Original Research

ScopeMed

Lupus in medical education: student awareness of basic, clinical, and interdisciplinary aspects of complex diseases

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ABSTRACT

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Objective: Systemic Lupus Erythematosus (SLE) is a systemic autoimmune disease that necessitates a multidisciplinary approach. The aim of our study is to assess the awareness and depth of knowledge of SLE in medical students. By identifying the shortcomings of lupus-related medical education, the results can be generalized to other disease processes that require care from multiple medical specialties. **Methods:** We surveyed undergraduate medical students in two Greek medical schools using a structured questionnaire. The questionnaire consisted of two parts. Part A assessed the students' knowledge of SLE regarding the disease epidemiology, pathology, pathophysiology, diagnosis and treatment. Part B inquired the students about ways that SLE is currently taught in their medical school and suggested methods to improve it. Students were divided into 2 groups according to their medical school curriculum: the preclinical and the clinical years. **Results:** A total of 260 students from both universities participated in our study, 114 students in preclinical years and 146 students in clinical years. We identified several misconceptions about the students' perception of the disease's epidemiology, pathophysiology, clinical manifestations and prognosis as well as statistically significant differences in the responses between the two groups. In addition, students in both groups stated that they would like a more in-depth understanding of SLE through more extensive hands-on experience with its laboratory investigation, seeing more patients in the wards or patient-actors in the auditoriums, watching educational videos and discussing clinical vignettes during lectures. **Conclusions:** These findings could potentially guide medical school faculty on modifying the school curriculum in order to prepare the next generation of physicians. In an era of rapidly enlarging biomedical knowledge, having an intimate understanding of complex disease processes is of paramount importance for optimal health care delivery to patients.

KEY WORDS: Systemic lupus erythematosus; Medical education; Complex diseases; Systemic diseases; Multidisciplinary approach

INTRODUCTION

Systemic lupus erythematosus (SLE) is an autoimmune disease with heterogeneous, multiorgan manifestations. It can present with a variety of signs and symptoms, which poses significant diagnostic and therapeutic challenges to physicians. Having a comprehensive understanding of the disease is of utmost importance to medical students and future doctors for differential diagnosis and proper investigation purposes. Therefore, we decided to assess the knowledge of students at 2 medical schools in Greece. Furthermore, we inquired the student's opinion on current approaches to lupus-related medical education. The aim of our study is to identify weak points in the medical school curriculum concerning lupus and suggest novel approaches in teaching procedure.

MATERIALS AND METHODS

Study design

For the purposes of our study, we structured a questionnaire [Supplemental Material 1] that consisted of 2 parts. The first part (Part A - 11 questions) assessed the students' general knowledge about lupus, including epidemiology, pathogenesis-pathophysiology and clinical manifestations.

The second part (Part B - 8 questions) focused on how SLE is taught in the 2 medical schools and gave students the opportunity to suggest changes to the SLE curriculum. The questionnaire was constructed in Greek language.

When developing questions for our survey, we first searched PubMed for any previous questionnaires used to assess knowledge of SLE. Search terms that were used are: systemic lupus erythematosus, questionnaire, curriculum, medical teaching. Our search did not yield any results. Therefore, the questions in our survey were developed by P.K., K.L, A.C., A.A., and A.B and were approved by the senior authors (P.S, D.B). The purpose was to evaluate the most fundamental and essential concepts about SLE for the clinical practice.

The questionnaires were anonymous, did not contain any identifying information and therefore under exemption of our institutional review board and ethics committee approval.

Inclusion and exclusion criteria

The study was carried out in March 2014. We approached medical students by face-to-face contact and open announcement in both schools and initially asked if they have ever heard of SLE and if the response was positive we handed out the questionnaires. The anonymous questionnaires were

randomly distributed in printed form after classes and lab courses. Participants were divided into two large groups: preclinical and clinical students. Preclinical students were defined as those who mostly attend basic science lectures and laboratory courses, whereas clinical students are entirely involved in clinical rotations at the University affiliated hospitals. Both medical schools have a 6-year medical curriculum. The two medical schools have a slightly different curriculum structure: in University #1, years four to six are the clinical years and there is no clinical exposure in years one to three, whereas in University#2 only the fifth and sixth years are the clinical ones and there is exposure to the clinical setting to a lesser degree in years one to four. First year medical students in both medical schools were excluded from the questionnaire distribution as first year curriculum includes very basic courses, such as anatomy, physiology and biology, which makes student's acquaintance with SLE highly unlikely.

