University Hospital in Philadelphia; John E. Rayl at the VA Medical Center in Lake City, FL; David R. Sanderson of the Mayo Clinic in Rochester, MN; and Paul Ward at the University of California in Los Angeles. Residents trained in bronchoscopy at these centers, beginning on or about June 1983, were entered into this training evaluation.

Statistical Design

The physician-supervisor at each training site supplied us with a list of trainees, and copies were sent to the statistical center (Research Assistance Corporation in Gainesville, FL). Using random numbers, the statistical center assigned trainees to the two groups (experimental and control) with balancing (equal allocation) within each cooperative medical center. Each list was returned to the physician-supervisor's secretary (or "designate"), who was responsible to show the videotapes to the trainees in the experimental group.

A physician at each bronchoscopy training site was designated as the physician-evaluator and was given the responsibility for the resident's subjective evaluation. Upon signing the trainee consent form, each resident had agreed not to reveal his or her assignment to the physician-evaluator so he was blinded as to which group the trainee was randomized. This masking was important in that the physician-evaluator must train all residents in the same manner and then must make subjective performance evaluations. Hence, we tried to avoid unconscious bias.

Performance Evaluation

Each resident was evaluated by the use of minimum competency requirements (MCRs [subjective evaluation]) and by visual discrimination testing (VDT [objective evaluation]). Both evaluations were accomplished after the tenth clinical bronchoscopic examination had been completed.

The subjective evaluation utilized 26 MCRs to evaluate the competency of each resident at the selected N-point using a rating scale for each requirement. These requirements are listed here (asterisks indicate competency requirements related to endoscopic programs in anatomy and pathology).

1. Identify indications. Determine need for additional workup.
2. Review x-ray films and localize lesions to specific segments.
3. Identify indications for rigid or flexible bronchoscopy.
4. Identify indications for transoral and transnasal flexible bronchoscopy.
5. Using lay terms with patient, obtain an informed consent.
7. Examine upper airway with flexible bronchoscope.*
8. Introduce flexible bronchoscope transorally or transnasally.
9. Examine oropharynx and hypopharynx with rigid bronchoscope.*
10. Introduce rigid bronchoscope with minimal discomfort.
11. Perform systematic examination including segmental bronchi.*
12. Identify eight anatomic landmarks or checkpoints.*
13. Use appropriate suction methods during rigid bronchoscopy.
14. Biopsy visible lesions and respond to excessive bleeding.
15. Perform brush and forceps biopsy with fluoroscopy.
16. Localize and remove foreign bodies.
17. Identify bronchoscopic features of acute inflammation.*
18. Identify bronchoscopic features of chronic inflammation.*
19. Identify subtle and overt features of carcinoma.*
21. Write appropriate postoperative orders.
22. Write appropriate postoperative progress notes.
23. Dictate satisfactory operative note.
24. Complete histologic or cytologic examination forms.
25. Correlate bronchoscopic features with histologic findings.
26. Monitor patient's status for 24 h following bronchoscopy.

This rating scale permitted performance evaluations on a zero (not observed) or 1 to 5 basis for each of the 26 MCRs. The 26 MCRs were selected to measure the overall quality of the clinical performance of each resident in bronchoscopy. The quality of the bronchoscopic examination considered the resident's demonstration of constant anatomic orientation and his or her discrimination between features of acute or chronic inflammation and the subtle changes that might suggest early carcinoma.

A VDT was used to evaluate the resident's visual identification and discrimination performance. This test utilized six videotape sequences of endoscopic examinations in patients with suspected cancer to test the resident's recognition of upper and lower airway.
Table 1—Anatomic and Pathologic Content of Visual Test*

<table>
<thead>
<tr>
<th>Test Sequence No.</th>
<th>Test</th>
<th>Anatomy</th>
<th>Pathology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nasopharynx</td>
<td>Oropharynx &amp; Hypopharynx</td>
</tr>
<tr>
<td>1</td>
<td>...</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
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<td>...</td>
<td>...</td>
</tr>
<tr>
<td>6</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Maximum score</td>
<td>12</td>
<td>11</td>
<td>13</td>
</tr>
</tbody>
</table>

*Above numbers indicate the distribution and maximum score for features of anatomy and pathology in each of the six test sequences.

