WJMER

World Journal of Medical Education and Research

An Official Publication of the Education and Research Division of Doctors Academy

DOCTORS ACADEMY

BETTER EDUCATION. BETTER HEALTH.

ISSN 2052-1715

Introduction

The World Journal of Medical Education and Research (WJMER) (ISSN 2052-1715) is an online publication of the Doctors Academy Group of Educational Establishments. Published on a quarterly basis, the aim of the journal is to promote academia and research amongst members of the multi-disciplinary healthcare team including doctors, dentists, scientists, and students of these specialties from around the world. The principal objective of this journal is to encourage the aforementioned, from developing countries in particular, to publish their work. The journal intends to promote the healthy transfer of knowledge, opinions and expertise between those who have the benefit of cutting edge technology and those who need to innovate within their resource constraints. It is our hope that this will help to develop medical knowledge and to provide optimal clinical care in different settings. We envisage an incessant stream of information flowing along the channels that WJMER will create and that a surfeit of ideas will be gleaned from this process. We look forward to sharing these experiences with our readers in our editions. We are honoured to welcome you to WJMER.

Volume 29, Issue 1, 2023, World Journal of Medical Education and Research (WJMER). An Official Publication of the Education and Research Division of Doctors Academy Group of Educational Establishments.

Electronic version published at	:	Doctors Academy UK, 189 Whitchurch Road, Cardiff, CF14 3JR, South Glamorgan, United Kingdom
Print version printed and published at	:	Abbey Bookbinding and Print Co., Unit 3, Gabalfa Workshops, Clos Menter, Cardiff CF14 3AY
ISBN	:	*978-93-80573-90-8.*
Designing and Setting	:	Doctors Academy, DA House, Judges Paradise, Kaimanam, Trivandrum, 695018, Kerala, India
Cover page design and graphics	:	Sreekant h S.S
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A WELCOME MESSAGE FROM THE EDITORS

It is with great pleasure that we bring you the twenty-ninth edition of the World Journal of Medical Education and Research (WJMER), which includes several noteworthy articles from around the world.

The opening article by Ma et al. explores how Special Study Modules (SSMs) can allow medical students with an interest in Plastic Surgery to engage with the specialty. An SSM in Plastic Surgery was designed, and feedback was received from medical students who participated in the pilot.

In the following article, Chan et al. report two cases of breast angiosarcoma and discuss the differences encountered between the two types. They conclude that, whilst surgery is the mainstay of treatment for the disease, the role of adjuvant treatment remains uncertain.

Rowe et al. evaluate an online e-learning musculoskeletal medicine programme for junior emergency doctors. The programme was launched online, and the Kirkpatrick Model was used to assess its impact on learners. The study shows that a bespoke musculoskeletal medicine e-learning programme increases the knowledge acquisition of emergency doctors.

Borrelli questions why the human body attacks rapidly dividing cancer cells but not a fast-growing foetus. This literature review deduces that, whilst there have been new discoveries regarding the immune cells involved in promoting the anti-inflammatory and tolerogenic environment seen in pregnancy, the full extent of this across the entire gestation period is still not completely understood. There are continuous findings that support the idea that sex hormones during pregnancy play a role in promoting this environment, but there are controversies as to whether they induce protection against cancer.

The penultimate article by Enoch delves into the unprecedented rise of vaping among teenagers, a trend that has gained significant traction in recent years. She examines the factors specifically influencing teenagers' attraction to vaping, its impact on their health, and the unique regulatory challenges vaping poses in this demographic. Additionally, the article discusses the potential benefits and risks associated with vaping, including its perceived efficacy as a smoking cessation tool and the concerns regarding its long-term effects on the user's well-being and health.

This edition concludes with an analysis of the effect of a surgical skills course on the self-evaluated competency levels of medical students and junior doctors by Williams et al.. The study finds that a one-day surgical skills course resulted in a statistically significant improvement in the self-evaluated competency levels of medical students and junior doctors in essential surgical skills pertinent to their level. It evidences the ability of a short surgical skills course to prepare medical students and junior doctors for clinical practice.

We sincerely hope that you find these articles engaging, intellectually-stimulating, and enjoyable to read.

Ms Karen Au-Yeung
Associate Editor

Dr Rebecca Williams
Associate Editor

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An Official Publication of the Education and Research Division of Doctors Academy

Special Study Modules on Plastic Surgery in the Undergraduate Curriculum – A Medical Student Perspective

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WJMER, Vol 29: Issue 1, 2023

Abstract:
This article explores how Special Study Modules (SSMs) can allow medical students with an interest in Plastic Surgery to engage with the specialty. An SSM in Plastic Surgery is designed, and feedback is received from 13 third-year medical students who participated in the pilot.

Key Words:
Medical School Curriculum; Medical Student; Plastic Surgery; SSM

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Revisions of the medical school curriculum have resulted in Plastic Surgery occupying a 'near-negligible' portion of the curricula in several medical schools with only 16.5% medical school curricula offering compulsory Plastic Surgery teaching in 2013 compared to 78% in 1986.[1,2] Studies have shown that career choices of medical students are strongly influenced by experiences in medical school.[3] Therefore, to optimise the future sustainability of this specialty, innovative methodologies in fostering medical student engagement must be explored. [4]

The use of Special Study Modules (SSMs) is an effective method of improving engagement with medical students. This view is explored by Siraj et al in their cross-sectional study evaluating the SSM experiences of both students and alumni of a medical school. Ninety percent of respondents in both groups felt the modules were enriching and 80 -90% felt that the SSM experience was pleasant. Half of respondents believed that the SSMs contributed towards level of interest in the proposed specialty.[5]

The senior author (MAAK) designed a Plastic Surgery SSM during his postgraduate degree to mitigate this growing negligence of the specialty in the curricula. A pilot study involving 13 third year students was conducted with the SSM consisting of a balance between clinical, practical and theoretical aspects of Plastic Surgery. SSM students were provided with a four-component induction pack at the start of the SSM placement. The first three components consisted of a Departmental Handbook (a simplified version of the handbook provided to rotating junior trainees in the department to enable understanding of departmental processes), a SSM Rotation Plan/Calendar (with assigned clinical/ academic commitments improving attendance and promoting better student involvement) and a list of 'Key Topics in Plastic Surgery' (e.g., skin cancer guidelines, lower limb trauma guidelines etc) that was explored and understood in the course of the SSM (by being mapped to clinical cases/clinical commitments). The fourth component consisted of a guideline for formative and summative assessment of the module to enable successful completion of the SSM. The formative assessments during the SSM included student-led teaching sessions, regular journal clubs to improve principles of evidence-based medicine and written case-based assignments to increase depth of knowledge of the speciality. This was supplemented with an 'end-of-SSM' marked quiz to gain an objective mark for the theoretical learning during the SSM to tick the summative assessment box. Furthermore, feedback assessment tools were provided to tailor the

teaching, so that students can maximise their educational experience.

The clinical and practical component of the SSM was similarly designed with components to address SSM student needs. Ward rounds involving SSM students was organised to allow greater bedside teaching while enabling medical students to appreciate the attention to detail in planning the care of the Plastic Surgery in-patient (especially one that has undergone a complex reconstruction). Attendance in clinics started off with observation and step-by-step escalation of involvement into history taking, examination, diagnosis and management planning. Attending dressing clinics with nursing staff and hand therapy clinics with physiotherapists were often a great resource for medical students to appreciate the benefits of the multidisciplinary team approach. Similarly, gradual escalation of operating theatre involvement, from observation to active assisting became a positive exercise in improving medical student confidence in the operative setting and in improving their exposure to the reconstructive aspect of Plastic Surgery. During the SSM, the Plastic Surgery team members were instructed to make themselves available to students for advice, teaching and mentoring.

This integrative process was established to widen the scope for students and strengthen the student-mentor relationship, thus increasing the likelihood of the student committing to the specialty. The overall feedback received from the students was positive with most students strongly agreeing that the SSM provided a good learning experience and inspired consideration to pursuing a career in Plastic Surgery.

The involvement of the Plastic Surgery fraternity in collaborating with medical schools to design and implement a structured and standardised SSM in Plastic Surgery shall be a positive step towards changing the perceptions of students, medical schools and government institutions towards our specialty. This collaboration can also involve various national, Plastic Surgery based institutions who can also help motivate, educate and encourage medical students to consider a career in Plastic Surgery by using their platforms. These alliances shall go a long way towards improving the representation of Plastic Surgery within the compulsory component in the undergraduate curriculum and by helping to recruiting quality torch bearers to our profession; it shall help towards safeguarding the future of our versatile speciality.

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Case Report
DAUIN 20230204

World Journal of Medical Education and Research:
An Official Publication of the Education and Research Division of Doctors Academy

A Comparison between Primary and Secondary Breast Angiosarcoma: Our Local Experience

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WJMER, Vol 29: Issue 1, 2023

Abstract:
Breast angiosarcoma is a rare form of cancer and can be classified into primary or secondary types. We report two cases of breast angiosarcoma in our locality, and illustrate the differences encountered between the two types. There is no standard treatment for this disease. Surgery is the mainstay of treatment, but the role of adjuvant treatment remains uncertain.

Key Words:
Breast Angiosarcoma; Primary Breast Angiosarcoma; Secondary Breast Angiosarcoma; Spontaneous Breast Angiosarcoma; Radiation-Induced Breast Angiosarcoma

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Introduction

Angiosarcoma of the breast is a rare and highly aggressive cancer, accounting for only 0.04% of all breast malignancy.[1] It can occur as a primary lesion of the breast or as a secondary lesion after breast irradiation or in patients with chronic lymphedema after axillary dissection (Stewart - Treves syndrome). Diagnosis is difficult and the prognosis is poor, with optimal adjuvant treatment based mainly on expert opinion due to the rarity of the condition.[2] We report two cases in our locality and compare the differences encountered between primary and secondary disease.

Case 1

Miss C is a 46-year-old lady, whose mother was diagnosed with breast cancer at age of 56, presented with progressive right breast engorgement and mastalgia in 2021. Physical examination revealed breast asymmetry with an 8cm firm mass over the upper outer quadrant of the right breast which was not fixed to the underlying muscle or overlying skin. The nipple areolar complex was not affected and there were no palpable axillary lymph nodes. Ultrasound and bilateral mammogram (Figure 1) was performed which showed a large 7.9x 3.1 x 8.8cm irregular mass at the right upper outer quadrant with no suspicious microcalcification and no axillary lymphadenopathy bilaterally. Core biopsy of the lesion showed atypical vascular proliferation, most in keeping with well differentiated angiosarcoma. A whole-body positron emission tomography computed tomography (PET-CT) showed no distant metastasis. After discussion with the multi-disciplinary team, Miss C underwent a right skin sparing mastectomy with transverse rectus abdominis myocutaneous (TRAM) flap reconstruction and sentinel lymph node biopsy. Pathology confirmed angiosarcoma with clear margins (most margins >2cm), and sentinel lymph node was negative for malignancy. Adjuvant radiotherapy was offered for improving local control based on retrospective series, but Miss C was not keen.

