Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
An Online Case-Based Clinical Elective in Hematology for Medical Students

Robert T. Means, Jr., MD

Departments of Internal Medicine, Medical Education, and Pathology, James H. Quillen College of Medicine, Johnson City, TN

Blood (2020) 136 (Supplement 1) : 14.

http://doi.org/10.1182/blood-2020-142455

Background: The Covid-19 pandemic has created significant challenges for medical student education. Many if not most medical schools have placed significant limitations on direct patient contact by medical students which may persist indefinitely. Novel approaches are required to provide students with clinical experience. In response to this need, a case-based fourth year medical student (M4) elective was developed.

Description of elective: In the first five offerings of the elective, two to nine M4 students enrolled. M4 electives are scheduled to begin on Mondays. On the first Monday morning, following a brief orientation, a lecture on aspects of the physical examination relevant to Hematology (such as physical findings of anemia, polycythemia, thrombocytopenia, lymph node examination, and spleen palpation) was presented using the Zoom application.

Otherwise, the structure of Monday-Thursday sessions were identical. Each morning by 730 AM, students received an email containing a brief PowerPoint representing the information that was known to the Hematology attending at the time of initial clinic or inpatient referral. All identifiers were removed from the PowerPoint. All cases represented patients actually followed by the elective's faculty member (RTM). Students were expected to research the case and be prepared with additional history questions and additional laboratory tests. For tests requested, students were expected to have a plan for follow-up testing based on the different possible results. Students were also expected to have a differential diagnosis and, where appropriate, a proposal about whether treatment was indicated. At 1PM each day, students and the faculty member assembled on Zoom. After class discussion of the patient's presentation, diagnostic evaluation, and differential diagnosis. Images of blood and bone marrow were provide when appropriate. This segued into a discussion of the natural history, pathophysiology, and
treatment of the patient's clinical diagnosis illustrated by the patient's results and clinical course. Rationale for the clinical decisions made were presented and discussed. Following the discussion, students were provided a copy of the discussion PowerPoint and copies of relevant references. For each case, students were expected to provide a reflective statement indicating what they had known before the case, what they had learned, and issues about which they had additional questions. The students were also asked to submit a diagnostic algorithm for the clinical topic discussed that is relevant for their residency career choice.

Fridays used a different approach. The faculty physician presented an evolving case on Zoom in an effort to replicate something comparable to a real-time clinic experience. A microscope with a web-camera attachment was used to review the patient blood films.

An example of elective topics in one offering of the elective is shown in Table 1.

**Results:** Over the first five offerings of the selective, 30% of the M4 class participated. Three additional offerings are planned in this academic year. Students represented a diverse array of residency aspirations (Table 2), reflecting career aspirations of the overall class. End-of-elective feedback from students was uniformly positive. Features of the elective eliciting favorable comment included that these were real cases; the structure of the Monday - Thursday cases replicating a ward or clinic type experience (student "sees" the patient in the morning and then discusses the case at "attending rounds" in the afternoon); explication of clinical correlations of laboratory tests and their underlying mechanisms; the opportunity to think through the diagnosis while developing the algorithm for each case; feedback on the algorithms and reflective statements; and to the "real-time" nature of the evolving case. Suggestions for improvement mostly reflected a wish that additional areas be covered (lymphoma, acute leukemia and pediatric Hematology).

**Conclusions:** The Covid-19 pandemic has created a need for creative approaches to clinical education and medical students. Hematology, with its strong connection to the diagnostic laboratory, is ideally
situates to provide clinical exposure that allows clear correlation between patient presentation and natural history, foundational basic science, the diagnostic laboratory, and clinical management.

| Table 1. Case topics |
|----------------------|
| **Week 1** | **Week 2** |
| **Monday** | Leukocytosis (CLL) | Elevated ferritin (Hereditary hemochromatosis) |
| **Tuesday** | Leukocytosis (Myeloproliferative 1: CML) | Iron deficiency (Autoimmune gastritis) |
| **Wednesday** | Leukocytosis/Thrombocytosis/Erythrocytosis (Myeloproliferative 2: Polycythemia vera) | Bleeding/bruising (Acquired factor VIII inhibitor) |
| **Thursday** | Thrombocytopenia (ITP) | Thrombophilia (Lupus anticoagulant) |
| **Friday** | Evolving case: Neutropenia (LGL leukemia) | Evolving case: Prolonged PT, anemia; thrombocytopenia (Hematologic complications of liver disease) |

| Table 2. Student residency goals (n=21) |
|---------------------------------------|
| Family Medicine | 6 |
| Internal Medicine/subspecialty | 3 |
| Primary Care, not otherwise specified | 1 |
| Emergency Medicine | 4 |
| Pathology | 2 |
| Pediatrics | 2 |
| Obstetrics/Gynecology | 1 |
| Surgery/subspecialties | 2 |

**Disclosures**

**Means:** WoltersKluwer: Patents & Royalties: Wintrobe Clinical Hematology editor; UpToDate author, editor; Cambridge University Press: Patents & Royalties: textbook editor; SpringerNature: Patents & Royalties: Textbook editor.

**Author notes**

* Asterisk with author names denotes non-ASH members.

© 2020 by the American Society of Hematology