Clinical Investigation: Education

Assessing the Value of an Optional Radiation Oncology Clinical Rotation During the Core Clerkships in Medical School

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Summary

In July 2010, Jefferson Medical College began offering a 3-week radiation oncology rotation as an elective course for third-year medical students during the core surgical clerkship, including clinics, inpatient consults, didactic sessions, and case-based presentations by students. Prerotation and postrotation examination scores showed an 18% improvement, from 64% to 82%, in oncology knowledge. This radiation oncology clinical rotation, as an option in the core medical school curriculum, improves student knowledge of radiation oncology, including aspects of clinical oncology.

Purpose: Few medical students are given proper clinical training in oncology, much less radiation oncology. We attempted to assess the value of adding a radiation oncology clinical rotation to the medical school curriculum.

Methods and Materials: In July 2010, Jefferson Medical College began to offer a 3-week radiation oncology rotation as an elective course for third-year medical students during the core surgical clerkship. During 2010 to 2012, 52 medical students chose to enroll in this rotation. The rotation included outpatient clinics, inpatient consults, didactic sessions, and case-based presentations by the students. Tests of students' knowledge of radiation oncology were administered anonymously before and after the rotation to evaluate the educational effectiveness of the rotation. Students and radiation oncology faculty were given surveys to assess feedback about the rotation.

Results: The students' prerotation test scores had an average of 64% (95% confidence interval [CI], 61–66%). The postrotation test scores improved to an average of 82% (95% CI, 80–83%; 18% absolute improvement). In examination question analysis, scores improved in clinical oncology from 63% to 79%, in radiobiology from 70% to 77%, and in medical physics from 62% to 88%. Improvements in all sections but radiobiology were statistically significant. Students rated the usefulness of the rotation as 8.1 (scale 1–9; 95% CI, 7.3–9.0), their understanding of radiation oncology as a result of the rotation as 8.8 (95% CI, 8.5–9.1), and their recommendation of the rotation to a classmate as 8.2 (95% CI, 7.6–9.0).

Conclusions: Integrating a radiation oncology clinical rotation into the medical school curriculum improves student knowledge of radiation oncology, including aspects of clinical oncology.
Introduction

Cancer is a frequent cause of morbidity and mortality in the United States and throughout the world (1). It is important for all medical practitioners to have knowledge of the basic aspects of oncology. In 1994, the International Union Against Cancer recognized an imbalance between cancer prevalence and the number of oncologists (2). It advised further integration of oncology into medical school curricula (2—4). However, recent literature has shown that medical students’, residents’, and general practitioners’ knowledge of core oncology information is relatively low in the United States (5) and abroad (6, 7). Furthermore, radiation oncology is underrepresented in the curricula of most medical schools (8, 9), despite the observation that around 60% of all cancer patients receive radiation therapy at some point during their disease course (10). A recent survey of physicians in the United Kingdom revealed that recent medical school graduates report low rates of prior exposure to cancer patients and that only 15% of respondents thought they knew enough about radiation therapy and chemotherapy (11). There are few studies about integrating teaching of radiation oncology into the medical school curriculum (8, 12—14).

Selected medical schools have chosen to emphasize oncology in their curricula (2), and Dennis and Duncan recently reviewed reports of radiation oncology in undergraduate medical education (15). Boston University has reported the implementation of an Oncology Education Initiative, which included a course with structured didactics by an attending physician, delivered in a lecture format. In the system at Boston University, all students are exposed to radiation oncology before graduation through a series of lectures during a core radiology clerkship (8, 13). The program improved trainee oncology knowledge, was well received by graduates, and influenced a change in the institutional curriculum (16, 17).

At Jefferson Medical College, as may be the case in many institutions, the faculty in radiation oncology recognized a potential gap in basic understanding of radiation oncology among resident and attending physicians engaged in inpatient care and other specialties. Based on the desire to improve general knowledge of radiation oncology within the broader medical community, a clinical rotation was developed for inclusion in the third-year medical school curriculum, as a choice within the core clinical clerkships at our institution. This new course was approved by the curriculum committee at our institution for inclusion as an optional component of the 12-week clerkship in surgery. Jefferson Medical College students are required to complete a 6-week rotation in general surgery and then to choose two additional 3-week rotations from among several surgical subspecialties and selected nonsurgical rotations (e.g., radiation oncology or physical medicine and rehabilitation). The first cohort of students started in July 2010.