In December 2022, she presented with haemoptysis with ~5mL fresh blood with clots during each coughing episode. On examination, a discrete 2cm right upper jugular cervical lymph node was palpable, and a plain chest radiograph revealed a 18mm opacity over the left hilar region. Ultrasound-guided fine needle aspiration of the enlarged cervical lymph node showed atypical cells. Excisional biopsy of the lymph node was performed, and the resulting pathological findings were consistent with metastatic angiosarcoma. Her PET-CT revealed

Figures for breast angiosarcoma case report

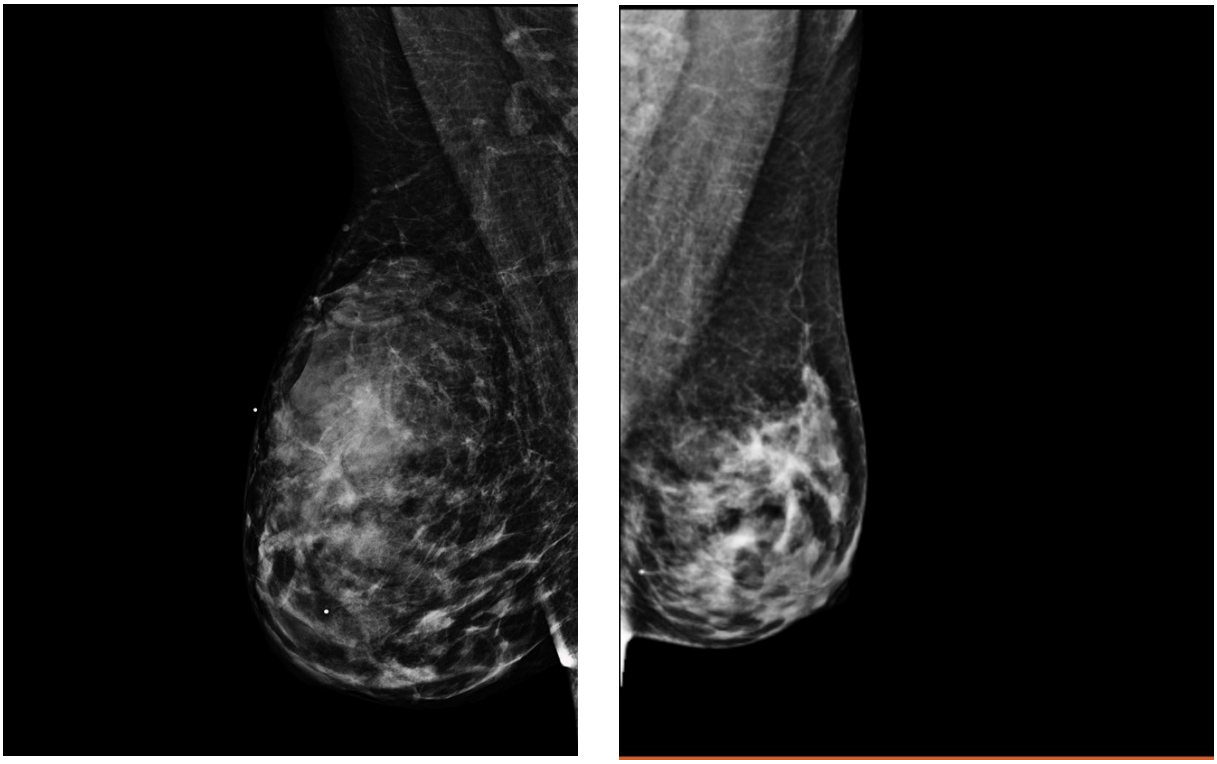

Figure 1(a): *Right MLO and Left MLO views respectively, with right MLO view showing a large iso to hyperdense mass occupying most of the upper outer portion of the right breast.*

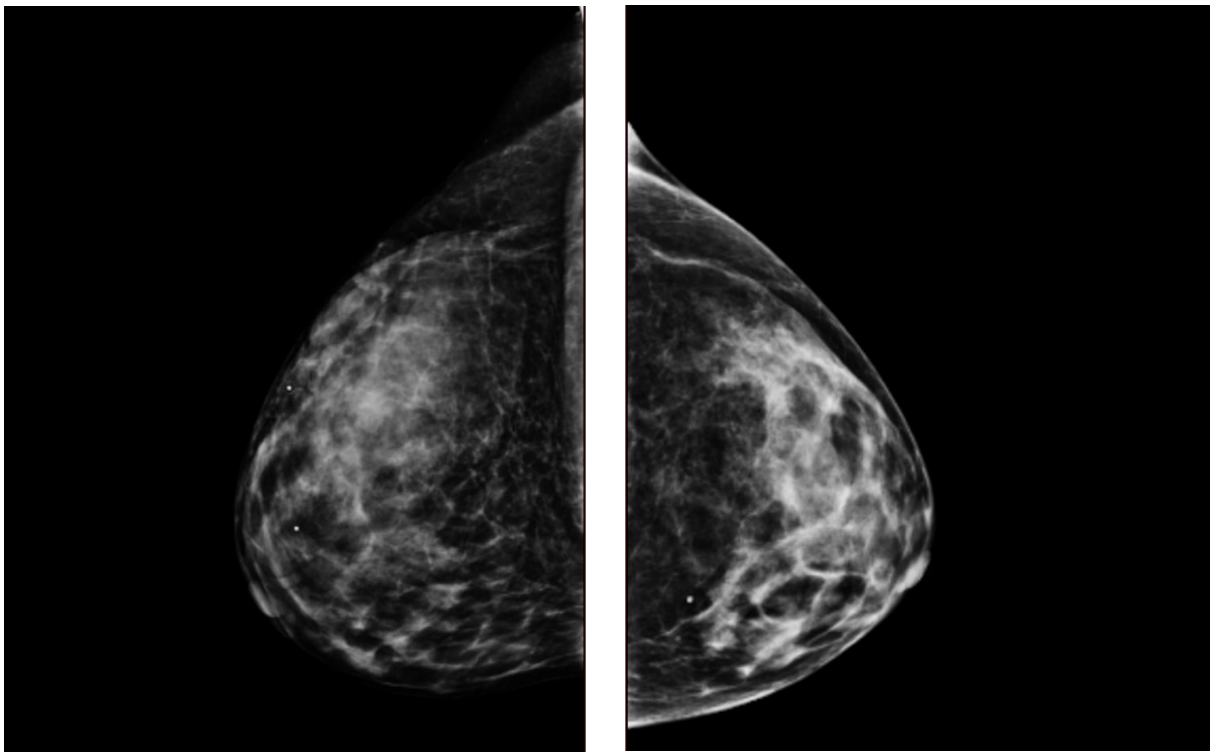

Figure 1(b): *Right MLO and Left MLO views respectively, with right MLO view showing a large iso to hyperdense mass occupying most of the upper outer portion of the right breast.*

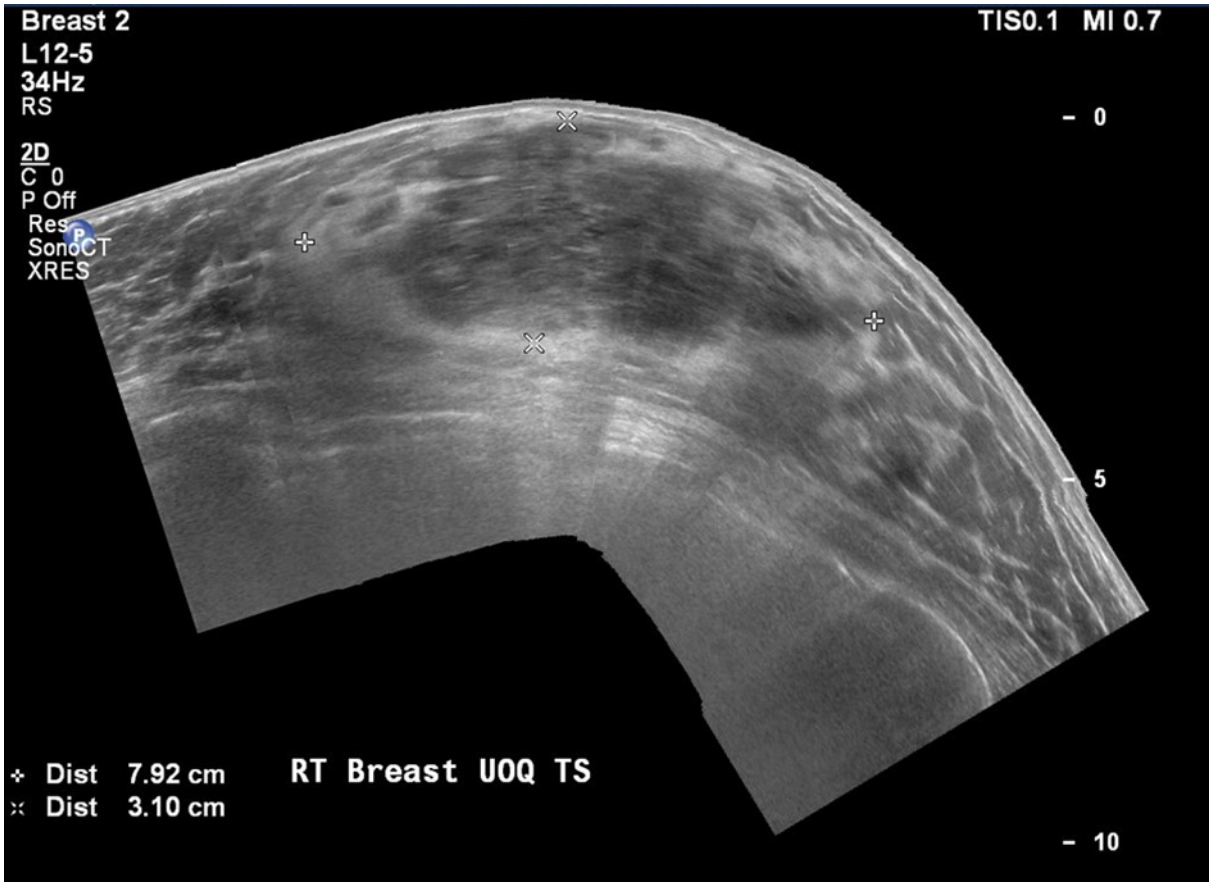

Figure 1(c): *Ultrasound imaging of the right breast showing a large irregular heterogeneous mass 7.9x3.1x8.8cm in size. Its periphery is mainly hyperechoic and blend-in with the normal breast tissue, limiting accurate delineation of the lesion extent.*

multiple new hypermetabolic bilateral lung nodules with adjacent ground glass densities which were suggestive of haemorrhagic metastasis of angiosarcoma. Within a month of her recurrence, she also developed multiple scalp, gum and skin nodules (Figure 2) with occasional bleeding. She was started on palliative chemotherapy, initially with paclitaxel which was later changed to adriamycin and zometa after she developed bone and liver metastasis. She then developed brain metastasis for which she was given radiotherapy (Figure 3).

Case 2

In comparison, Madam S is a 76-year-old lady with a right breast ductal carcinoma in situ in 2010, for which she underwent a right-sided breast-conserving therapy, sentinel lymph node biopsy with adjuvant radiotherapy. In 2014, she had a screen-detected lesion for which she underwent left sided breast-conserving therapy and sentinel lymph node biopsy (pT1cN0 ER/PR+ invasive ductal carcinoma, margins clear) with subsequent radiotherapy and hormonal treatment. Post-treatment, she has been kept on regular surveillance with no recurrence seen on her latest mammogram and ultrasound in January 2021.

Other significant medical history includes papillary thyroid cancer, for which she received a total thyroidectomy and adjuvant radioactive iodine therapy.

In November 2022, Madam S presented with a left breast nodule with associated pain and bleeding. Clinically there was a 1x1cm round nodule at the left 5 o'clock region, 2cm from the nipple with easy contact bleeding. Physical examination revealed no other suspicious breast lump or palpable axillary lymphadenopathy. There was also no lymphoedema. The working diagnosis at the time was a bleeding pyogenic granuloma. In

Clinical photographs of metastatic spread of the angiosarcoma.