Questionnaire structure and scoring

Most questions had only one correct answer, except for some questions where students could select more than one answer and special instructions were given. In part A, the correct answers (in bold) to the questions derived from the most current literature and guidelines from rheumatologic and lupus associations [1]. In part B, students could choose only one answer for questions structured on a Likert grading scale [2] and more than one answer for questions that inquired about their perception of SLE's importance. Finally, in questions that inquired student's opinion on novel ways to improve SLE education, students could choose more than one question as well as suggest their own preferred method.

Statistical analysis

Answers from the preclinical students were compared with those from the clinical students. Differences in the responses were evaluated using the chi-square test. Odd ratios and p-values were calculated only for the correct answers in the relevant questions and for every answer for the rest of the questions. P-values less than 0.05 were considered to be statistically significant. All analyses were performed using commercially available software (StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: StataCorp LP).

RESULTS

A total of two hundred and sixty eligible students agreed to participate in the survey (participation rate=100%). In University #1, 160 students completed the questionnaire (second-year students, n=30; third year, n=31; fourth year, n=49; fifth year, n=8; and sixth year, n=42). In University #2, 100 students completed the questionnaire (second-year students, n=17; third year, n=16; fourth year, n=20; fifth year, n=24; sixth year, n=23).

Part A – SLE Knowledge Assessment [Table 1]

Students in the clinical years were more likely to have seen or examined a patient with SLE compared to the preclinical students (63% vs 21%, p<0.001). Given this fact, we generally found statistically significant differences in students' responses regarding basic facts, including epidemiology, pathology-pathophysiology and clinical manifestations, with the preclinical students being less likely to choose the correct answers: women are more frequently affected [3] (68% vs 94%, p<0.001), average age of onset is 20-40 years [3] (74% vs 86%, p<.014), SLE can occur in mild or severe forms [3] (85% vs 95%, p=0.004) and the clinical manifestations [Tables 1 & 2]. Specifically, most students seem to recognize that SLE can harm any organ-system in the human body [4], but gastrointestinal, endocrine and sensory (eyes, ears) systems were selected less frequently. Moreover, clinical students tended to choose more systems overall. In a hypothetical case scenario, most students agreed that a complete blood count should be one of the first tests to be performed in high suspicion of SLE when imaging and laboratory resources are limited. Nevertheless, a sizeable number of students were more aggressive in their investigation, with the clinical students being more likely to order lupus anticoagulant studies (54% vs 37%, p=0.006), chest radiograph (51% vs 13%, p<0.001), ESR and CRP (81% vs 41%, p< 0.001), and the preclinical students more likely to choose skin biopsy (32% vs 18%, p< 0.001).

Concerning mortality, we found that both preclinical (55%) and clinical students (72%) reported that opportunistic infections and renal insufficiency account for most deaths in patients with SLE. Interestingly, the vast majority of clinical students failed to recognize that dialysis and renal transplantation has led to improved survival rates in patients with end-stage renal disease [4] and that cardiovascular complications of chronic inflammation are the most hazardous long-term consequences [3]. Lastly, regarding SLE and pregnancy, half of the students in both groups believe that SLE poses significant risks to the fetus and women with lupus should be advised against having a baby.

Notably, we observed comparable response rates between the preclinical and the clinical students in some questions: incidence rate (51% vs 46%, p=.49), most common presenting symptom (24% vs 23%, p=.75) and how the diagnosis is made [5] (81 vs 84%, p=.45)

Part B - SLE Education in Medical Schools [Table 2]

Most students (68% and 82% in preclinical and clinical years respectively) believe that SLE represents a model autoimmune systemic disease that can provide the opportunity for deeper understanding of other systemic autoimmune diseases [Figure 1]. This is further supported by question n.2 responses, where all the participants answered that SLE should be taught in current medical school curricula, with the majority of them choosing its intriguing pathophysiology as a means to elucidate the immune's system regulation mechanisms and its associated disorders (76% and 77% in the preclinical and the clinical years respectively). In addition, 71% of clinical students and half of the preclinical students acknowledge that SLE needs a multidisciplinary approach and therefore is an integral part of the biomedical knowledge taught in contemporary medical schools [Figure 2].

