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ISSUES & OPINIONS

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Virtual neuromuscular ultrasound courses during COVID-19 pandemic: Leveraging technology to enhance learning opportunities

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Abstract

Introduction/Aims: Hands-on supervised training is essential for learning diagnostic ultrasound. Unfortunately, the coronavirus disease 2019 (COVID-19) pandemic led to suspension of in-person training courses. As a result, many hands-on training courses were converted into virtual courses during the pandemic. Several reports regarding virtual ultrasound courses exist, but none has addressed virtual neuromuscular ultrasound courses, their design, or participants' views of this form of training. Therefore, the aims of this study were: (1) to determine the feasibility of conducting virtual neuromuscular ultrasound courses during the COVID-19 pandemic; and (2) to report the positive and negative aspects of the courses through the analyses of the responses of post-course surveys.

Methods: Two virtual neuromuscular ultrasound courses, basic and intermediate level, were conducted by the Egyptian Neuromuscular Ultrasound society during August 2020. Post-course, the attendees were directed to an electronic survey that consisted of eight questions. Ninety-three responses (23.8%) were obtained from the survey of the basic course and 156 responses (44.4%) were obtained from the survey of the intermediate course.

Results: Ninety-eight percent of the respondents to basic course surveys, and 100% of the respondents to the intermediate course survey found the courses useful or very useful.

Discussion: This report demonstrates the utility of virtual neuromuscular ultrasound courses for those participants willing to respond to a survey and describes a proposed design for such courses. Although hands-on supervised ultrasound training is ideal, virtual courses can be useful alternatives to in-person training when in-person interaction is restricted.

KEYWORDS
COVID-19, neuromuscular ultrasound, training, ultrasound imaging, virtual course

Abbreviations: COVID-19, coronavirusvirus disease 2019; CPD, Continuing Professional Development.

1 | INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic negatively impacted health and economics as well as in-person medical training. Almost all scheduled hands-on ultrasound courses were suspended during the pandemic. As a result, the Egyptian Neuromuscular Ultrasound Society converted the in-person neuromuscular courses that were planned to be held in August 2020 into virtual courses. A few reports have documented the effectiveness of virtual education in different ultrasound domains,[1-3] and one has addressed residents' neuromusculoskeletal education via teleguidance technology,[4] but none has reported the designs or participants' views of virtual neuromuscular ultrasound courses. Therefore, the authors' aims in this report were to: (1) determine the feasibility of conducting virtual neuromuscular ultrasound courses during the COVID-19 pandemic; and (2) report the positive and the negative aspects of the courses through the analyses of the responses of post-course surveys.

2 | METHODS

2.1 | Course descriptions and designs

Two consecutive virtual neuromuscular ultrasound courses (basic and intermediate levels) were organized by the Egyptian Neuromuscular Ultrasound Society during the pandemic in collaboration with the African Society of Musculoskeletal and Neuromuscular Ultrasound and the Physical Medicine & Rehabilitation Department – Ain Shams University. The aim of the faculty was to provide interested physicians with continuing medical education in neuromuscular ultrasound during the pandemic. The courses were open to anyone from any country at no charge.

The two courses were held via the Zoom platform (Zoom Video Communications, Inc., San Francisco, CA). The Pro monthly plan with Webinar Add-ons was chosen, which allows an unlimited number of webinars for an unlimited time and up to 500 attendees. Each course was given over 2 days: the basic course was held August 10–11, 2020, and the intermediate course was held August 27–28, 2020.

The courses' faculty members were international neuromuscular experts who have experience as neuromuscular ultrasound speakers and tutors. The basic course faculty included authors E.T., F.W., M.C., N.A., and P.I., and the intermediate course faculty included authors A.K., D.L., E.T., and N.W.

The learning objectives and the curriculum of the two courses were derived from the published guidelines for neuromuscular ultrasound training.[5] The courses' programs are shown in Supporting Information Figures S1 and S2, which are available online The target audience included physiatrists, neurologists, clinical neurophysiologists, rheumatologists, radiologists, neurosurgeons, and orthopedic surgeons. No prerequisites were required to attend the basic course, but previous basic neuromuscular ultrasound training was recommended before attending the intermediate course to achieve maximum benefit from the course. The official language was English, and registration was free for both courses. The basic course was approved by the Federation of the Royal College of Physicians of the United Kingdom for six category one (external) Continuing Professional Development (CPD) credits.