Figure 2(a): *Gum nodule*

Figure 2(b) *Scalp nodule*

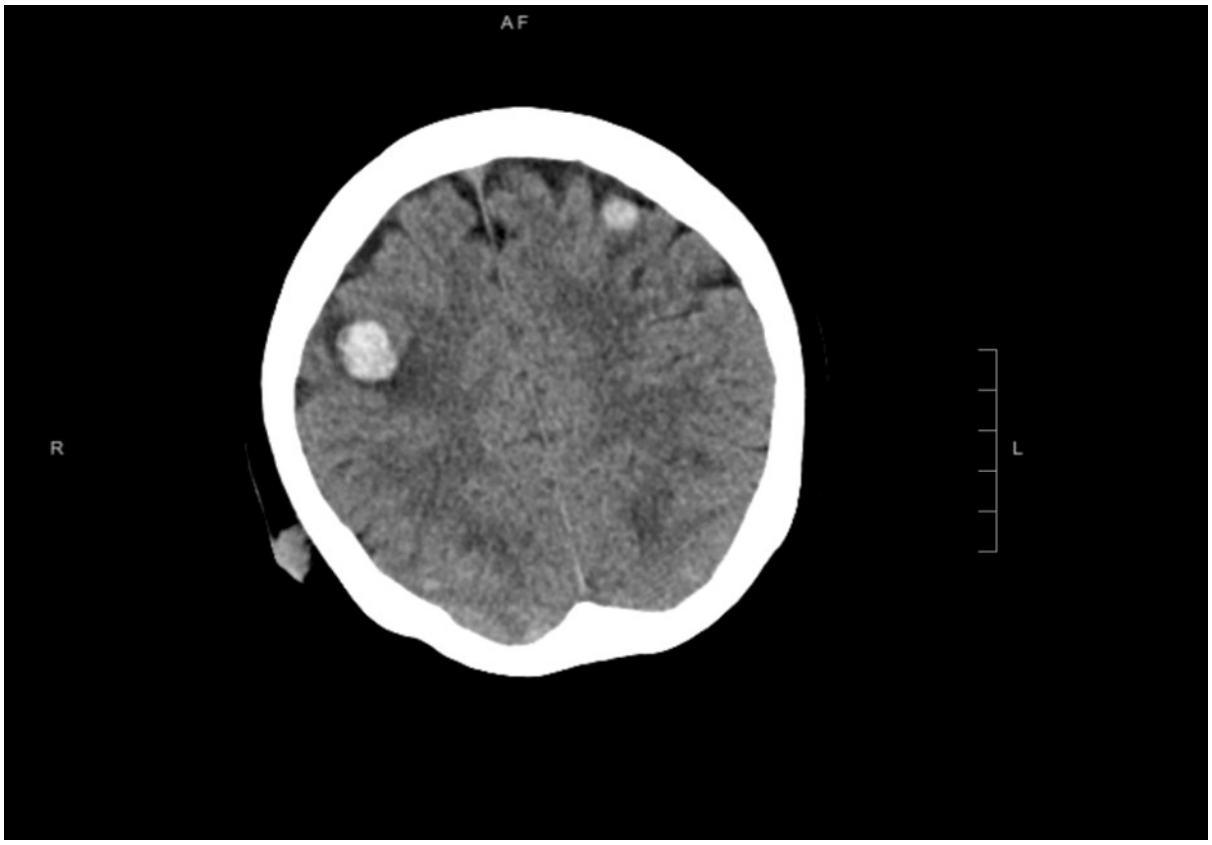

Figure 3: *Plain CT scan of brain showing multiple hyperdense lesion within the brain parenchyma*

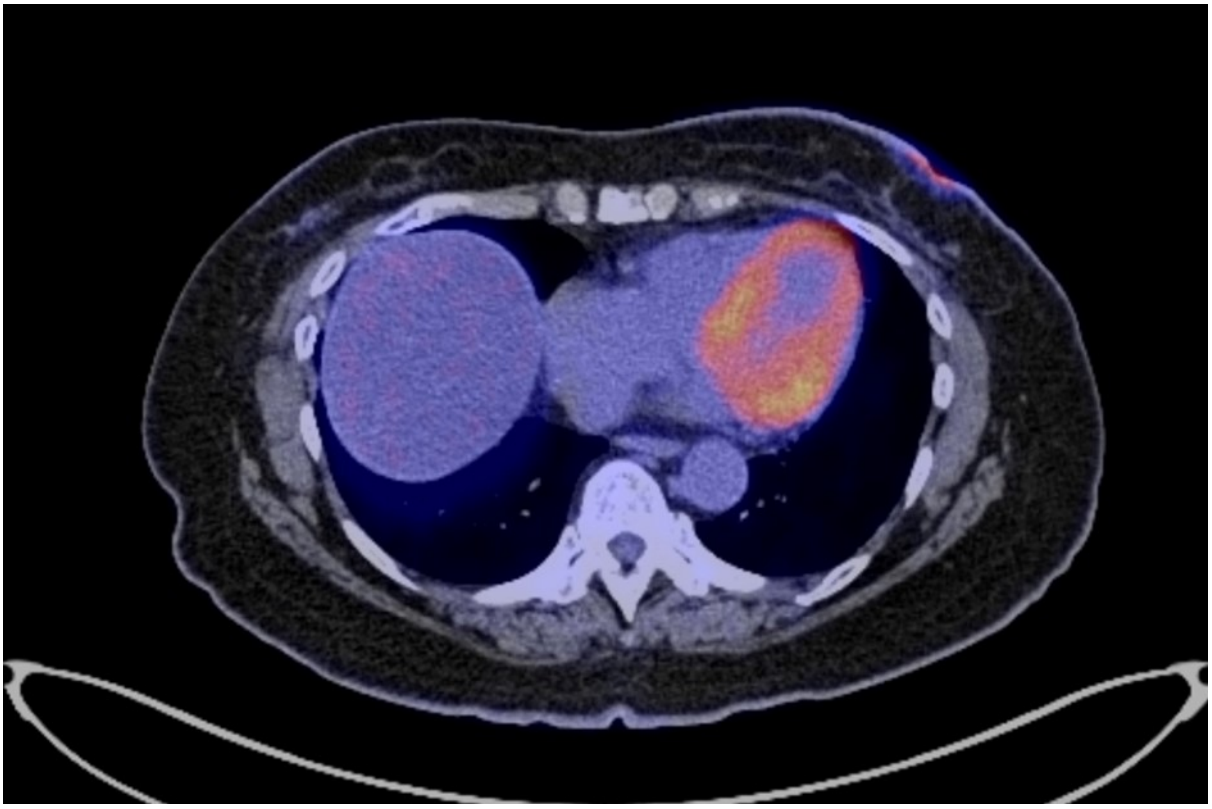

Figure 4: *PET image showing FDG uptake over site of excisional biopsy*

view of the persistent troublesome bleeding and history of bilateral breast cancer, the lesion was excised under local anaesthetic. The pathology was consistent with moderately differentiated angiosarcoma with the close margins (closest 1mm). A PET-CT was performed which showed only the hypermetabolic skin lesion over the left breast related to excisional biopsy (Figure 4), with no nodal or distant metastasis. Madam S later underwent wide local excision with no axillary treatment in private in January 2023.The pathology showed no residual tumour. No adjuvant therapy for her breast angiosarcoma was required, and there was no evidence of recurrence at her latest follow up with oncology.

Discussion

Angiosarcoma of the breast is extremely rare and can be divided into the de-novo (primary) or therapy-related (secondary) form. Primary breast angiosarcoma usually occurs between females between 20-50 years of age, [3,4,5] whilst secondary breast angiosarcoma is typically seen in older women, with the mean age of 70.[6] Secondary cases occur following a latent period after radiation or in patients with chronic lymphedema after axillary dissection (Stewart - Treves syndrome). In contrast, there are no known risk factors for the primary form. High grade breast angiosarcomas are associated with a poor prognosis, tend to metastasize early, often to the lungs or liver and have a 5-year survival rate of only 15%.[7] Low grade and intermediate grade tumours fare better in some studies.[7] However, according to Nasciemento et al, there is no correlation between histologic grade and patient outcome in their review of 49 cases.[8]

Patients with breast angiosarcoma can present with diffuse breast enlargement or a rapidly growing palpable breast mass which may have a tinge of purple discolouration, due to its highly vascular nature. Diagnosing breast angiosarcoma can be difficult as the radiological findings are non-specific. Tumours may appear hypoechoic, hyperechoic or heterogeneous on ultrasound, with high vascularity.[9] Mammographically, breast angiosarcomas can appear as large dense homogenous mass with no calcifications or spiculations,[9] and up to 33% of the tumours can have normal mammogram findings.[10] Magnetic resonance imaging (MRI) or computed tomography (CT) with contrast can help confirm the hypervascular nature of these lesions. Primary angiosarcomas are often located deep in the breast parenchyma.[11] Hence, pathological confirmation with core biopsy may have false negative rates of up to 40% of cases.[12]

Currently there is no standard treatment for breast angiosarcoma in view of the small number of reported cases. Surgical resection with negative margins is typically performed, with preference for mastectomy over wide local excision due to lower estimated recurrence rate (8% vs. 23%, respectively).[13] Axillary dissection is usually not required as lymph node involvement is uncommon (<5% of cases).[14] Ragavan *et al.* performed a retrospective review between 2006 and 2019 on axillary lymph node dissection in breast angiosarcoma patients in Singapore with no positive lymph node metastasis detected in their cohort of thirteen cases.[15] The role of chemotherapy and radiotherapy in breast angiosarcomas is not well established. For primary breast angiosarcoma, adjuvant radiotherapy after surgery allows for better local control with lower recurrence rate according to Johnstone *et al.*,[16] but the overall survival rate was comparable with those without radiotherapy.[17] The role of adjuvant chemotherapy is undefined at present, being based mainly on adult soft tissue sarcomas. Current literature suggests that patients with large high grade angiosarcoma or recurrence may benefit from chemotherapy[18] as this subset of patients has a poor prognosis. Anti-angiogenic and immunological therapies have also been described, but to date have had disappointing results.[19]

Conclusion

In conclusion, we report two cases of breast angiosarcoma in our locality. Given the aggressive nature of the disease, early detection and prompt surgical treatment are needed. Further studies are needed to guide adjuvant treatment modalities and their survival benefit. In addition, it is still unclear whether treatment for primary vs secondary angiosarcomas differ given the rarity of the disease.

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World Journal of Medical Education and Research:
An Official Publication of the Education and Research Division of Doctors Academy

Medical Education
DAUIN 20230205

E-Learning is an Acceptable and Effective Method to Improve Emergency Physicians' Musculoskeletal Knowledge

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WJMER, Vol 29: Issue 1, 2023

Abstract:
Background: Emergency medicine physicians are commonly tasked with the initial assessment and management of musculoskeletal presentations despite widely reported poor musculoskeletal competency. This study aimed to develop and evaluate an online E-Learning musculoskeletal medicine programme for junior emergency doctors.
Methods: A prospective observational study was conducted. A musculoskeletal E-learning programme, which was developed from the Royal College of Emergency Medicine curriculum, was launched on the online learning platform 'Edmodo©'. A convenience sample of all junior emergency medicine doctors in an Irish emergency department was taken. The Kirkpatrick model of learning evaluation was used to assess the impact of the programme. Evaluation at Kirkpatrick Level 1 (response) occurred via a learner feedback questionnaire. Participant's learning (Kirkpatrick Level 2) was assessed using pre-learning and post-learning knowledge quizzes and changes in self-reported knowledge.
Results: Nineteen of twenty-three (83%) of junior emergency doctors participated in the programme. 93% of responders agreed or strongly agreed that they were satisfied with the content received. There was an increase in knowledge scores between the pre and post-learning quizzes (overall pre-learning mean score 55.2% v overall post-learning mean score 84%, $p < 0.05$). Participants' self-reported knowledge improved post completion of the E-learning programme (9 positive pre-learning self-reported responses v 37 positive post-learning self-reported responses, $p<0.05$).
Conclusion: This study shows that a bespoke musculoskeletal medicine E-learning programme is acceptable to emergency medicine doctors and increases their knowledge acquisition.

