

Original Publication

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Immune Response in Allergic Contact Dermatitis: An Integrated Learning Module

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Abstract

Introduction: Medical students are introduced to skin rashes during their preclinical years and often express difficulty in differentiating the underlying mechanisms. The preclinical lessons regarding immunologically mediated skin rashes are largely forgotten by the time the students begin diagnosing and treating skin rashes during clinical rotations. This module aims to enhance student understanding of immunologic concepts by integrating material across disciplines, contextualizing within a clinical scenario, and providing opportunity for self-testing. **Methods:** A diagram illustrating immune responses in allergic contact dermatitis was used in the Texas Tech University Paul L. Foster School of Medicine preclinical curriculum. This diagram was updated as an audiovisual learning module that traced the immune mechanisms and pathogenesis of contact dermatitis from allergen exposure to skin-rash development. A self-assessment quiz and a clinical vignette with questions were included in the module. Student usage was monitored, and an in-class survey evaluating student perception was administered. **Results:** Sixty-four (58%) first-year medical students used this module. Twenty-eight students completed the in-class survey. Over 95% of respondents felt that the module helped them learn the new material, identify areas of weakness, and both understand the underlying pathology and big picture for this immune response. **Discussion:** Student survey results indicate the module is clinically relevant and enhances learning. The module may be used as a component of self-directed learning in any immunology curriculum or may be used in any basic immunology course to exemplify the role of the immune system in disease.

Keywords

Lymph Node, Pathology, Immunology, Delayed-type Hypersensitivity, MHC I, MHC II, Dendritic Cells, CD4+ Th1 Cells, CD8+ CTL

Appendices

- A. Learning Module.swf
- B. Survey Questions.docx
- C. PowerPoint Presentation .pptx
- D. Module Quiz.swf
- E. Clinical Vignette.swf
- F. Quiz with Answers.doc
- G. Quiz without Answers.doc

All appendices are peer reviewed as integral parts of the Original Publication.

Educational Objectives

By the end of the session, learners will be able to:

1. Explain the role of the immune system in contact dermatitis.
2. Summarize the steps of the immune response in contact dermatitis.
3. Relate the immune mechanism with the pathogenesis, morphologic findings, and histologic findings in contact dermatitis.

Introduction

The term “integrated curriculum” first appeared in medical education approximately 3 decades ago,¹ and McMaster University in Canada was one of the first medical schools to implement an interdisciplinary curricular model across all years of its curriculum.² Curriculum integration in undergraduate medical education has rapidly risen in global popularity with the support of many national medical education organizations including the Liaison Committee on Medical Education, the AAMC, the General Medical Council in the United Kingdom, the Association of Faculties of Medicine of Canada, the Australian Medical Council, and the Inquiry on Medical Education in Sweden.³ With the aim of enhancing medical students’ retention of clinical knowledge by improving connections between the basic and clinical sciences, curriculum integration can be achieved at the session, course, or program level.⁴ This learning module integrates curriculum at the session level utilizing the methods of: (1) contextualization of basic science

material, whereby a clinical case or situation is used to demonstrate a basic science principle to provide a more practical setting for knowledge, and (2) shared teaching, whereby basic scientists and clinicians come together to teach.⁴

The topic for this integrated learning module was chosen based on student feedback collected from anonymous evaluations completed after the Integumentary, Musculoskeletal and Nervous Systems (IMN) Unit. Students consistently express difficulty in understanding the mechanisms underlying the cutaneous rashes. This module expands upon a diagram that was used in the immunology portion of the Texas Tech University Paul L. Foster School of Medicine (PLFSOM) preclinical curriculum to help illustrate the immune response in allergic contact dermatitis. A narrated audiovisual presentation traces the steps from allergen exposure to the development of skin rash and contains relevant clinical and histopathologic images. A fact-based self-assessment quiz and a clinical vignette with associated questions test students' understanding of the content. This format is the same used in a recent publication by the co-authors⁵ and is supported by Knowles, Molton, and Swanson's adult learning principles which state that adult learners: (1) need to know why they need to learn something, (2) need to learn experientially, (3) approach learning as problem-solving, and (4) learn best when the topic is of immediate value.⁶ Additionally, Baatar, Lacy, Mulla, and Piskurich⁷ have recently shown that repeated use of self-assessment quizzes and self-testing with learning tools such as these resources improves medical student performance on basic science examinations.

Comprehensive resources such as ours that integrate material across multiple basic science disciplines, contextualize the basic science material within a clinical scenarios, and provide students with the opportunity to utilize a variety of active strategies to aid their learning are unique. We were recently approached by another institution that was making improvements in their immunology curriculum and looking for comprehensive immunology resources like this one, providing further evidence that this resource is an important contribution to medical education. Besides enhancing medical student understanding of fundamental immunologic concepts, it also serves as an example for others who are undergoing the process of curriculum integration and change.

Methods

This learning module was originally designed for use at the PLFSOM in El Paso, TX. Our curriculum included a course entitled Scientific Principles of Medicine (SPM) wherein students were taught the basic sciences in the context of clinical presentations with an overarching organization that was organ system-based.⁸⁻¹⁰ Within each organ system unit, all foundational disciplines, including immunology, were taught synchronously and in the context of approximately 100 common clinical presentations (e.g., fever, chest pain, dysphagia, etc.). During this integrated 2-year preclinical SPM course, students were introduced to each clinical presentation in the form of a branching diagram called a scheme that illustrated the major decision branch points in the diagnostic reasoning of an expert clinician in the field. The schemes were presented at the beginning of each week of instruction by a clinician from that specialty. The remainder of the week was devoted to learning the basic science material that was used to differentiate the diagnoses within the clinical scheme branches.