Table 1. Answers to Part A of the questionnaire, comparing preclinical and clinical years

Question	Available Data	Preclinical, N [%]	Clinical, N [%]	OR (95% C.I)	P-value
Have you ever seen a patient with SLE?					
Yes	260	24 [21%]	92 [63%]	0.16 (0.09-0.28)	**< .001**
What do you think is the annual incidence of SLE?					
5 cases per 100.000		30 [27%]	33 [23%]		
50 cases per 100.000	256	57 [51%]	67 [46%]	1.19 (0.71-2.01)	.49
500 cases for 100.000		16 [14%]	31 [22%]		
1000 cases for 100.000		9 [8%]	13 [9%]		
Which gender is more frequently affected in SLE?					
Men		13 [12%]	5 [3%]		
Women	258	76 [68%]	137 [94%]	0.14 (0.06-0.32)	**< .001**
Rate is equal between men and women		23 [20%]	4 [3%]		
What is the average age of onset of SLE?					
0-20		3 [3%]	5 [3%]		
20-40	257	83 [74%]	125 [86%]	0.46 (0.23-0.90)	**.014**
40-60		22 [20%]	15 [11%]		
60+		4 [3%]	0 [0%]		
What is the most common presenting symptom of a patient with SLE?					
Non-specific symptoms [fever, fatigue, weight loss]		30 [27%]	69 [47%]		
Raynaud's phenomenon	257	15 [14%]	8 [5%]		
Malar rash		39 [35%]	36 [25%]		
Arthralgia		27 [24%]	33 [23%]	1.10 (0.59-2.05)	.75
How is the diagnosis of SLE made?					
It is purely a clinical diagnosis		5 [4%]	10 [7%]		
It is mainly a laboratory diagnosis	258	12 [11%]	8 [6%]		
It is mainly a pathologic diagnosis		5 [4%]	5 [3%]		
A combination of clinical, laboratory and pathologic diagnosis		91 [81%]	122 [84%]	0.78 (0.39-1.56)	.45
Which systems are affected in SLE? (you can choose more than one choice)					
Hematopoietic		81 [71%]	126 [86%]	0.39 (0.20-0.76)	**.002**
Cardiovascular		76 [67%]	106 [73%]	0.75 (0.43-1.33)	.30
Skin		96 [84%]	113 [77%]	1.56 (0.79-3.09)	.17
Gastrointestinal		28 [25%]	100 [68%]	0.15 (0.08-0.26)	**< .001**
Respiratory	260	46 [40%]	114 [78%]	0.19 (0.11-0.32)	**< .001**
Musculoskeletal		80 [70%]	144 [99%]	0.03 (0.01-0.14)	**< .001**
Urinary		63 [55%]	125 [86%]	0.20 (0.11-0.37)	**< .001**
Endocrine		32 [28%]	67 [46%]	0.46 (0.27-0.77)	**< .001**
Sensory Organs [eyes, ears]		34 [30%]	85 [58%]	0.30 (0.18-0.51)	**.000**
CNS		64 [56%]	115 [79%]	0.34 (0.20-0.59)	**.000**

Table 1. Resume

Question	Available Data	Preclinical, N [%]	Clinical, N [%]	OR (95% C.I)	P-value
You are working in a rural health center with limited availability of laboratory and imaging equipment. A female patient with a possible diagnosis of SLE comes in. What tests would you order? (you can choose more than one choice)					
Complete blood count		96 [84%]	129 [88%]	0.7 (0.33-1.52)	0.33
ANA and complement		97 [85%]	129 [88%]	0.75 (0.35-1.64)	0.43
Chest radiograph		15 [13%]	74 [51%]	0.14 (0.08-0.27)	< .001
Skin biopsy		32 [28%]	14 [10%]	3.68 (1.85-7.30)	< .001
Urinalysis	260	45 [40%]	97 [66%]	0.33 (0.20-0.55)	.000
Renal ultrasound		29 [26%]	33 [23%]	0.75 (0.35-1.64)	0.43
ESR,CRP		47 [41%]	118 [81%]	0.16 (0.09-0.29)	< .001
Basic blood biochemical panel		49 [43%]	94 [64%]	0.41 (0.25-0.69)	.001
Lupus Anticoagulant Studies		42 [37%]	79 [54%]	0.49 (0.3-0.81)	.006
What is the most common cause of death of patients with SLE?					
Opportunistic infections in the early cause of the disease and renal failure in the late course of the disease		60 [55%]	102 [72%]		
Opportunistic infections in the early cause of the SLE and cardiovascular causes in the late course of the disease	251	22 [20%]	11 [8%]	2.95 (1.36-6.40)	.005
Encephalopathies, especially in middle-aged patients		5 [5%]	4 [3%]		
Thrombotic and thromboembolic episodes, due to concomitant anti-phospholipid syndrome		23 [20%]	24 [17%]		
What's the prognosis of SLE?					
SLE is lethal in 100% of cases		3 [3%]	0 [0%]		
SLE is not a lethal disease	258	5 [4%]	2 [1%]		
SLE can occur in a mild and a severe form		95 [85%]	139 [95%]	0.28 (0.11-0.70)	.004
SLE prognosis is the same with that of hematologic malignancies		9 [8%]	5 [4%]		
A female patient with SLE seeks prenatal counseling. What do you advise her?					
You advise her against having a baby		13 [12%]	1 [1%]		
You inform her that the great majority of women with SLE have uncomplicated pregnancies	252	39 [35%]	70 [49%]	0.56 (0.33-0.94)	.028
You inform her that approx. 1/3 of women with SLE have complicated pregnancies		58 [53%]	71 [50%]		