Key Words:
E-Learning; Musculoskeletal Medicine; Sports Medicine; Emergency Medicine; Medical Education

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Introduction

Acute musculoskeletal injuries may result in loss of playing time, on-going pain and disability for athletes and patients. Furthermore, musculoskeletal injuries are a major cause of absenteeism, affecting 480,000 individuals in the UK resulting in 8.9 million lost working days in 2019/2020.[1] The emergency department (ED) is often the first point of access for the initial assessment and management of acute musculoskeletal injuries. Indeed, musculoskeletal presentations as a whole may account for up to 20% of ED presentations.[2] The increased promotion of physical activity and rising levels of sporting participation increases the importance of good musculoskeletal management into the future.[3,4]

Despite the high prevalence, evidence suggests that medical students graduate without sufficient knowledge of musculoskeletal medicine.[5-7] In Ireland, Canada and the USA, deficiencies in injury knowledge have been noted in medical students, general practice trainees and general practitioners.[6,8,9] Junior emergency medicine doctors come from various clinical backgrounds and may lack experience in managing injuries. This is supported by low levels of musculoskeletal competency being observed in American emergency physicians.[7,10] To combat this gap in knowledge there have been calls to increase musculoskeletal medicine education at an undergraduate and postgraduate level.[11]

The emergency department is a challenging learning environment where shift work, clinical demands and time limitations reduce opportunities for in-person classroom teaching. E-learning can be defined as learning where content is delivered electronically to remote learners via a computer network.[12] Advantages of E-learning include interactivity, efficacy, flexibility and the potential to allow users

engage at a convenient time and location.[13] Furthermore, E-learning allows teaching to proceed while adhering to social distancing guidelines. This has allowed some medical education to proceed during the COVID-19 pandemic and provides certainty and continuity for future pandemics where in-person teaching may not proceed.

To date there has been a paucity of evidence in the literature looking at the effectiveness of a musculoskeletal E-learning programme targeted at emergency medicine physicians. The aim of this study was to develop and evaluate a musculoskeletal medicine E-learning programme for emergency medicine doctors; specifically incorporating fractures, soft-tissue injuries and concussion.

Materials and Methods

A prospective observational study was conducted in Tallaght University Hospital, Dublin, Ireland. The department is a tertiary urban adult ED treating approximately 52,000 annual presentations. The joint research ethics committee of St James's Hospital/ Tallaght University Hospital granted the study ethical approval.

The primary objective of the study was to develop and evaluate the efficacy of a musculoskeletal medicine E-learning programme for junior emergency department doctors.

Development of the Musculoskeletal Medicine E-learning Programme

A six-module E-learning programme was developed to reflect common musculoskeletal injuries that present to the ED. The six modules covered included ankle, knee, shoulder, elbow and wrist injuries and concussion. Each module focused on the anatomy, epidemiology, diagnosis, and management of common musculoskeletal presentations (Appendix 1) and was designed to take approximately one hour to complete. The content was developed by a sports medicine clinician and adhered to the Royal College of Emergency Medicine curriculum.[14] The modules were peer reviewed independently by a consultant in emergency medicine and a senior musculoskeletal physiotherapist.

Each module, except the concussion module, was accompanied by a clinical musculoskeletal examination video demonstrated by the sports medicine clinician. Each video was based on a 'look, feel, move, associated special test' approach and lasted five to seven minutes.

Evaluation of the E-learning Programme.

The musculoskeletal injury E-learning programme was evaluated using the Kirkpatrick learning evaluation module.[15] Kirkpatrick's level I evaluates the degree to which participants find the training favourable, engaging and relevant to their clinical role. Kirkpatrick's level II assesses the participant's learning outcomes and increase in knowledge.

Evaluation at Kirkpatrick Level I (reaction) was assessed at the end of each module via a questionnaire asking learners to rate the content, length and complexity of the modules and whether they would recommend it to others. A five-point Likert scale was used to respond to statements. Specific questions targeting the musculoskeletal exam videos included if participants found they were now more confident in musculoskeletal exam and if they found the videos more helpful compared to text and pictorial demonstration.

Evaluation at Kirkpatrick Level 2 (learning) was achieved via a knowledge assessment quiz, based on the content provided, containing five to ten true/ false or multiple-choice questions. An identical quiz was taken before (pre-learning) and after (post-learning) completion of each module. Participants were not provided with answers to the pre-learning quiz but did receive feedback following the post-learning quiz. Although a 60% pass mark is common in medical education, the pass mark was set at 75% to account for the true/false style multiple-choice questions used.[16] Secondarily, participants were asked to evaluate their topic-specific knowledge before and after the modules.

Roll-out of the E-learning Programme

The E-learning programme was hosted on the free online E-learning platform Edmodo © (Edmodo, San Mateo, California USA https://edmodo.com/). The platform was chosen for its accessibility, provision of immediate feedback and was available via personal computer or as a smartphone application. A virtual classroom was created for the participants and all content was available on launch. Informed consent for inclusion in the study and use of anonymised data was obtained from participants via a check-box agreement prior to enrolment.

Participants were recruited via an email sent to all junior doctors working in the ED and announcements at shift handovers. The email contained a link to join the virtual class online. The programme ran for four weeks from November 2nd to November 29th 2020.

Promotion of the E-learning Programme

Weekly emails were sent to participants informing them of the programme. Due to restrictions in face -to-face teaching during the COVID-19 pandemic this online learning programme replaced the usual departmental teaching for the duration of the study. Participation in the E-learning programme was taken as attendance at departmental teaching. Upon

completion of the programme a certificate was issued which could be used by the doctors for continuous professional development requirements. In line with rates reported by similar studies, we aimed for 80% enrolment and a participation rate of 55% of eligible doctors.[17,18]

Data Analysis

Statistical analysis was performed using Microsoft Excel (Microsoft Professional Plus, Redmond, Washington, Seattle, USA) and IBM® SPSS® version 27 (IBM Armonk, New York, USA). An initial Kolmogorov-Smirnov test was performed which revealed a non-normally distributed data set, therefore a T-test was not performed. Any statistical change between pre-learning and post-learning knowledge quizzes was assessed using a non-parametric Wilcoxon signed-rank test. Participants' self-reported knowledge level before and after completing each E-learning programme were evaluated for significance of difference using a Chi-squared test by segregating responses into two groups: high and very high and unsure, low and very low. A p value of <0.05 was used to define statistical significance.

Results

Nineteen of twenty-three (83%) junior doctors working in the Emergency Department at the time of study joined the virtual class (Table 1). This included ten male and nine female doctors. There was a 74% completion rate with fourteen doctors (61%) completing at least one feedback form.

Evaluation at Kirkpatrick Level 1

Overall, there was very positive participant responses to the E-Learning programme (Figure 1). 93% of responses either agreed or strongly agreed that they were satisfied with the information they received and a similar 93% either agreed or strongly agreed that they would recommend the programme to others. There were similar positive reactions for the musculoskeletal examination videos (Figure 2); 87% of responses either agreed or strongly agreed that they preferred the videos to slides and 84% of responses agreed or strongly agreed that they were more now confident in musculoskeletal examination.

Evaluation at Kirkpatrick Level 2

There was an increase in the knowledge scores between the pre and post-learning quizzes (overall pre-learning mean score 55.2% v overall post-learning mean score 84%, p <0.05) (Table 2). The overall mean score surpassed the arbitrary pass mark (75%) in one module in the pre-learning knowledge quizzes compared to five modules in the post-learning quizzes (Table 2). Participants' self-reported knowledge improved post completion of the E-learning programme (9 positive pre-learning self-reported responses v 37 positive post-learning self-reported responses, p<0.05) (Table 3).

Staff Grade	**Number**
Specialist Registrar	3
Registrar	4
Senior House Officer	10
Intern	2

***Table 1*:** *Staff Grade of Participants*

	Pre-Learning Completed Tests	**Mean %**	**SD %**	**Post-Learning Completed Tests**	**Mean %**	**SD %**	***P* Value**
Ankle Injuries	9	82.2	9.2	9	93.3	5.3	<0.05*
Knee Injuries	10	54.2	13.6	9	73.3	18.2	<0.05*
Concussion	10	70.5	20.4	10	77.9	16.6	0.402
Wrist Injuries	10	73.8	10.2	10	89.3	10.4	<0.05*
Elbow Injuries	11	47.6	15.5	10	81.2	20.3	<0.01*
Shoulder Injuries	12	64	19.7	11	89.2	9.9	<0.001*
Overall	62	55.2	14.8	59	84	13.4	<0.001 *

***Table 2*:** *Mean results and standard deviation of pre- and post-learning knowledge quizzes. Star symbol (*) indicates statistical significance from Pre-learning quiz at P < 0.05.*

	Pre-Learning	**Post-Learning**
Very High	0	3
High	9	34
Total positive	9	37*
Unsure	25	17
Low	17	0
Very Low	2	0
Total negative	44	17*

Table 3: *Participants' self-reported knowledge before and after learning. Star symbol (*) indicates a statistically significant change from the Pre-learning quiz at P < 0.05.*

Discussion

The aim of this study was to develop a musculoskeletal injury E-learning programme for emergency medicine physicians who are often the first health care professionals to assess an acutely injured athlete. Kirkpatrick's learning evaluation model was selected as it is widely used and accepted in healthcare settings.[19,20] With positive participant responses and improvements in knowledge seen following completion of the programme, the study achieved its aims.

Firstly, it was recognised when designing the programme that its potential success would directly correlate to the perception of the programme being appealing and recipient orientated.[21,22] Evaluation at Kirkpatrick Level 1 revealed favourable learner responses and high user satisfaction. There was a high participation rate by the emergency medicine clinicians working in our department represented by 83% of participants reviewing content and 61% of the cohort completing module feedback and quizzes. We therefore achieved our target aim of 80% enrolment and 55% completion. This compares well with a 54% participation in junior doctors by Goh *et al.*[18] and 55% E-Learning completion rate reported in paediatric emergency medicine doctors and students reported by Chang *et al.*[17], although it was below their reported 90% enrolment.

Secondly, a successful learning programme must not only be acceptable to the user but also result in knowledge translation. Our study showed that pre-learning knowledge in musculoskeletal injuries in emergency medicine physicians were less than desirable; only one module (ankle injuries) attracted a mean passing grade. This correlates with our cohort's self-reported level of knowledge; 17% reported high or very high knowledge pre-learning. Our results validate the view that emergency physicians may not be receiving adequate education to achieve clinical competency in musculoskeletal medicine during training.[7,23,24]

Evaluation at Kirkpatrick level 2 showed significant improvements in musculoskeletal medicine knowledge and mean passing grades. These results are compatible with those observed by Wünschel *et al.* and Back *et al.* who observed significant improvements in knowledge following orthopaedic online education programmes for medical students.[25,26]

E-learning has become integral to medical education.[12,27] Similar to other studies, our data confirms that E-learning can be well-received by doctors and is an effective method of knowledge translation.[18,28] This is particularly satisfying as the study was conducted when ED face-to-face teaching had been suspended due to COVID-19 social distancing restrictions.