The purpose of this report is to evaluate the impact of an optional clinical rotation in radiation oncology during the core third-year medical school surgery clerkship on students’ knowledge of essential general oncology and radiation oncology information.

Methods and Materials

In July 2010, our institution began offering a 3-week clinical rotation in radiation oncology to third-year medical students. This rotation is offered as an option during the 12-week core surgical clerkship, and it is separate from the traditional 4-week elective in which two to three fourth-year medical students enroll each year. Apart from this new rotation, radiation oncology is included in the core curriculum of the medical school as a 30-minute introductory lecture during the second-year Foundations of Clinical Medicine course, and a radiation oncologist attends an annual career fair that is optional for students. During 2010 to 2011, a total of 35 third-year medical students enrolled, among a total of 264 students in the Jefferson Medical College Class of 2012. During the first half of 2011 to 2012, an additional 17 students completed the rotation, among a total of 261 students in the Jefferson Medical College Class of 2013. The total number of students included in the study was 52. Two to three students were enrolled during each 3-week block. After implementing the selective course, there was no change from the usual number of fourth-year medical students (two to three per year) who usually have prior exposure and plan a career in radiation oncology, completing an elective in our department. The number of students at our institution who chose radiation oncology as a specialty also did not change from the baseline rate of two per year.

The rotation includes time spent in outpatient clinics, with inpatient consults, and in didactic sessions. Twice per week, a 1-hour small group didactic session is led by a radiation oncology faculty member or chief resident for the third-year students. Session titles include Introduction to Radiation Oncology, Basics of Radiobiology and Medical Physics, Treatment of Common Cancers, Radiation Emergencies, and Palliative Radiation Therapy. Each didactic session is standardized, guided by a written syllabus, and supplemented with slides. Students interact directly with nine clinical faculty and eight residents, who share responsibility for teaching, which occurs primarily in the outpatient clinic and includes inpatient consultations.

Emphasis is placed on students completing patient interviews and presenting patient histories in the outpatient clinic, physical examination of oncology patients (e.g., neurologic deficits and nodal examination), multidisciplinary management approaches, assessment of late toxicity after radiation therapy, and evaluation of inpatient consults. Students are integrated into the clinical team, rather than relegated to observer status. Students also spend an afternoon observing simulation, treatment planning, and treatment delivery performed by simulation technicians, dosimetrists, and radiation therapy technicians, respectively. Students are not taught by radiobiologists but do have limited interactions with medical physicists in the course of clinical care. At the end of each
rotation, the students give 10-minute presentations that include a case presentation and a review of one or more relevant articles from the medical literature.

All students took anonymous prerotation and postrotation tests, which each consisted of 50 questions, given over 1.5 hours. The question stems on both tests were identical; only the order of the questions and answer choices were shuffled to decrease recall bias. Of the 50 questions, 28 related to clinical oncology, 6 to radiobiology, and 16 to medical physics. A sample question from each category is shown in the table. The content of the test questions was influenced by a report of radiation oncology in undergraduate medical education published by Hirsch et al. (13).

Students and radiation oncology faculty, all of whom were directly involved with the course, were given surveys about the rotation. The survey was scaled from 1 to 9, with 1 indicating the minimum value or negative feedback and 9 indicating the maximum or positive feedback. For students, the survey consisted of three prompts: (1) how useful the rotation was, (2) how one’s understanding of radiation oncology improved as a result of the rotation, and (3) how much the student would recommend the rotation to a classmate. For faculty, the survey consisted of three questions: (1) how much the student would recommend the rotation to a classmate, (2) how appropriate the responsibilities of the student were in the clinic, and (3) how appropriate the lectures were for students.

The outcome measures of the study were (1) prerotation and postrotation test scores, (2) students’ surveys regarding the radiation oncology elective, and (3) faculty members’ surveys regarding the radiation oncology elective. A two-tailed $t$ test was used to test all hypotheses. A $p$ value $<0.05$ was considered significant.