Table 2. Answers to Part B of the questionnaire, comparing preclinical and clinical years

| Question	Available Data	Preclinical N [%]	Clinical N [%]	OR (95% C.I)	P-value
Why do you think scientists discussing extensively about SLE nowadays? (you can choose more than one choice)					
The etiology of the disease is not yet fully elucidated		34 [30%]	62 [42%]	0.57 (0.34-0.96)	.036
The mortality rate in patients with SLE remains higher compared to the general population		16 [14%]	32 [22%]	0.58 (0.29-1.18)	.1
Current treatment strategies are not targeted and can have severe adverse effects	260	47 [41%]	61 [42%]	0.98 (0.58-1.66)	.93
SLE is a model autoimmune disease and its study will provides the opportunity for deeper understanding of other systemic autoimmune diseases		78 [68%]	119 [82%]	0.49 (0.27-0.87)	.015
Do you think that SLE should be included in current medical school curricula? If yes, why? (you can choose more than one choice)					
Because it affects multiple organs and can therefore bring together different medical specialties		60 [53%]	104 [71%]	0.44 (0.26-0.75)	.002
Because it has an intriguing pathophysiology and may help in elucidating the regulation of the immune system and its associated disorders	260	87 [76%]	112 [77%]	0.98 (0.53-1.82)	.94
Because it can connect basic science teaching with clinical practice		35 [31%]	67 [46%]	0.52 (0.31-0.87)	.013
Would you like to learn more about SLE pathophysiology and its clinical manifestations?					
Definitely or Probably not	258	7 [5%]	4 [3%]	2.34 (0.60-9.81)	.17
Definitely or Probably yes		106 [95%]	142 [97%]	0.43 (0.10-1.68)	.17
From a scale from 1 to 5, please rate how important you think the understanding of the pathophysiologic mechanisms of SLE for the medical student is					
Not/a little important	257	4 [3%]	8 [5%]	0.65 (0.16-2.44)	.48
Moderate/very/extremely important		107 [97%]	138 [95%]	1.55 (0.41-6.31)	.48
Would you like to have more hands-on experience with the laboratory investigation of SLE?					
Definitely or Probably not	258	8 [7%]	29 [20%]	0.31 (0.12-0.75)	.004
Definitely or Probably yes		104 [93%]	117[80%]	3.22 (1.33-8.04)	.004
Do you believe that an elective course specific for SLE should be added to current medical school curricula?					
Definitely or Probably not	258	66 [59%]	88 [60%]	0.95 (0.56-1.61)	.83
Definitely or Probably yes		46 [41%]	58 [40%]	1.06 (0.62-1.80)	.83
How would you like to learn more about patients with SLE? (one or more possible answers)					
See patients in the wards and analyze the disease pathophysiology, diagnosis and treatment		95 [83%]	131 [90%]	0.57 (0.26-1.25)	.13
See a patient-actor with SLE during class and discuss symptoms, diagnosis, differential diagnosis and treatment.	260	23 [20%]	58 [40%]	0.38 (0.22-0.67)	0.001
Watch educational videos with real patients		38 [33%]	41 [28%]	1.28 (0.75-2.17)	.13
Discuss clinical vignettes during lectures		2 [1%]	1 [0%]	n/a	n/a
In which year of studies and which course do you believe that SLE should be first taught?					
1st - Biology or Biochemistry		1 [1%]	2 [1%]	.	1
2nd - Physiology or Histology and immunology		32 [30%]	17 [12%]	3.23 (1.68-6.22)	.000
3rd - Pathologic physiology or Pathology	253	57 [53%]	92 [63%]	0.67 (0.39-1.15)	.12
4th – Introduction to Internal Medicine		15 [14%]	28 [19%]	0.69 (0.33-1.43)	.28
5th - Rheumatology		1 [1%]	6 [4%]	.	1
6th - Internal medicine		1 [1%]	1 [1%]	.	1
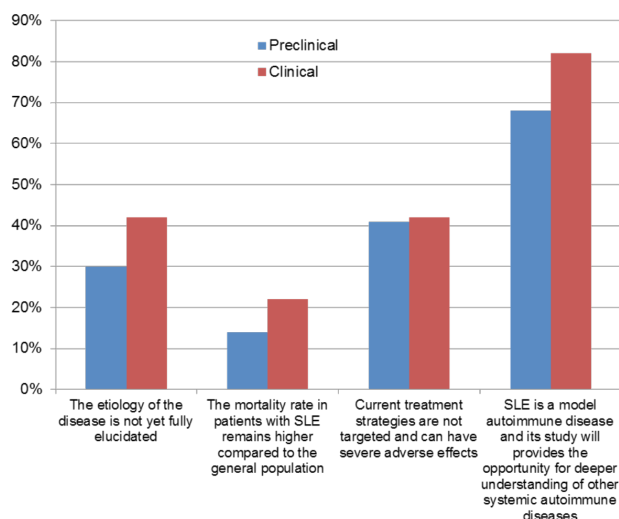
Figure 1. Students' responses about why scientists discuss extensively about SLE nowadays
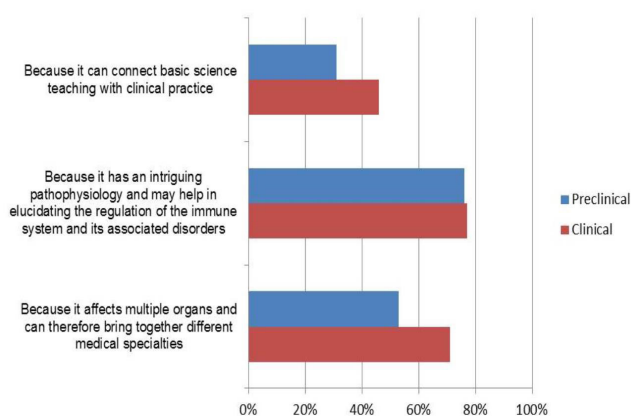