Our use of video demonstration was well-received by participants, who reported that the video was more useful than slides and were now more confident in musculoskeletal examination. However it is recognised that practical skills and communication are better taught face-to-face and these skills will be incorporated into a future blended learning programme in our ED.[29]

Strengths

In sports medicine, studies are still comparatively rare evaluating E-learning as a knowledge translation tool. This is the first study to assess a bespoke musculoskeletal injury E-learning programme's influence on acquisition of knowledge and acceptability to emergency medicine doctors. A further strength of the programme was the use of Kirkpatrick's level I and II training evaluation model to assess its acceptability and impact on physician's level of knowledge.[15] While other non-healthcare

settings often evaluate using only Kirkpatrick level I we evaluated up to level II. Any change in patient outcomes (Kirkpatrick level III) was beyond the scope of the study, although it is possible that improved physician knowledge can lead to improved patient care. As reported by Sinclair et al.[13] no studies reporting a change in patient outcomes following a healthcare-based E-learning programme have been published to date; future studies should attempt to establish any link between E-Learning and patient outcomes.

The programme reflected components of effective E-Learning in that it was interactive, varied, promoted participant engagement and provided feedback. We included a few key design components; namely videos of the musculoskeletal exams and designing the content to be as visual as possible with anatomical diagrams and images of radiographs. Participant feedback reflected positively on the programme, with 96% agreeing or strongly agreeing that the modules were well-structured and easy to follow.

To ensure that the content of the E-learning programme was of high quality, the material was derived from the Royal College of Emergency Medicine curriculum and reviewed by a consultant in emergency medicine and a senior musculoskeletal physiotherapist. For future iterations of our programme, we will also incorporate the American College of Sports Medicine's recently published standardized musculoskeletal and sports medicine curriculum for emergency medicine training.[23]

Limitations

Whilst, this was single centre study with a small number of participants, the study demonstrated improvements in learner knowledge. Our ED has new doctors rotating every three to six months. Following this successful study, the programme will be delivered to all new doctors, and we believe the programme could be adapted by other emergency departments and other learners such as emergency advanced nurse practitioners.

Secondly, not all doctors completed all quizzes and feedback questionnaires. This is in keeping with other online responses for physicians, which often show low levels of engagement.[30] Nevertheless, our target completion rate of 55% was surpassed. The authors of this study felt participation was enhanced using regular reminders at clinical board rounds, offering certificates of completion for continuous professional development requirements and documenting engagement with the E-learning programme on the doctors' performance reviews. Finally, a selection bias could not be excluded due to the voluntary nature of participation, and it is possible that others may not have responded to the programme as positively.

Conclusion

Emergency medicine physicians may not be receiving adequate education to achieve clinical competency in musculoskeletal injuries and sports medicine. The development of a bespoke musculoskeletal medicine E-learning programme is acceptable and can increase knowledge acquisition amongst emergency medicine doctors.

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Literature Review
DAUIN 20230206

World Journal of Medical Education and Research:
An Official Publication of the Education and Research Division of Doctors Academy

Why Does the Body Attack Rapidly Dividing Cancer Cells but Not a Fast-Growing Foetus?

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WJMER, Vol 29: Issue 1, 2023

Abstract:
The foetus is semi-allogenic so contains expression of foreign antigens like cancer cells as well as self-antigens. However, unlike most cancer cells the foetus is not recognised as foreign so is not attacked by the mother. This is because during pregnancy the environment switches from pro-inflammatory to anti-inflammatory. Sex hormones released through pregnancy are thought to help maintain this immune tolerance and induce protective effects against women developing cancer.

Aims:
1. To examine the role of the maternal immune system in protecting the foetus from rejection and how this can be used for future treatments of tumour rejection.
2. To investigate the role of hormones in pregnancy and how they protect the foetus.
3. To explore if women are protected from cancer during pregnancy.

Methods/Results: The databases used for the literature search were Scopus, Web of Science and Medline via OVID. After screening the papers and looking at their eligibility eight were selected. Four investigated the maternal immune system and tolerance, three investigated how hormones during pregnancy maintain a tolerogenic state and one investigated pregnancy induced protection against breast cancer.

Conclusions: There have been new discoveries regarding the immune cells involved in promoting the anti-inflammatory and tolerogenic environment seen in a successful pregnancy but the full extent of this across the entire gestation period is still not completely understood. There are continuous findings that support the idea that sex hormones during pregnancy do play a role in promoting this environment however there are controversies as to whether they induce protection against cancer specifically breast cancer.

Key Words:
Foetus; Pregnancy; Hormones; Tumour; Tolerogenic

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Introduction:

Shared characteristics between trophoblast cells and cancer cells:

At the point of fertilisation, a human zygote forms consisting of two primary cell lines known as the embryoblast (inner cell mass) and the trophoblast (outer cell mass). These trophoblasts rapidly proliferate and invade the maternal endometrial decidua at around day 7. The ability of these trophoblast to proliferate, migrate and form their own blood supply makes them very similar to cancer cells[1].

Foetus vs cancer cells:

Although cancer cells and a foetus appear to be phenotypically similar the main thing that distinguishes them is that cancer cells proliferate and grow uncontrollably whereas in the foetus this process is highly regulated. This was demonstrated by Lui et al in 2010[2] which found that there was a highly conserved juvenile multiorgan genetic program that down regulated many genes required for rapid proliferation in early life. Lui et al did further investigations in this and in 2013[3] looked at the mechanisms that caused the down regulation after birth of an important foetal growth factor that is involved in the juvenile multiorgan genetic program called Insulin-like growth factor 2 (IGF2) which is also commonly upregulated in many cancers. They found that the expression of IGF2 was controlled by the E2f transcription factor family specifically E2f3. The E2f3 positively regulates the expression of IGF2 so when it binds to the IGF2 promoter it activates its transcription. Therefore, the downregulation of the E2f3 is what helps drive the downregulation of IGF2 seen post-natal. In many cancers this process is reversed and overexpression of this E2f3 is what leads to the oncogenic expression of IGF2. It is thought that this occurs in cancers because they lose the retinoblastoma

protein (Rb) which binds to this E2f3 and supresses its activity.

Maternal immune system during pregnancy:
During pregnancy the growing embryo is semi-allogenic because it has half of its genetic material from the mother and the other half from the father. This means that there is expression of antigens that are both foreign and self to the mother. Therefore, for the pregnancy to be successful the foreign antigens coming from the father need to be tolerated and not destroyed by the maternal immune system. This occurs by immune suppression and the mechanisms by which this happens are very similar to cancer with the main difference being that in cancer this process is continuous whereas in pregnancy the immune suppression is precisely timed as it follows an "immune clock of pregnancy"[4].

Immune suppression during pregnancy:
Regulatory T-cells (Tregs) are one of the important immune cells that permit this immune tolerant environment during pregnancy. Tregs are a subset of CD4+ T-cells that have high expressions of an Interleukin (IL) 2 receptor subunit on their cells surface known as CD25+. By having the CD25+ on their cell surface it allows the Tregs to absorb IL-2 from the microenvironment. This inhibits the proliferation of effector T-cells that rely on IL-2 for this and triggers their apoptosis reducing the immune response[5]. The Tregs are highly expressed during pregnancy specifically in the first and second trimester and are essential for normal gestation. Since the Tregs behave similarly in pregnancy and in cancer the deletion of Tregs could be potentially used as a therapeutic treatment in the future for tumour rejection. Another mechanism that prevents the maternal rejection of the foetus is the switch from type 1 T-helper cells (Th1) to type 2 T-helper cells (Th2) cells which are both groups of activated effector T lymphocytes. Th1 cells produce pro-inflammatory cytokines such as IL-2, IFN-γ (interferon gamma), and TNF-α (Tumour necrosis factor alpha) which are mainly involved in killing external pathogens. Th2 cells produce interleukins such as IL-4, IL-5, IL-10, IL-13 and IL-25 that increase an antibody-specific response. Therefore, Th1 can cause damage to the body and Th2 can protect the body. When pregnancy starts the microenvironment is Th1-dominant, but as the pregnancy progresses this quickly shifts to a Th2 environment to allow immunological tolerance which allows the pregnancy to continue. This shift is important because a more dominant Th1 microenvironment has been observed in women with a history of recurrent spontaneous miscarriages. However, this shift does increase the risk of maternal infection which is why it is important that at post-partum the Th1/Th2 balance is restored. This shift is also seen in tumours and malignancies such as melanoma and glioma which favour a Th2 microenvironment[6].

Sex hormones:
During pregnancy there is a systemic rise of sex hormones such as progesterone (P4), oestradiol (E2), estrone (E1) and human chorionic gonadotropin (hCG). These hormones not only play a role in controlling and coordinating anatomical modifications in the foetus but also facilitate the maintenance of immune tolerance in pregnancy. hCG is a glycoprotein hormone which is synthesised by the syncytiotrophoblast straight after embryo implantation and is key for maintaining the E2 and P4 hormones during pregnancy before the placenta is developed. But it has recently been suggested that it also drives IL-10 producing regulatory B cells during pregnancy so controls undesired immune activation. Progesterone is a steroid hormone that is required for the development of the uterine structure to maintain pregnancy. It also influences the activity of different types of immune cells such as dendritic cells (DCs), monocytes and macrophages. It also impacts the levels of galectin-1 which acts as a negative regulator of Th1 immune response and recruits suppressive uterine DCs[7].

Protective effects of pregnancy:
The influence of pregnancy on maternal health has been an important focus on research. It has been shown that an early first full-term birth is the most effective way of preventing breast cancer with the potential of reducing the risk up to 50%. In spontaneous mice carcinoma models the protective effects of pregnancy were investigated by using hormone doses at levels that were like pregnancy. It was found that E2 alone decreased the tumour burden in mice and together with P4 enhanced this protective effect. But the stage of the pregnancy cycle that is most important in reducing cancer risk is still unclear[8].

Aims and Objectives:

1. The role of the maternal immune system in protecting the foetus from maternal rejection and how this can be used for future treatments of tumour rejection.
2. The role of hormones in pregnancy and how they protect the foetus.
3. If women are protected from cancer during pregnancy.