The courses included live lectures as well as demonstration sessions to try to substitute for the lack of hands-on supervised training. Almost all demonstration sessions in the two courses took the form of pre-recorded videos showing tracings of nerves and muscles. The basic course included one live streaming session demonstrating live tracing of lower limb nerves. The form of the demonstration session and the preparation method of the pre-recorded videos were left to the preference of each speaker and are described in Table 1. The videos that were pre-recorded via video camera or the offline recording software were uploaded on YouTube (Google; Mountain View, CA) prior to the courses. During the scheduled demonstration sessions, the attendees were directed to a link to view the pre-recorded videos and they were instructed to return to the main platform to continue the course. Each lecture/demonstration session was followed by a 10-min live "question and answer" sessions. An additional discussion session was also provided at the end of each day. The attendees submitted their questions in the "questions and answers" chat box on their screens and the speakers answered questions instantly online. At the end of each course, the attendees were directed to an anonymous electronic survey (Google Forms). The same

TABLE 1 The various forms of demonstration sessions and the technology used in each option

Form of the demonstration session	The technology used
1. Pre-recorded ultrasound videos embedded in PowerPoint (Microsoft, Redmond, WA) with demonstration during live lectures.	None
2. Pre-recorded ultrasound videos with voiceover editing.	Open Broadcaster Software (OBS) Studio (https://obsproject.com)
3. Prerecorded demonstration: Prerecorded Picture-in-Picture (PiP, Google, Mountain View, CA) recording with audio.	Video camera
4. Live demonstrations: Livestream of PiP ultrasound and scanning technique with live audio	A. Hardware: • Videocamera HDMI to PC video capture card (Dark crystal HD Capture, AverMedia, New Taipei City Taiwan). • Ultrasound DVI to PC video capture card • Microphone to audio interface (Zoom HN4) to PC audio input B. Software: • Capture Studio (AverMedia) • Open Broadcaster Software (OBS) studios.

survey was used for the two courses and included eight questions. The second question included two sub-questions to rate the course program and the organization, and the third question included subsections for rating each lecture (Table 2). The responses were then collected and analyzed. After the courses, certificates of attendance were sent to the attendees via email after verifying attendance through the attendance report generated by the platform.

The two courses were recorded, and the recordings were uploaded to an online channel created specifically for the courses. A link to the recordings was sent via email to the course attendees to allow them to view any missed sessions for 3 mo after the event.

3 | RESULTS

In total, 534 registrants registered to the basic course and 406 registrants registered to the intermediate course, but not all attended the event. A total of 390 participants attended the basic course and 351 participants attended the intermediate course. The attendees were from 44 countries and 5 continents including Africa, Asia, Europe, and North and South America. Live attendees in each session ranged from 180 to 250. A majority of the participants attended more than 80% of the basic course time on the first (56%) and second day (59%); Attendance for more than 80% of the time was similar in the intermediate course: 55% on the first day and 64% on the second. The majority of those who attended more than 80% of the course time joined the courses from the start. A small group, not more than 11.8% of the participants, attended for less than 20% of the courses' time. Analysis of the attendance pattern showed that many attendees logged out of the courses and re-logged in again several times within a few minutes.

Nearly all attendees were physicians and only 17 participants were non-physicians. Clinicians constituted most of the attendees. The majority were physiatrists, neurologists, clinical neurophysiologists, rheumatologists, and radiologists. A few internists, pediatricians, and surgeons attended the course. The non-physicians included technologists, medical imaging officers, clinical business directors, executive directors, and product managers.

Ninety-three attendees (23.8%) responded to the basic-course survey and 156 attendees (44.4%) responded to the intermediate-course survey. More than 97% of the respondents found the two courses either extremely useful or useful. The overall impression of the events was excellent or good. Most of the respondents found the courses' programs and organization excellent (Figure 1). When asked to rate the degree of usefulness of each lecture/session, more than 90% of the respondents found all lectures either extremely useful or useful.