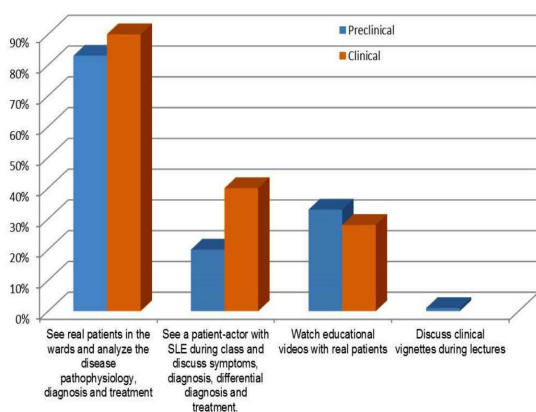**Figure 2.** The reasons why SLE should be taught in medical schools according to participants

Figure 3. Students' opinion on they would like to learn more about SLE

Regarding the students' desire to study SLE in more depth, 95% of preclinical and 97% of clinical students stated that they would like to learn more about the pathophysiology of SLE and its clinical manifestations. Similar responses applied also to question number 4, where participants consider the understanding of the pathophysiologic mechanisms for current medical students important. In addition, more extensive hands-on experience with the laboratory investigation of SLE is preferred by 93% of the preclinical students. Likewise, most students from clinical years (80%) agreed with this proposal. Surprisingly, although most students are eager to learn more about lupus, approximately 60% in both groups answered that an elective course for SLE should not be currently included in the medical curriculum.

In question number 7, students were inquired about their preferred method(s) of choice to learn more about patients with SLE [Figure 3]. They were free to choose more than one answer as well as to write down their own ideas. The majority (83%) of preclinical students from both institutions wish to gain further experience with patients in the wards, where they can discuss with the faculty and the residents the disease pathophysiology, diagnosis and treatment; fewer wanted to see patient-actors in the lecture theaters (20%) or use educational videos (33%).