Methods and Results:
Before starting the literature search several scoping searches were done to provide an overview of the literature. After this a research question was

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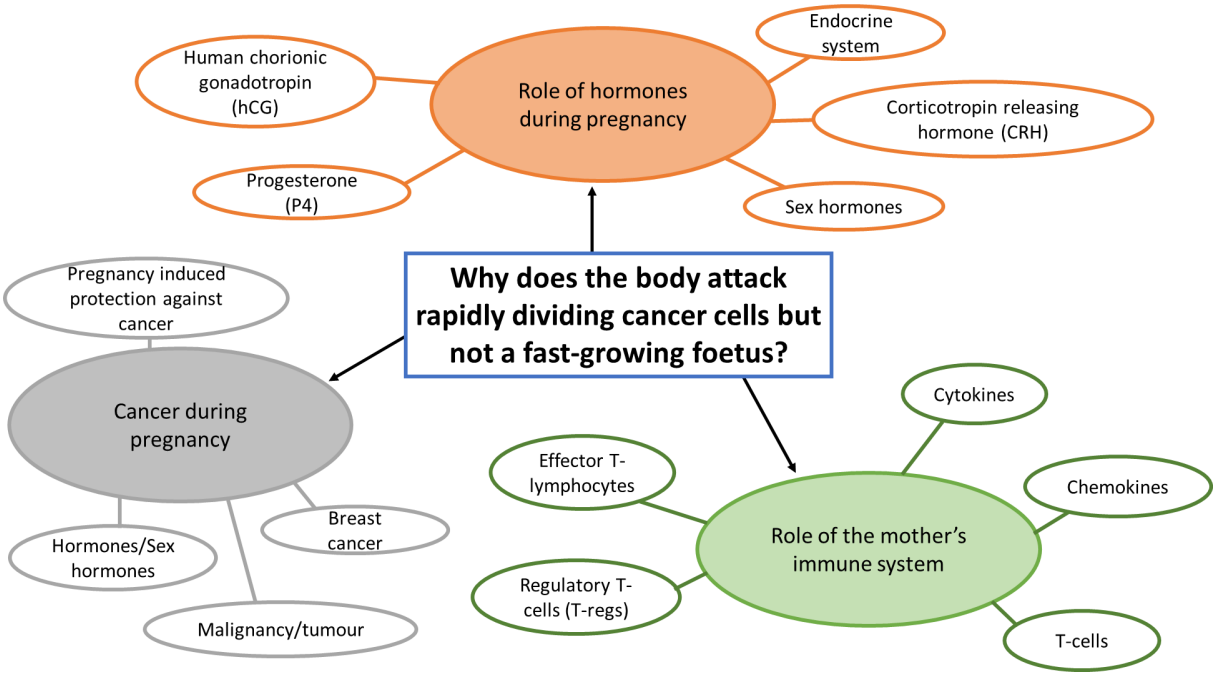

Figure 1: *Mind map that was done to prepare for the literature search*

formulated with a stepwise approach by using the FINERMAPS (feasible, interesting, novel, ethical, relevant, manageable, appropriate, potential value, publishability, and systematic) criteria to ensure that it was original, answerable and addressed gaps in the field[9]. A mind map (figure 1) was created to identify and isolate key topics in the research question.

Information Sources:
Papers abstracts and titles were screened based on a pre-defined inclusion/exclusion criterion (table 1). This allowed for quick removal of obvious irrelevant studies bringing the total number of potential papers down to 59. For these papers the full text was obtained so that they could be further examined in much more detail using the inclusion/ exclusion criteria.
As a result, **8 papers were selected:** 4 studies looked at the maternal immune system and its effect on maternal-foetal tolerance, 3 studies looked at how hormones during pregnancy prevent the body from attacking the foetus and 1 study looked at pregnancy induced protection against breast cancer (see figure 4 for an overview of the search process).

Literature Review and Synthesis:
The research question posed in this literature review was "Why does the body attack rapidly dividing cancer cells but not a fast-growing foetus?" Understanding what mechanisms are in place that allow the mother to tolerate the alloy-antigens expressed by the father can help predict what conditions are required for a successful pregnancy. This can help develop novel strategies that can help prevent spontaneous abortion in high risk patients [10].

Inclusion Criteria	Exclusion Criteria	Justification
Published peer-reviewed literature	Unpublished or non-peer-reviewed literature.	Only published peer-reviewed literature was considered because unpublished literature may be unrepresentative of the wider population and validity of the results has not been confirmed so could not be very accurate or repeatable.
Primary randomised or non-randomised studies	Secondary resources such as reviews or chapters in a book/ textbook.	Secondary resources were used for background research and only primary studies were selected to make sure that the data collected was relevant and accurate.

Inclusion Criteria	Exclusion Criteria	Justification
Prospective studies	Retrospective or case-based studies.	Retrospective studies analyse pre-existing data so are more prone to bias and scientists have not originally collected the data themselves so important evidence could be missing. Case-based studies are also prone to bias as researcher may allow their feelings to influence the study and are very difficult to replicate because they are not representative of the wider population.
Literature published in the last 10 years (2012-present)	Literature published more than 10 years ago (before 2012).	Studies that had been published in the last 10 years were included to make sure that the sources being used in the review were up to date and more credible.
English Language	Foreign Languages.	Due to time constraints could not translate papers. Also, information could be misinterpreted via translations causing key messages/findings of a paper to be lost. However, there was no restriction in place as to where the candidates in the study came from to ensure research was as inclusive as possible.
Human studies either in vivo or in vitro	Studies that were non-human i.e., using animals.	Only studies that looked at human patients or samples were included to make sure that the data obtained from the papers was relevant and answered the research question and aims in a representative way.
Studies done on women with a "normal healthy pregnancy"	Studies involving woman that have uterine abnormalities such as polycystic ovaries or woman that have health or obstetric complications.	By looking at papers that only used woman with a "normal healthy pregnancy" as their patient sample it made sure that the results obtained were more representable of the wider society and repeatable. It also made sure that the results obtained were more relevant to the research questions and more controlled as there are no other factors apart from the topics researched that could have affected them.
Adult participants over the age of 18 years old but younger than 45	Paediatric participants (younger than 18 years old) and adults' participants older than 45.	Pregnancy in children/teenagers is more likely to be associated with obstetric complications that could affect the outcome which is why they were excluded. Women who are 45 years old and older are much less likely to get pregnant or have a successful pregnancy due to a decline in fertility. Therefore, they were also excluded from the study.
Study done more than 2 years ago was cited by other research papers.	Study done more than 2 years ago was not cited by any research papers.	If a paper has been cited by other research paper it is a good indication that it has impacted the field and is of good quality. This may not be feasible for research papers released in very recent years because ongoing studies may not have been carried out which is why the criteria was for papers published more than 2 years ago. However, the number of citations was not included as a criterion as this could have led to bias.

Table 1*: Inclusion/Exclusion criteria that was used when screening the studies that were obtained from the databases online and selecting them to include in the results section of the review.*

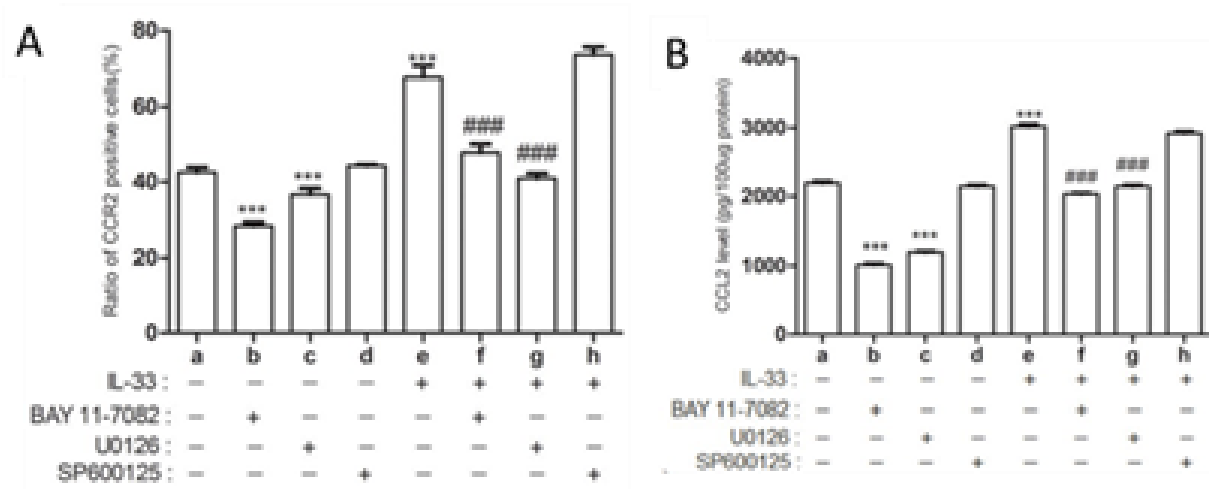

Figure 2: *The specific signalling pathways involved in CCL2/CCLR2 expression in DSCs.*

IL-33 as a potential novel factor in pregnancy success:

Interleukin-33 (IL-33) is a cytokine of the immune system and is part of the IL-1 (interleukin- 1) family and is normally expressed for optimal biological activity. In 2012 a study found that CCL2 (Chemokine (C–C motif) ligand 2) which was secreted from the decidual stromal cells (DSCs) interacted with CCR2 (chemokine (C–C motif) receptor 2) found on decidual leukocytes (DLs) and stimulated them to release Th2 associated cytokines. However, what was not clear was the stimulation of the secretion of the CCL2[11]. Hu et al[12] was one of the first studies to look at the role and mechanism of IL-33 on DSCs and to make a direct correlation between IL-33 and CCL2 in pregnancy. They found that when BAY 11-7082 (inhibitor of NF-κB) and U0126 (inhibitor of ERK1/2) where present and IL-33 was either absent or present the expression of both CCL2 and CCR2 was statistically significantly decreased in both cases. This suggested that these inhibitors not only had a direct effect on CCL2/CCLR2 expression but also reversed the effects of IL-33 as by itself IL-33 statistically significantly increased CCL2/CCR2 expression (figure 2). The JNK (Jun N-terminal kinase) inhibitor SP600125 had no effect which confirmed that IL-33 inducing CCL2/CCR2 expression depended on NF-κB and ERK (extracellular signal-regulated kinase) 1/2 signalling pathways. Therefore, their overall finding was that IL-33 can stimulate CCL2/CCR2 expression through activating NF-κB and ERK1/2 pathways which then stimulates Th-2 associated cytokine stimulation and can promote proliferation and invasion of DSCs. This finding is pivotal as it provides a pathway that enables foetal tolerance and scientist can study it further and come up with effective therapeutic approaches when treating miscarriages.

A limitation of the study is they only looked at the first trimester. A study done in 2011 found that a decoy receptor of IL-33 known as sST2 (soluble variant of ST2) increases in the third trimester so could cause IL-33 to decrease[13] Therefore, by limiting their samples to only the first trimester Hu et al fail to see what the true effects and levels of IL-33 are across the whole pregnancy.

Role of Decidual Natural Killer Cells (dNK) in pregnancy:

In humans around 70% of dNK have the phenotype CD56brightCD16 which are essential at the maternal-foetal interface as they create a microenvironment that is favourable to pregnancy. There are two forms of CD56CD16- natural killer cells: CD56brightCD16− and CD56dimCD16− . CD56dimCD16− have a higher cytotoxicity whereas CD56brightCD16− have an immunoregulatory role and produce anti-inflammatory cytokines[14]. Yang et al[15] were the first study to look at the involvement of the cytokine IL-24 in this dNK conversion during early pregnancy. In their study they found that IL-24 triggers CD56dimuNK cells to differentiate into CD56brightCD16−dNK that had low cytotoxic activity, high immunomodulation, and angiogenic activities. This was highlighted by the fact that when IL-24 was neutralised killer and pro-inflammatory molecules such as CD16, Granzyme B and perforin were statistically significantly upregulated (figure 3A+B) whereas anti-inflammatory molecules IL-10, TGF-β, IL-8 and inhibitory receptors KIR2DL1 and KIR3DL1 were statistically significantly downregulated (figure 3C). In prostate cancer reduction of CD56bright cells has been observed which leads to dysfunctional natural killer cells and impaired cytotoxicity[16]. The above findings indicate that IL-24 could be used as a potential immunotherapeutic therapy against prostate cancer

as it may be able to increase the levels of CD56bright cells and rescue the cytotoxicity.