Immunology was introduced in the first preclinical year during the first SPM unit titled Introduction to Health and Disease. The content pertaining to this learning module occurred during the third IMN SPM unit, which ran from around mid-October through early December of the first preclinical year. The corresponding clinical schemes for the week were nonvesiculobullous and vesiculobullous rashes. Prerequisites for utilization of the module were an introductory knowledge of innate and adaptive immune responses to specific stimuli. The ideal context for implementation would be during an introductory course in immunology where the role of the immune system in disease is taught.

The learning module (Appendix A) was created using iSpring Suite 8.5 software and was based on two textbooks written for medical students.¹¹⁻¹² It consisted of: (1) a 13-slide, narrated audiovisual presentation

tracing in a step-by-step fashion the immune mechanisms and pathogenesis of contact dermatitis from allergen exposure to development of skin rash with incorporated clinical and histopathologic images; and (2) a self-assessment quiz consisting of 13 fact-based questions and a clinical vignette with six associated questions designed to test students' understanding of the content. The module was submitted for publication as a Shockwave Flash (.swf) file as part of the recommended learning materials for immunology sessions during the nonvesiculobullous and vesiculobullous clinical schemes in the first week of the IMN unit.

Flash movie files (files with .swf extension) were played with Adobe Flash Player version 10 or above. If the stand-alone player was not available, we recommended using internet browsers that had built-in player plugins such as Firefox (for Mac OS) and Internet Explorer (for Windows OS). Please note that the Safari and Chrome browsers may not work. The browser's plugin must be activated and updated to the latest version. Please note that the plugin is OS- and browser-specific. The Flash movies automatically advanced to the next slide once the narration ended. Students moved to the next slide by clicking the "Next" button or slide number provided in the outline. Students could also choose to skip the narration and go straight to the quiz or clinical vignette. The module was published on our learning management system (LMS) as a shareable content object reference model (SCORM) 1.2-compliant content (zipped folder), which allowed us to track the module usage and quiz scores. A zipped folder containing SCORM files is available upon request. Usage was tracked via the LMS (Canvas Inc.). Approximately 4 months later, an anonymous seven-question survey (Appendix B) was administered during class using an audience response system (Poll Everywhere) to gauge the students use and perceptions of the module as a learning tool.

Additional versions and formats of the learning material intended for in-classroom use are also provided. An annotated PowerPoint version of the presentation slides without the self-assessment quiz or clinical vignette (Appendix C), a Flash movie version of the self-assessment quiz (Appendix D), a Flash movie version of the clinical vignette with associated questions (Appendix E), and Word document versions of the self-assessment quiz, both with and without answers (Appendices F and G, respectively), are provided.

Results

Out of a class of 110 students, 64 (58%) students accessed the module. Twenty-six students completed the quiz with a mean score of 78.1%. Twenty-eight students participated in an anonymous in-class survey (Table), and all reported using the module. The majority of students (96.4%) felt that the module helped them learn the new material (Q1), helped them identify areas of weakness (Q2), and helped them to understand the big picture for this immune response (Q4). Survey responses also indicated that the majority of students better understood the underlying pathologic process (96.4%, Q5) and considered the content clinically relevant (92.8%, Q7).

Table. Survey Results (N = 28)

Question	%					
	Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
Q1: This module helped me to learn the new material.	54	39	4	0	0	4
Q2: This module helped me identify areas where my understanding was weak.	39	46	11	0	0	4
Q3: This module helped me review the material for the unit.	46	36	11	4	0	4
Q4: This module helped me understand the big picture for this immune response.	57	29	11	0	0	4
Q5: The immunology content of the module helped me to understand the relevant pathologic process.	50	39	7	0	0	4
Q6: The material was presented in a format that helped me learn.	57	32	4	4	0	4
Q7: Overall, I have learned something that I consider useful for me as a future clinician.	36	36	21	4	0	4

Discussion

This module was designed for first-year medical students to enhance their understanding of fundamental immunologic concepts. It integrates curriculum at the session level utilizing the methods of contextualization of basic science material and shared teaching, and it provides the students with opportunities for self-testing.⁴ The module is meant to be used as a component of self-directed learning to complement an existing immunology curriculum, rather than as a stand-alone immunology course. However, it can be used in any basic immunology course when students are introduced to the role of the immune system in disease.

A potential challenge to implementation of the module within an immunology course is the lack of familiarity with the incorporated histopathologic images. To circumvent this, we have labeled these images and provided explanations to assist instructors with their interpretation and presentation. Since medical students may need additional help with basic histology interpretation, we have also identified the basic tissue and cell types along with the type of staining for each image.

A limitation of our study was that the response rate for the student survey was low. Since neither class attendance nor completion of the survey was mandatory, we likely did not capture responses for students who are more self-directed learners and actually prefer to use online learning resources to augment their study rather than attend class. It was also a challenge to evaluate the learning module's impact on student learning since it was not possible to design questions based on material that was only covered in the module and not presented elsewhere. For this reason, we based our results on the students' perceptions of the module's usefulness for their learning.

Curriculum integration at the session level offers almost infinite possibilities not just for reinforcing basic science principles that underlie clinical manifestations, but also for introducing students to the interdisciplinary work they will practice throughout their careers. Our comprehensive learning module provides material in several formats and utilizes a variety of active learning strategies, features that are unique and greatly contribute to the current medical education literature. Student survey results indicate the module is clinically relevant and enhances learning. Echoing our students' positive perceptions, we have begun receiving requests from other institutions in the United States to adapt our learning modules as part of their preclinical curriculum.

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Ethical Approval

This publication contains data obtained from human subjects and received ethical approval.

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