Table 1 Sample questions from the prerotation and postrotation examination categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Sample question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical</td>
<td>What is the typical dose fractionation used for daily radiation therapy for patients being treated definitively?</td>
</tr>
<tr>
<td></td>
<td>A. 1.0–1.2 Gy</td>
</tr>
<tr>
<td></td>
<td>B. 1.2–1.6 Gy</td>
</tr>
<tr>
<td></td>
<td>C. 1.8–2.0 Gy</td>
</tr>
<tr>
<td></td>
<td>D. 2.5–3.0 Gy</td>
</tr>
<tr>
<td>Radiobiology</td>
<td>Match the malignancy that is commonly treated with radiation therapy with the associated infectious agent. Tonsillar cancer:</td>
</tr>
<tr>
<td></td>
<td>A. Epstein-Barr virus</td>
</tr>
<tr>
<td></td>
<td>B. Human papillomavirus</td>
</tr>
<tr>
<td></td>
<td>C. Schistosoma haematobium</td>
</tr>
<tr>
<td></td>
<td>D. Hepatitis B</td>
</tr>
<tr>
<td></td>
<td>E. Helicobacter pylori</td>
</tr>
<tr>
<td>Radiophysics</td>
<td>What is the most commonly used imaging modality for the simulation and planning of radiation therapy treatment?</td>
</tr>
<tr>
<td></td>
<td>A. X-ray</td>
</tr>
<tr>
<td></td>
<td>B. Positron emission tomography</td>
</tr>
<tr>
<td></td>
<td>C. Magnetic resonance imaging</td>
</tr>
<tr>
<td></td>
<td>D. Computed tomography</td>
</tr>
<tr>
<td></td>
<td>E. Physical examination</td>
</tr>
</tbody>
</table>

Results

All students completed the prerotation and postrotation examinations. Figure 1 shows students’ prerotation and postrotation test scores overall and by category type. The average prerotation test score was 64% (95% confidence interval [CI], 61–66%). The average postrotation test score was 82% (95% CI; 80–83%), representing an absolute improvement of 18% ($p < 0.001$). In examination section analysis, scores improved in clinical oncology from 63% to 79%, radiobiology from 70% to 77%, and medical physics from 62% to 88%. All improvements, except for radiobiology, were statistically significant ($p < 0.001$). The table shows three sample questions, each from one of the examination categories. Figure 2 shows the percentage of students answering these questions correctly, before and after rotation.

Figure 3 shows the results of student surveys. Students rated the usefulness of the rotation as 8.1 (scale 1–9; 95% CI, 7.3–9.0), their understanding of radiation oncology as a result of the rotation as 8.8 (95% CI, 8.5–9.0), and their recommendation of the rotation to a classmate as 8.2 (95% CI, 7.6–9.0).

Radiation oncology faculty rated their belief that this rotation would be valuable to students as 8.2 (scale 1–9), that students had appropriate responsibilities in the clinic as 7.9, and that the lectures and meetings that students attended were at an appropriate level as 8.1.

Discussion

The current study evaluated the impact of an optional 3-week clinical rotation in radiation oncology on third-year medical students’ knowledge of core general oncology and radiation oncology information. Among 52 students who completed the rotation during 2010 to 2012, there was an 18% absolute improvement, from 64% to 82%, in scores on an examination of general oncology and radiation oncology content. The largest improvement from prerotation to postrotation examinations was...
seen in the medical physics score, which increased from 62% to 88%. Students reported that they were satisfied with the usefulness of the rotation, that their understanding of radiation oncology increased during the rotation, and that they would recommend the rotation to their peers. Similarly, the rotation was well received by radiation oncology faculty.

Improvement in oncology knowledge among all physicians is a worthwhile goal. About half of all men and about one third of all women in the United States will develop cancer in their lifetime. The total cost of treating cancer in the United States was $228.1 billion in 2008, and most of this cost was secondary to the indirect morbidity and mortality associated with the loss of productivity and premature death resulting from cancer (1). The majority of cancer patients are still seen by their respective primary care physicians and specialists for the treatment of medical comorbidities. Thus, nononcologists may benefit from a basic understanding of oncology, and it follows that it is essential to present core oncology information during undergraduate medical education. The Ideal Oncology Curriculum for Medical Schools addressed this concern by providing objectives to adequately train nononcologists and exceptionally prepare cancer specialists (3, 4). Nonetheless, few students today are given formal clinical training in general oncology or radiation oncology (11), with the exception of student-selected electives during the fourth year (18). It has been shown that many students and medical practitioners are not comfortable in their knowledge of general oncology and radiation therapy (5, 6, 11, 19, 20), suggesting a need to expand oncology education in the undergraduate medical school curriculum.