Lastly, a few students added that they would like to discuss relevant clinical vignettes during lectures. We observed a similar distribution of answers from the clinical students, although the preference for seeing actual patients was higher (90%). More than 50% of students (57 in preclinical years and 94 in clinical years) in both preclinical and clinical years believed that SLE should start to be taught during year 3 (of a 6-year medical curriculum) as part of pathology or pathophysiology. According to a smaller percentage of students (20%), year 2 was more suitable, probably in physiology or histology, or year 4 (17%), when students have their first official contact with patients in the Introduction to Clinical Medicine course [Figure 4].
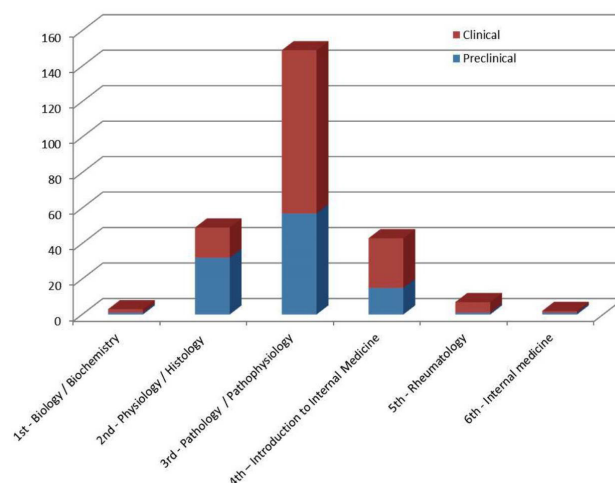

Figure 4. The ideal year of studies and class to start teaching about SLE, according to participating students overall

DISCUSSION

Medical education is unquestionably the most important step in a physician's career. During undergraduate studies, students expose themselves to multiple different biomedical areas and learn to acquire a wide variety of skillsets, ranging from basic laboratory skills to broad clinical knowledge and health care delivery. In the era of personalized and precision medicine, medical knowledge expands exponentially and our understanding of the human body and human disease is more profound than ever. Medical students are bombarded with medical information that can be difficult to handle unless there is structured, organized guidance from the faculty.

Medical school curriculum in the United States, which is an education model for several other countries, changes at a very slow pace. Time is limited during the clinical years and in most schools students do not have the luxury of conducting a laboratory investigation firsthand. Accreditation agencies are not taking any initiatives to correct these obstacles because no persuasive evidence suggests that this experience changes physician competency. However, a suggestion for such a curriculum has already been published [6] and the current study can act as a trigger for a number of future studies that could test the extent of exposure to laboratory medicine that is appropriate during medical education.

During their busy clinical rotations, students rarely have the time to reflect on their basic science knowledge; this lack of integration is a definite shortcoming to the curriculum because at the clinical stage, students are more mature and can transfer knowledge more easily from bench to bedside. Unfortunately, as Magid et al commented [7], little progress has occurred in the integration of the required pathology in the clinical years. A recent study from the University of Pittsburgh [8] reported that this integration is welcomed by the students and helps them acquire a deeper comprehension of pathophysiologic mechanisms and targeted therapeutics. The same team also suggested that students can investigate different clinical and science perspectives of a disease through problem-based learning. This opinion is supported by Diaz-Perez et al [9] and Dequcker et al [10] as well, who used informatics and videos in the problem-solving process to provide their audience with a well-rounded perspective through active learning. Surprisingly, a study by Des Marchais et al [11] extensively studied problem-based learning method and concluded that weekly tutor-dependent written exercises and standardized oral examinations would enhance student performance. Their study is of great importance, as it showed that students are mainly motivated by examinations and they adjust their studying approaches accordingly.

Lupus is also a great example of a disease that must be well understood at the basic science level, as evidenced by the majority of our students choosing "because it can connect basic science teaching with clinical practice" as the reason for discussing extensively about lupus. A review of the current literature on current lupus education approaches as well as general teaching methods reveal a wealth of ongoing discussion. A recent study from Harvard Medical School recently published on a novel elective rotation as a great start for a holistic student experience [12]. The students not only followed the visits of a patient with SLE across all medical specialties but also participated in the laboratory investigation, where they learned the testing protocols that accompany lupus diagnosis. In the present study, although around 60% of the students stated that an elective course specific for SLE should not be currently included in the medical curriculum, more than 86% of the participating body expressed a desire to participate in the laboratory investigation of SLE. A possible interpretation for this discrepancy is that students feel there is a lack of laboratory exposure in their medical training but such a specific course is not one of the priorities of curriculum remodeling.