RESULTS

Out of 78 residents who cooperated in this study, 65 were randomized into two groups (experimental and control), and their responses were tabulated for this report. The specialty listed by each of these 65 residents included: three in anesthesiology, 14 in pulmonary medicine, 30 in general surgery, four in head and neck surgery, one in surgical oncology, nine in otolaryngology, and four in thoracic surgery. The 13 nonrandomized residents were from two institutions who refused randomization but wanted to take part.

When the average scores per question for all 26 subjective evaluations were compared for each resident group, no significant difference was noted between residents in the control and experimental groups. As noted in Table 2, the experimental group averaged +5 percent, with a p value of 0.19. However, when the six MCRs that were related only to endoscopic anatomy and pathology were compared, the experimental group of residents had significantly higher scores than the control group at the same institution. Scores in anatomy were +8 percent, and in pathology they were +13 percent, with a p value of 0.06 and 0.02, respectively. Therefore, there was a significant advantage of the videotape programs on these specific components as judged by the physician's subjective evaluations. Note that nine randomized residents did not complete the subjective evaluations (N = 56 in Table 2).

In the VDT, the number of correct answers recorded by the experimental group of residents was significantly greater than those recorded by the control group. Scores in anatomy were +12 percent, and in...
Table 3—Objective Impact of Preclinical Training

<table>
<thead>
<tr>
<th>Objective Tests</th>
<th>Estimated Net Difference, Adjusted for Institution*</th>
<th>One-Sided p Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatomy (N = 65)</td>
<td>+5.3 (12%)</td>
<td>0.01</td>
</tr>
<tr>
<td>Pathology (N = 65)</td>
<td>+3.5 (17%)</td>
<td>0.01</td>
</tr>
<tr>
<td>Total (N = 65)</td>
<td>+8.8 (14%)</td>
<td>0.01</td>
</tr>
<tr>
<td>Test time (N = 65)</td>
<td>+7 min (12%)</td>
<td>0.16</td>
</tr>
</tbody>
</table>

*Number given is the estimate of the difference in mean response between an experimental subject and a control subject at the same institution. In parentheses is the percentage of increase in the mean score of all subjects. For example, the mean score on objective pathology was 20.3 (3.5/20.3 = 17%).
†From Hodges and Lehmann.1

pathology they were +17 percent, with a p value of 0.01 and less than 0.01, respectively (Table 3). This objective evaluation implies greater accuracy in recognizing bronchoscopic anatomy and pathology. For example, the visual test had a maximum of 111 correct responses in anatomy and pathology together, so the net difference of +8.8 represents about eight additional correct responses by the experimental group within each training site as compared with responses of the control group.

It was of interest to note that the experimental group of residents at each training site utilized more time in recording their responses to the visual test than the control group. This increase in test time closely corresponded to the greater number of correct answers recorded by the experimental group.

DISCUSSION

One method considered for reducing the length of each resident's clinical training period and yet ensuring that he or she has observed an optimal variety of endoscopic pathology was to provide preclinical training with the use of videotape programs in endoscopic anatomy and pathology, viewed prior to the residents' first clinical experience. For example, the three programs in bronchoscopic pathology that were evaluated in this research investigation presented a total of 86 selected endoscopic sequences that demonstrated lesions due to chronic inflammation, acute inflammation and carcinoma. This type of preclinical training should provide a variety of simulated visual experiences with magnified and highly detailed views that should compress the learning process of visual discrimination.

Although we have assumed that these programs help in the learning process, the instructional value of endoscopic videotape programs has not been previously evaluated by testing with a broad segment of the target audience and by using performance-based methods. Before a study of this type was initiated, a bibliographic search that included audiovisuals (AV) was made and it revealed one publication by Konrad et al2 that described the advantage of using in-house videotape recording for teaching endoscopic diagnosis and evaluation of laryngeal carcinoma. However, this AV search revealed no instructional videotape programs in endoscopy that had been assessed by performance-based evaluations. We felt that such an evaluation would greatly contribute to the credibility and usefulness of videotape programs as educational adjuncts in endoscopic training.

This project therefore was designed to evaluate the effectiveness of preclinical training which used five specific videotape programs in bronchoscopic anatomy and pathology. It has shown subjective and objective evidence that this preclinical training has improved the diagnostic skills of bronchoscopy residents during their early clinical experiences.

The five programs utilized in this project had an educational design and a technical quality that demonstrated endoscopic scenes equal to those observed directly through the eyepiece of a bronchoscope with excellent optical quality. The quality of these five videotape programs was evidenced by the fact that, together, they have received 39 awards in national and international competitions.

REFERENCES