Few articles investigating teaching radiation oncology to medical students have been published (8, 12, 14, 21). Although the ideal oncology curriculum learning objectives have been proposed, the proper implementation technique of these objectives is still under research. Only Boston University (8, 13) and Duke University (14) have published evidence of integrating radiation oncology lectures into the medical curriculum. Hirsch et al. had success in integrating a radiation oncology didactic lecture (13) and elective (16) into the medical school curriculum. They saw improved test scores in oncology and received positive feedback about the program from students (16, 17). However, the initial reports were limited by their focus solely on didactic lectures. The Jefferson Medical College course differs in that it is a structured clinical rotation with didactic sessions targeted toward third-year medical students. And, whereas Hirsch et al. observed that scores are likely affected by the time in the fourth year when a test is taken because students are likely affected by a preresidency syndrome of educational apathy (8), one might expect that the timing and the experiential, hands-on nature of the clinical rotation at Jefferson Medical College avoids the “senioritis” condition among our third-year students.

Although the clinical rotation in radiation oncology at our institution has been associated with improvements in oncology and radiation oncology knowledge, as assessed by anonymous examinations before and after the rotation, there are limitations to the course structure and current report that should be addressed. First, the course cannot be completed by the entire third-year class because of space restrictions and competing clerkship choices that the students opt for instead (e.g., physical medicine and rehabilitation). During 2010 to 2011, the radiation oncology course was completed by 35 students, about one fifth of the Class of 2012 at our institution. Comparatively, in the study by Hirsch et al. (8), 153 students, nearly all of the graduating class at Boston University, completed the lecture-format program. The Jefferson Medical College course differs from the Boston University program because the former is a clinical rotation rather than a series of lectures. One strong disadvantage of the third-year clinical rotation structure is the lack of scalability of this program. Owing to the small size of the radiation oncology services at our institution, it is not possible to offer the rotation to all students; a lecture-based format seems preferable in this aspect. However, it has been suggested that exposure to cancer patients improves medical students’ oncology knowledge, particularly with respect to physical examination and communication skills (22), so undergraduate medical education would ideally include some exposure to oncology clinics. Another limitation of the radiation oncology course at Jefferson Medical College is that it is limited to a 3-week experience to allow for the other required third-year rotations. Although the short duration of the course limits the amount of clinical exposure to radiation oncology, this is an improvement from zero weeks in most curricula and the
previous curriculum at Jefferson Medical College. Furthermore, the overall educational needs of medical students must be considered from a broad perspective, and additional oncology education may detract from important clinical training in primary care or other medical specialties. The net benefit of the current rotation, with respect to the opportunity costs of enrolling in the radiation oncology selective rotation rather than additional surgical education, cannot be elucidated from the current study and is an important consideration.

Finally, the limitations of the prerotation and postrotation examinations should be discussed. The examination is not a validated instrument for radiation knowledge assessment, although the content of the questions was influenced by prior reports of undergraduate medical education in radiation oncology (13, 15). The statistical strength of the current analysis is limited by the large number of examination items and the relatively small sample of students, so the examination results must be interpreted with caution. Given that the prerotation and postrotation examinations contained the same set of 50 questions, the scores on the postrotation examination may be inflated by recall bias. However, recall bias is likely minimized by the 3-week gap between examinations and the scrambling of the order of questions on the postrotation examination.

In conclusion, we have shown that the addition of a radiation oncology elective significantly improves medical students’ knowledge about the topic, including aspects of clinical oncology, radiobiology, and medical physics. After graduation, these students will go on to pursue graduate training in various specialties at different hospitals, and it is the hope of the radiation oncology faculty at Jefferson Medical College that these students will share their special knowledge of radiation oncology with their peers, more senior residents, attendings, and future students. Based on the effectiveness of this undergraduate medical education intervention, and the importance and relevance of oncology within general medicine, we will continue to offer the selective rotation in radiation oncology to third-year students at our medical school. We encourage the inclusion of clinical experiences in oncology within the core curriculum of medical schools, although this must be weighed against the need for education in other topics. We also encourage collaboration among faculty at different institutions to share course materials and ideas to help with the implementation of new courses in radiation oncology during undergraduate medical education. We recommend that a multi-institutional team work to formulate (1) core oncology competencies that should be introduced into undergraduate medical education, (2) a list of common cancers that should be seen and evaluated by each rotating student, and (3) an examination consisting of clinical and nonclinical sections (as seen in our study) and common cancer diagnoses and treatments.

References