The best aspects, the worst aspects, and the impact of the courses as judged by the respondents are shown in Table 3. All respondents to the question asking about the extent of presenters' bias believed that all speakers provided a well-balanced and evidence-based view of the topics. The negative aspects of the courses included occasional network interruptions, lack of hands-on training, a low sound level in some video recordings, and time zone differences that did not suit all attendees. When the attendees were asked if they had

TABLE 2 Survey questions for the two virtual courses and rating categories (in parentheses)

1. How useful did you find the event? (Extremely useful, useful, fairly useful, not useful).
2. What was your overall impression of this event as regards: (a) the program and (b) the organization? (Excellent, good, fairly good, poor, very poor).
3. How useful to you personally was each lecture (consisted of subsections according to the number of lectures)? (Extremely useful, useful, fairly useful, not useful).
4. What was the best aspect of this event? (Short answer text).
5. What was the worst aspect of this event? (Short answer text).
6. What impact will this event have on your future practice? (Short answer text).
7. To what extent did the presenters provide a balanced (evidenced based where possible) view of the topic? (Short answer text).
8. Please write down any additional comments or suggestions (short answer text).

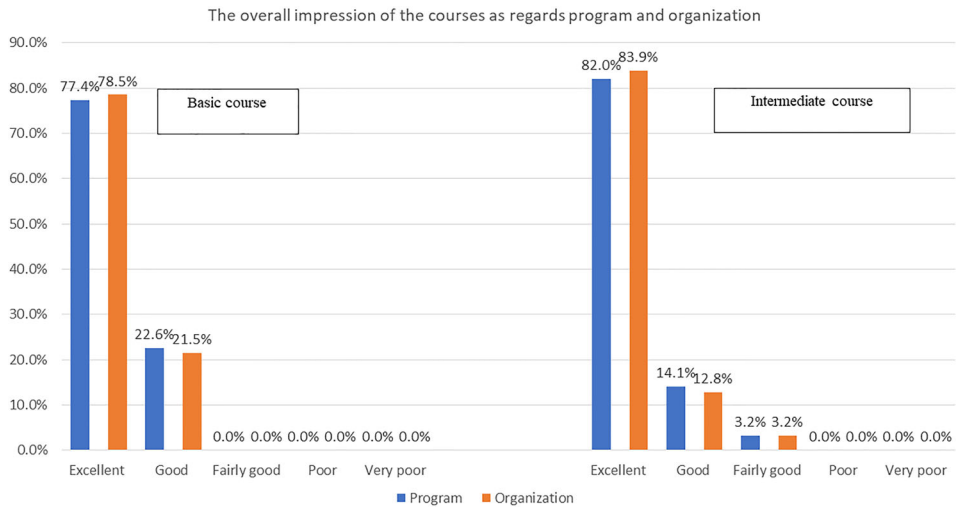

FIGURE 1 Survey respondents' rating of the courses' program and organization

TABLE 3 Best and worst aspects of the courses and courses' impact on attendees' future practice

Best aspects	Worst aspects	Impact on attendees' future practice
1. Skilled presentable speakers. 2. Meeting experts in the field and sharing their knowledge 3. Informative excellent lectures 4. Video demonstrations and live presentations 5. Practical tips given by the faculty 6. Anatomy is well explained 7. Questions/answers sessions and willingness of speakers to answer all questions 8. Case-based discussions 9. Continued education during the pandemic 10. Excellent organization and sharp schedule 11. Being online and made available to view again. 12. The new knowledge presented during the courses	1. Occasional network disruption. 2. Difference in time zone between countries 3. Lack of hands-on training 4. Some lectures were scientifically heavy for some attendees 5. Low sound level in some videos	1.Tremendous, valuable impact. 2. Increased interest in NMUS 3. Better understanding of NMUS-EDX interrelationship 4. Fine tuning of practical skills 5. Will improve patient's care 6. Will encourage setting up new ultrasound service in practice and integrating NMUS with EDX. 7. Enriched the knowledge about NMUS. 8. Open new horizon in clinical and research work 9. Helped to know when to refer patients to NMUS 10. Will improve ultrasound examination techniques and clinical applications

Abbreviations: EDX, electrodiagnosis; NMUS, neuromuscular ultrasound.

other comments or suggestions, the majority mentioned that all course aspects were satisfactory. Some respondents requested similar courses as well as an advanced course in the future. Others suggested more breaks between the sessions, more video demonstrations and case-based discussions, post-session knowledge assessment, and distributing the course content over three or more days.

4 | DISCUSSION

This report demonstrates the feasibility of conducting virtual neuromuscular ultrasound courses that could help in planning future virtual courses. The proposed design of the courses was derived from published guidelines for neuromuscular ultrasound training and was positively perceived by those who responded to the survey. Nevertheless, it should be noted that the educational value of the courses is unknown. We did not objectively assess the learning outcome because the large number of course registrants made it impractical to apply pre- and post-course tests.