Unfortunately, as Wilson correctly stated, the new Harvard clerkship is an exemption and a similar experience is not offered elsewhere [6]. Corroborating the potential impact of such a clerkship experience, the majority of our surveyed students (63%) believe that lupus could serve as a great bridge between medical sub-specialties. Lupus may not be commonly encountered during residency, but it is an opportunity for students to learn to value the benefits of teamwork. Ogino et al [13] stressed the importance of interdisciplinary education between pathologists, physicians, and epidemiologists to create the infrastructure for the new era of molecular epidemiology, which is important for lupus as no two patients with SLE have the exact same underlying molecular pathology.

An interesting suggestion comes from van Gessel et al [14], who proposed a transitional learning unit from the preclinical to clinical years in order to train students on basic and standardized problems before they encounter the complex nature of the admitted patients. Such a learning unit should foster the creation of links between the basic sciences and the diagnostic approach, emphasizing the recognition of key findings, and establish a hierarchical classification of working hypotheses. Furthermore, Kassebaum et al [15] underscored that schools with well-designed objectives that identify items of measurable knowledge are more likely to have an evolving curriculum, problem-based learning, rich basic science courses, and effective student assessment tools. Such a structured plan of evaluation could possibly help incorporate laboratory medicine experience into the curriculum by aiding schools to adapt dynamically to student performance.

Study strengths and limitations

To the best of our knowledge, this is the first study to assess medical students' knowledge and awareness of basic, clinical and interdisciplinary elements of a complex disease process, ie SLE. We used a structured questionnaire with questions that were approved by the senior authors (P.S and D.B), which have years of clinical expertise in lupus and medical education. Our study has some inherent limitations as well. As with any survey-based study, there is a risk of interviewer and sampling bias. In order to mitigate that error,

we consulted statisticians to ensure that all questions are constructed in an unbiased and simple yet comprehensive way. Future studies that will incorporate basic-laboratory and clinical aspects into an integrated model are needed in order to provide deeper insight in the optimal student education models.

CONLUSION

In the present study we used a structured questionnaire to assess the students' knowledge and awareness of SLE. Moreover, their opinions on current lupus-related medical education and suggestions on ways to improve it were recorded. The findings of our study can guide medical schools on a global scale in shedding more light on novel methods of approaching SLE education as well as other systemic diseases that require a multidisciplinary approach.

CONTRIBUTORS

Conception: PS, GB and DB; Questionnaire design: PK, KL, AA, AC and AB; Distribution of questionnaires: PK, KL, AA, AC, AB and AL; Analysis and interpretation of data: PK, KL, AA, AC and AB; Drafting the manuscript: PK and KL; critically revising the article: PS, GB, MB, and DB; Reviewed submitted version of manuscript: all authors; approved the final version of the manuscript on behalf of all authors: PK, PS and DB; Study supervision: PS, GB and DB.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The questionnaires were anonymous, did not contain any identifying information and therefore under exemption of our institutional review board and ethics committee approval.

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QUESTIONNAIRE

Part A

1. Have you ever seen a patient with SLE?
☐ 1. Yes
☐ 2. No

2. What do you think is the annual incidence of SLE;
☐ 1. 5 cases per 100,000
☐ 2. **50 cases per 100,000**
☐ 3. 500 cases per 100,000
☐ 4. 1000 cases per 100,000

3. Which gender is more frequently affected in SLE?
☐ 1. Men
☐ 2. **Women**
☐ 3. Rate is equal between men and women

4. What is the average age of SLE onset?
☐ 1. 0 – 20
☐ 2. **20 – 40**
☐ 3. 40 – 60
☐ 4. 60 +

5. What is the most common presenting symptom of a patient with SLE?
☐ 1. Non-specific symptoms (low-grade fever, malaise, weight loss)
☐ 2. Raynaud's phenomenon (vasoconstrictive disorder characterized by episodes of transient decreased blood supply to fingers and toes)
☐ 3. Malar rash
☐ 4. **Arthralgia**

6. How is the diagnosis of SLE made?
☐ 1. It's a purely clinical diagnosis
☐ 2. It's mainly a laboratory diagnosis
☐ 3. It's a pathologic diagnosis
☐ 4. **It's a combination of the above**