The two courses were free of charge to eliminate the financial burden on the participants during the difficult times of the pandemic. The absence of a need to pay for the course and travel costs is a great advantage to individuals with limited resources or to those who live far from the locations at which most courses are held. However, the lack of fees may have encouraged enrollment of participants with only borderline interest in the topic who may have thus been less motivated to attend the full course or to complete a feedback survey.

The faculty presented the lectures online during the course to keep the live nature of the courses and to allow maximum interaction between the speakers and the attendees. In contrast, many of the speakers preferred to pre-record the practical video demonstrations instead of performing live demonstrations. Live streaming of demonstrations can be technically demanding and requires direct interaction between the demonstrator and the volunteer/assistants which was not a safe option during the pandemic. Moreover, pre-recording the videos avoids video lag that commonly occurs when using online video communication platforms. An attractive alternative to hands-on training is teleguidance which allows distant supervised scanning.[1,2,4] Teleguidance involves simultaneous live streaming of the ultrasound image and/or the scanning technique via a virtual platform or directly through a hand-held ultrasound device (eg, Butterfly iQ, Butterfly Network, Guilford, CT). Either setting allows the faculty to evaluate the displayed image and guide the learner to capture the optimum image. We did not consider teleguidance in our courses because it is more suitable for one-on-one training, or at most a very small group of trainees,[1,2,4] while our courses were planned to target a broader audience on a global level.

The analysis of the attendance pattern showed that the majority of the participants who attended more than 80% of the courses' time joined the courses from the beginning suggesting dedicated interest. Frequent re-logging of the participants may be related to connection problem. Network interruption is common during live stream instruction and was reported by survey respondents; their prompt reconnection provides further evidence of engagement with the course.

The major disadvantage of virtual ultrasound courses is the lack of supervised hands-on training. This limitation is unavoidable during social distancing, but as mentioned previously other solutions like teleguidance have been reported. Another disadvantage is the time zone difference, which did not allow some of the participants to attend the full course. To overcome this limitation, we have made the recordings of the courses available for 3 mo after the course to allow the attendees to view any missed sessions.

The main limitation of this report is a response rate of 23.8% and 44.4% in the basic and intermediate course surveys, respectively, despite a short, focused format of the surveys. In general, Web-based or email surveys achieve lower response rates compared to paper surveys. Previous literature has reported response rates ranging from 20% to 32.3%.[3,6-10] The reasons behind low response rates are not well known but may be related to time constraints, lack of motivation to complete the survey, lack of rewards, lack of fees for the courses, or dropout of some attendees before the end of the course. We could have obtained higher response rates if filling out the survey was required to obtain the certificate of the attendance, but we preferred to keep the survey optional. .

In conclusion, in this report, the authors demonstrate the feasibility of providing an-online neuromuscular ultrasound course and document its positive and negative aspects. The findings indicate that virtual neuromuscular ultrasound courses could represent reasonable alternatives to in-person training when social distancing is mandatory as during the COVID-19 pandemic. Compared to the traditional in-person courses, virtual courses have several advantages. They allow easy gathering of experts without the need to travel and facilitate delivery of information to a wide audience of those unable to attend in-person training. This can facilitate introduction to neuromuscular ultrasound and fulfill part of the educational needs as the interest in neuromuscular ultrasound grows. The listed course disadvantages and limitations in this report provide insights to improve future courses. Furthermore, objective proof of the educational value of the virtual ultrasound courses is needed before integrating them as learning formats in other institutions.

The role of virtual ultrasound courses post-pandemic is unknown yet, but the authors believe that they will remain a part of the learning process in the future. A hybrid form of courses could be an option in the transition phase before returning to the normal pre-pandemic life. Even after the pandemic ends, hybrid courses may remain an attractive option as they combine the best features of online and in-person learning, and can be more flexible and cost-effective compared to the traditional in-person learning. Virtual courses could be utilized as a preparatory step before the practical hands-on training to save time during in-person courses for extensive hands-on training. They could also be used for distant training to provide a mentor in areas where no mentor is available. Moreover, they could be implemented in certification programs instead of the online pre-recorded modules that lack live interaction between the instructor and the participants.

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CONFLICT OF INTERESTS

None of the authors has any conflict of interest to disclose.

ETHICAL PUBLICATION STATEMENT

We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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