7. Which organ systems are affected in a patient with SLE? (you can choose more than one choice)
☐ 1. **Hematopoietic**
☐ 2. **Cardiovascular**
☐ 3. **Skin**
☐ 4. **Gastrointestinal**
☐ 5. **Respiratory**
☐ 6. **Musculoskeletal**
☐ 7. **Urinary**
☐ 8. **Endocrine**

☐ 9. **Sensory organs (eyes, ears)**
☐ 10. **Central Nervous System**

8. You are working in a rural health center with limited availability of laboratory and imaging equipment. A female patient with a possible diagnosis of SLE comes in. What tests would you order? (you can choose more than one choice)
☐ 1. Complete blood count (CBC)
☐ 2. Autoantibodies and complement levels
☐ 3. Chest x-ray
☐ 4. Skin biopsy
☐ 5. Urinalysis
☐ 6. Renal ultrasound
☐ 7. CRP, ESR
☐ 8. Basic blood biochemical panel
☐ 9. Lupus Anticoagulant Studies

9. What is the most common cause of death in patients with SLE?
☐ 1. Opportunistic infections in the early cause of the disease and renal failure in the late course of the disease
☐ 2. **Opportunistic infections in the early cause of the SLE and cardiovascular causes in the late course of the disease**
☐ 3. Encephalopathies, especially in middle-aged patients
☐ 4. Thrombotic and thromboembolic episodes, due to concomitant anti-phospholipid syndrome

10. What's the prognosis of SLE?
☐ 1. SLE is lethal in 100% of cases
☐ 2. SLE is not a lethal disease
☐ 3. **SLE can occur in a mild and a severe form**
☐ 4. SLE prognosis is the same with that of hematologic malignancies

11. A female patient with SLE seeks prenatal counseling. What do you advise her?
☐ 1. You advise her against having a baby
☐ 2. **You inform her that the great majority of women with SLE have uncomplicated pregnancies**
☐ 3. You inform her that approx. 1/3 of women with SLE have complicated pregnancies

1

Part B

1. Why do you think scientists discuss extensively about SLE today? (you can choose more than one answer)
   ☐ 1. The etiology of the disease is not yet fully elucidated
   ☐ 2. The mortality rate in patients with SLE remains higher compared to the general population
   ☐ 3. Current treatment strategies are not targeted and can have severe adverse effects
   ☐ 4. SLE is a model autoimmune disease and its study will provide the opportunity for deeper understanding of other systemic autoimmune diseases

2. Do you think that SLE should be included in current medical school curricula? If yes, why? (you can choose more than one answer)
   ☐ 1. Because it affects multiple organs and can therefore bring together different medical specialties
   ☐ 2. Because it has an intriguing pathophysiology and may help in elucidating the regulation of the immune system and its associated disorders
   ☐ 3. Because it can connect basic science teaching with clinical practice

3. From a scale from 1 to 5, please rate how important you think the understanding of the pathophysiologic mechanisms of SLE for the medical student is
   ☐ 1. Not important at all
   ☐ 2. A little important
   ☐ 3. Important enough
   ☐ 4. Very important
   ☐ 5. Extremely important

4. Would you like to have more hands-on experience with the laboratory investigation of SLE?
   ☐ 1. Absolutely not
   ☐ 2. Probably not
   ☐ 3. Probably yes
   ☐ 4. Absolutely yes

5. Do you believe that an elective course specific for SLE should be added to current medical school curricula?
   ☐ 1. Absolutely not
   ☐ 2. Probably not
   ☐ 3. Probably yes

   ☐ 4. Absolutely yes

6. Would you like to learn more about SLE pathophysiology and its clinical manifestations?
   ☐ 1. Absolutely not
   ☐ 2. Probably not
   ☐ 3. Probably yes
   ☐ 4. Absolutely yes

7. How would you like to learn more about SLE? (you can choose more than choice)
   ☐ 1. See patients in the wards and analyze the disease pathophysiology, diagnosis and treatment
   ☐ 2. See a patient-actor with SLE during class and discuss symptoms, diagnosis, differential diagnosis and treatment.
   ☐ 3. Watch educational videos with real patients
   ☐ 4. Other ways:
   _____
   _____
   _____

8. In which year of studies and which course do you believe that SLE should be first taught?
   Please fill out here _____

2