A limitation of this study is that they included women who underwent a myomectomy to remove fibroids in their endometrial tissue samples. Myomectomy can cause tissue trauma which leads to an inflammatory response and either a regenerative or fibrotic response to tissue healing. A study showed that during tissue/wound healing IL-24 was released suggesting that it could have a role in this process[17]. Therefore, the true conditions of the endometrial tissue are not accurately mimicked with these women.

Decidual CD8+ T-cells and progesterone:
Decidual CD8+ T-cells (CD8+dt cells) recognise and respond to foreign foetal, placental, and viral antigens as they are key cells in protecting the immune system from foreign infections. Therefore, it is crucial that their activation is regulated in order to maintain a healthy pregnancy[18]. Liu et al[19] performed an in vitro study that looked at the phenotype and transcriptional characteristics of decidual-derived CD8+ T-cells. They found that CD8+dt cells may undergo a specific type of TEM (effector T-cell) differentiation that causes them to be dysfunctional which was shown by their high expression of exhaustion-related molecules: Pd-1, Cd39 (figure 4A). They also showed residency because they had high expression of CD103 compared to peripheral CD8+ T-cells. These CD103+CD8+dT had low expression of Granzyme B suggesting compromised cytotoxicity (figure 4B) but showed higher levels of intracellular IFN-γ (figure 4C) which could indicate that that they are still capable of defending the foetus against pathogens. This confirmed the findings of a previous study that showed that although the activity of CD8+dt cells was reduced during pregnancy when they were activated produced pro-inflammatory cytokines so were not completely suppressed[18]. Overall Liu et al reemphasised previous findings and provided a novel understanding of the phenotype of CD8+ dt cells that previous papers failed to do. However, a limitation of this study is that the scientists did not provide a mechanism of what causes these CD8+dt cells to alter their function during pregnancy.

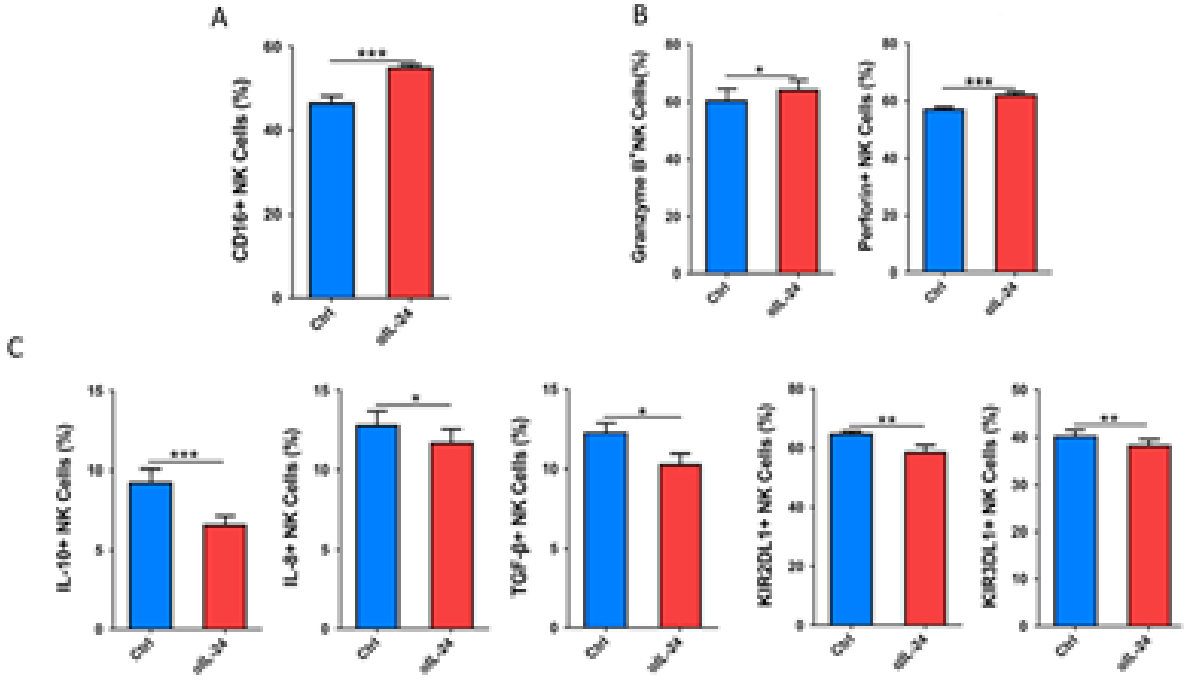

***Figure 3**: IL-24 derived from DSCs influence the differentiation of dNK.*

Decidual CD8+ T-cells and progesterone:

Decidual CD8+ T-cells (CD8+dt cells) recognise and respond to foreign foetal, placental, and viral antigens as they are key cells in protecting the immune system from foreign infections. Therefore, it is crucial that their activation is regulated in order to maintain a healthy pregnancy[18]. Liu et al[19] performed an in vitro study that looked at the phenotype and transcriptional characteristics of decidual-derived CD8+ T-cells. They found that CD8+dt cells may undergo a specific type of TEM (effector T-cell) differentiation that causes them to be dysfunctional which was shown by their high expression of exhaustion-related molecules: Pd-1, Cd39 (figure 4A). They also showed residency because they had high expression of CD103 compared to peripheral CD8+ T-cells. These CD103+CD8+dT had low expression of Granzyme B suggesting compromised cytotoxicity (figure 4B) but showed higher levels of intracellular IFN-γ (figure 4C) which could indicate that that they are still capable of defending the foetus against pathogens. This confirmed the findings of a previous study that showed that although the activity of CD8+dt cells was reduced during pregnancy when they were activated produced pro-inflammatory cytokines so were not completely suppressed[18]. Overall Liu et al reemphasised previous findings and provided a novel understanding of the phenotype of CD8+ dt cells that previous papers failed to do. However, a limitation of this study is that the scientists did not provide a mechanism of what causes these CD8+dt cells to alter their function during pregnancy.

Lissauer et al[20] previously highlighted that the potential mechanism that gives CD8+dt cells this unusual profile that enables maternal-foetal tolerance was progesterone. They found that with administration of progesterone at concentrations like pregnancy (10um) the polyfunctional cytokine profile of CD8+ cells and their proliferation rate were statistically significantly reduced causing the T-cells to be in a mature state. This could suggest that progesterone is what triggers the CD8+dt cells to undergo the specific type of TEM differentiation suggested by Liu et al which causes them to become less polyfunctional and more exhausted. Lissauer et al also found that progesterone decreases the level of pro-inflammatory cytokines released by CD8+dt cells in a dose-dependent manner. This could indicate that where the levels of progesterone are lower the CD8+dt cells retain their cytotoxicity and are able to fight away infections during pregnancy, but closer to the foetus where the levels of this hormone are higher the profile of this T-cell changes to permit foetal tolerance. Therefore, this may provide an explanation as to why high levels of INF-γ were seen in the Liu et al study.

Taken together Lissauer et al and Liu et al provide a more comprehensive mechanism that explains how the phenotype of CD8+ t-cells changes during pregnancy.

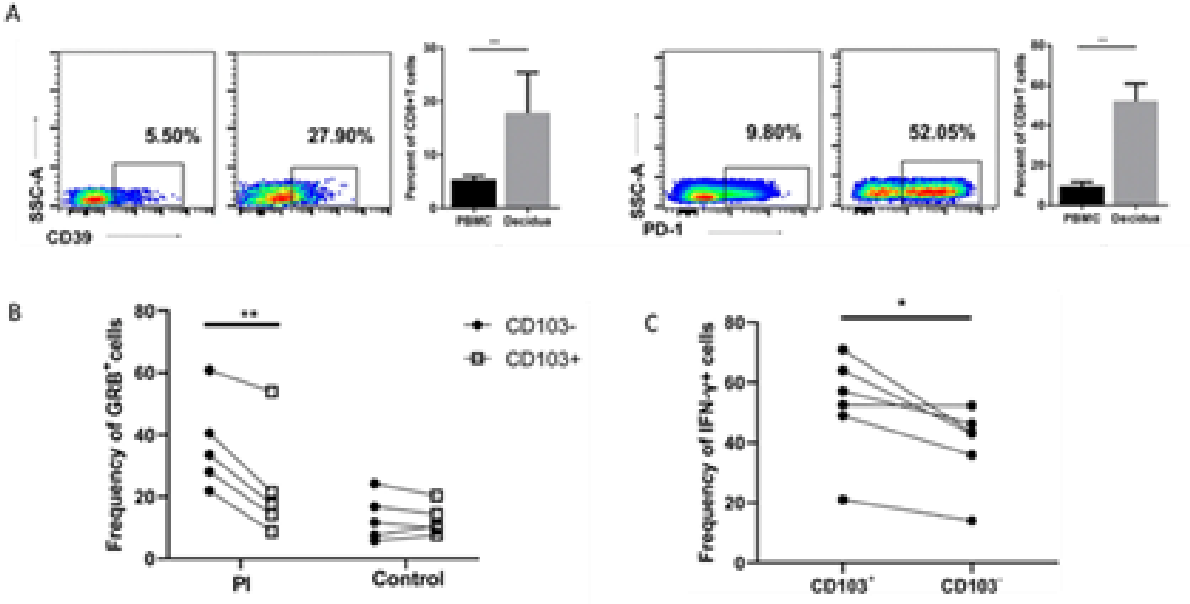

Figure 4*: : How CD8+dt cells change during pregnancy.*

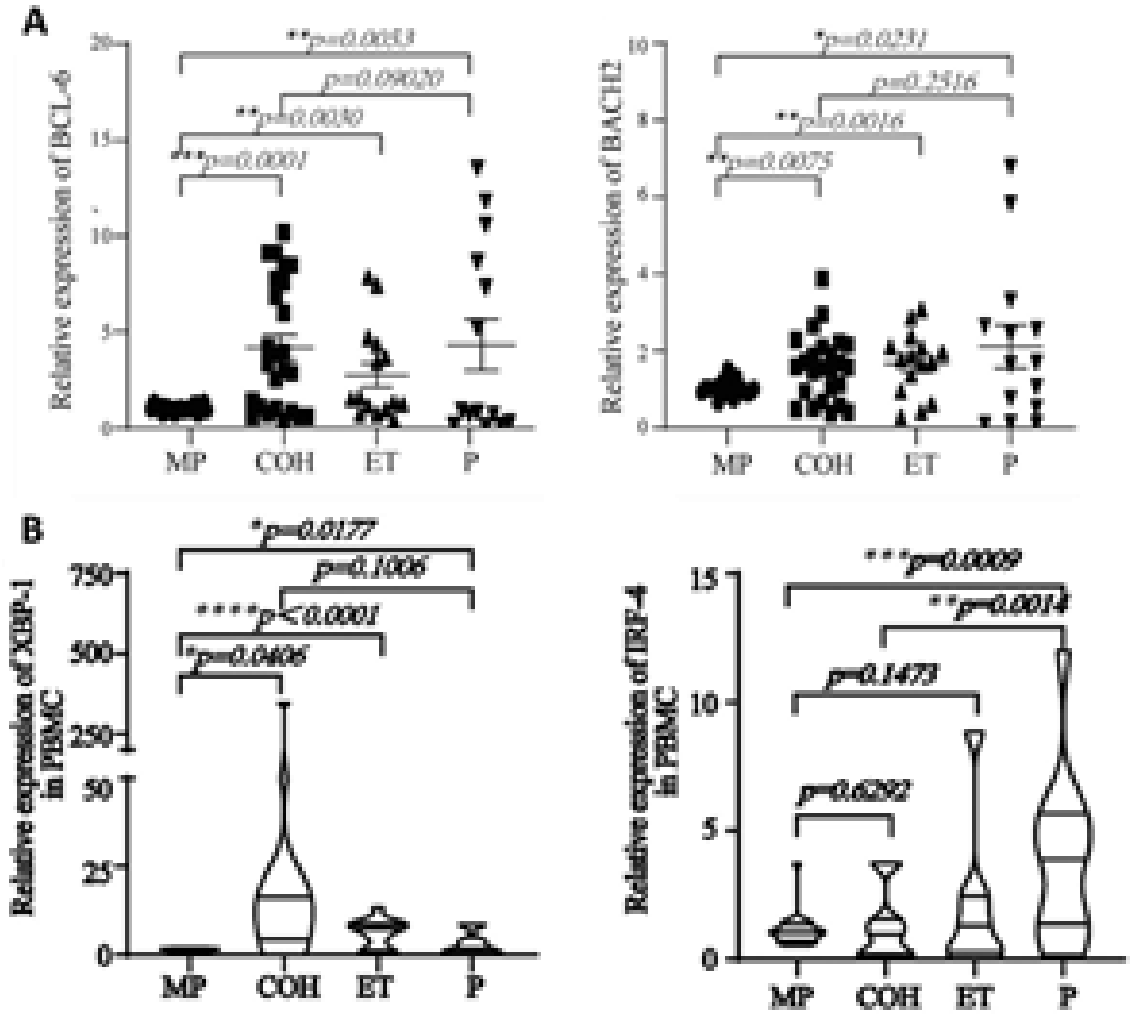

Figure 5*: How oestrogen can manipulate the function of Tfh cells.*

Oestradiol can manipulate Tfh cells:

T follicular helper cells (Tfh) are a subset of CD4+ T-cells so help promote B cell antibody production. During pregnancy it has been found that its essential that the accumulation of Tfh cells (which favours Th2 and balances Th1/Th2 immunity) is done in a timely manner for the pregnancy to be successful. This is because excessive or lack of accumulation could result in a miscarriage[21]. Hu et al[22] wanted to investigate if the function of Tfh could be manipulated by oestradiol in humans. They found that upon E2 exposure, a forward loop was formed in which GPER1 (G Protein-Coupled Oestrogen Receptor 1) was activated to increase BCL6 and BACH2 (functional genes for Tfh cells) and XBP1 and IRF4 (transcription factors involved in stages of B cell differentiation) therefore driving Tfh and plasma cell augmentation (figure 5).

Overall, the findings from this study[22] emphasise the need to add Tfh to the paradigm of T-cells that are crucial in pregnancy and illustrate how hormones work together with immune cells to maintain foetal tolerance.

A limitation of this study[22] was that they only looked at the expression of Tfh and the effects of oestrogen up to 9 weeks of gestation. Tfh cells have shown to be present abundantly in mid and late pregnancy. However, enhanced Tfh cell accumulation in the uterus and placenta has also been correlated with increased foetal reabsorption that is caused by PD1 blockade which enhances foetal rejection[23]. This shows how the expression of Tfh cells changes at the different stages of pregnancy and illustrates what could happen if this expression is not controlled. Therefore, by limiting their study to only 9 weeks of gestation Hu et al do not demonstrate whether the manipulative effects oestrogen has on Tfh cells are beneficial throughout the entire pregnancy.

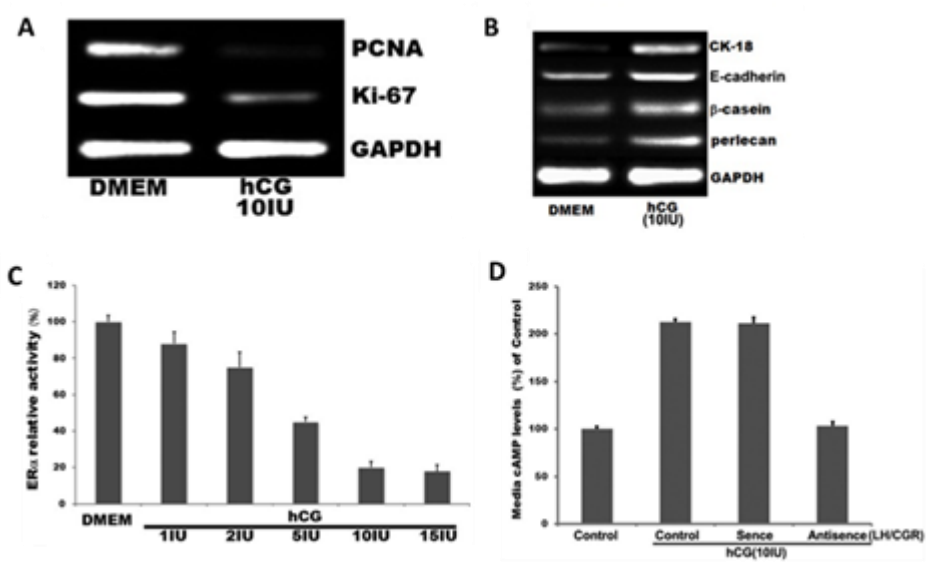

***Figure 6**:The role hCG has on human breast cancer cell line.*

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hCG may regulate human breast cancer cells:

Liao et al[24] wanted to investigate what affect hCG had on human breast cancer cell lines (MCF-7 cells) and its mechanism. They found that hCG inhibits the growth of MCF-7 cells and promotes cell differentiation by suppressing the expression of proliferation markers, PCNA and Ki-67 (figure 6A) and increasing the expression of differentiation markers, β-casein, perlecan, CK18, and E-cadherin (figure 6B). MCF-7 cells with high expression of hCG had reduced Erα (Oestrogen receptor alpha) expression (which can promote breast cancer cell motility and invasion) and increased cAMP expression (figure 6C+D), suggesting that hCG may control the breast cancer progression by stimulating the LH/hCGRs (luteinizing hormone/hCG receptors) to activate the cAMP signalling pathway.

A limitation of the study done by Liao et al was that they used a medium containing both hCG and LH (luteinising hormone) which activate the same signal transduction pathway. Therefore, it makes it hard to distinguish if the results obtained in the study were due to only the effects of hCG. In fact, a study down in 2021 that tested the effects of hCG without serum on MCF-7 breast cancer cell lines found that the hormone had the opposite effects as it stimulated their cell proliferation rendering the cancer cells more prone at colonizing primary organs and metastasize[25]. Since there are conflicts in the literature regarding the role of hCG in breast cancer further studies need to be done.

Conclusion:

Advancements in the field of research have provided more understanding to the different mechanisms in place that allow for a successful pregnancy. But there are still gaps in the literature that need addressing. Below are two future experiments that could help address some of the gaps there are in the literature and provide a more robust answer to the literature question posed in this review.

Looking at the whole gestation period:

PBMCs could be obtained by collecting blood samples from a large cohort of pregnant women and a control group (non-pregnant/pre-pregnant women) and single-cell RNA sequencing could be used to identify the PBMCs. Single-cell RNA would be more useful than traditional RNA-sequencing in this case because RNA-sequencing is used on bulk cells whereas single-cell RNA sequencing of PBMCs can provide a more in-depth analysis of the gene

expression of individual immune cells. Thus, revealing any new immune cells that are involved in maintaining maternal-foetal tolerance that have not yet been identified and providing a more accurate picture of the expression of these individual cells at various stages of pregnancy[26]. To increase the accuracy of the results it would also be important to make sure that this is the women's first pregnancy so that it eliminates the possibility of the women having had previous pregnancy complications and to exclude any women that have any uterine abnormalities or immune system diseases that could affect the pregnancy[27]. To reduce cohort heterogeneity, it would be beneficial to collect the blood samples of the patients at various stages of their pregnancy. To further validate the results post-partum blood samples should also be collected. This is because it has been recently suggested that there is existence of long-term immunological memory of pregnancy (IMOP) which may provide evolutionary advantage for future successful pregnancies[28].

Role of pregnancy hormones in breast cancer:

To address this scientist could use patient derived xenograft models. This means extracting human breast tumour and injecting it into the mouse. The advantage of using this model is that it can represent the biology and heterogeneity of breast cancer and can recreate the tumour microenvironment[29]. The sex hormones could be injected separately into separate mouse models at similar concentrations as to what they are in pregnancy. The effects the hormones each have on the breast cancer could be determined by measuring the tumour burden in the mice and comparing them to the control group. However, the disadvantage of this is that the mouse models are immunocompromised which means they don't truly mimic the conditions that are present in humans[30].

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World Journal of Medical Education and Research:
An Official Publication of the Education and Research Division of Doctors Academy

Health Education
DAUIN 20230207

Vaping: How a New Generation Has Become Hooked on Nicotine

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WJMER, Vol 29: Issue 1, 2023

Abstract:
This article delves into the unprecedented rise of vaping among teenagers, a trend that has gained significant traction in recent years. With the aim of providing a comprehensive analysis, it examines the factors specifically influencing teenagers' attraction to vaping, its impact on their health, and the unique regulatory challenges vaping poses in this demographic. Additionally, the article discusses the potential benefits and risks associated with vaping, including its perceived efficacy as a smoking cessation tool and the concerns regarding its long-term effects on the user's well-being and health.

Key Words:
Vaping; Teenagers; Smoking; Cigarettes; Harmful; Harming, Addiction

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Introduction

In 2020 the World Health Organization published a list of what they believed to be the biggest threats facing children in the modern world.[1] Among the problems identified were issues surrounding air pollution as a result of climate change, as well as problems associated with obesity. However, there was one threat that failed to be mentioned: vaping. According to Dr Mike McKean, vice-president of policy for the Royal College of Paediatricians and Child Health, vaping is becoming an "epidemic" among teenagers,[2] and it's not difficult to see why this description is being used. Walk past any British school and the odds are you will see young children sticking these rectangular pieces of plastic into their mouths only to exhale a grey vapour moments later. But what are vapes and how have they seemingly managed to hook this generation on a new form of nicotine?

History of the Vape

E-cigarettes were first created by Chinese pharmacist Hon Lik in 2003 as a way to help him cope with his nicotine addiction that had been formed due to cigarette use.[3] At the time, options for those who wished to overcome nicotine addiction were limited as they often found that nicotine patches failed to offer the 'hit' that they were craving. However, Lik's creation was more similar to a traditional cigarette in both appearance and function whilst simultaneously satisfying the user's nicotine craving. E-cigarettes work by heating a liquid (called an e-liquid) that typically contains nicotine, propylene glycol, vegetable glycerine, and flavourings. Furthermore, the fact that the nicotine is inhaled in a vapour form means that tobacco is not burnt and, therefore, neither tar nor carbon monoxide, two of the most damaging aspects of traditional smoking, is produced. These facts mean that vaping usage is undoubtedly better for the human body when compared to traditional cigarettes. One PubMed article researched how helpful vapes are compared to alternative methods when cigarette smokers are trying to quit cigarettes. The study estimated that, out of every 100 people who tried to quit smoking by vaping, nine to 14 might be successful.[4] When only using other methods, such as nicotine patches or behavioural counselling, only four to seven smokers out of 100 might quit.[4] Furthermore, according to the NHS, people are "roughly twice as likely to quit smoking if you use a vape compared with other nicotine replacement products, like patches and gum."[5] The article further states that switching to vaping "significantly reduces your exposure to toxins that can cause cancer, lung disease, and diseases of the heart and circulation like heart attack and stroke".[5] So, how did a seemingly beneficent and genuinely advantageous invention lead to a new generation of people developing a nicotine addiction?

Vapes vs Traditional Cigarattes

One common misconception that is held by those who vape is that the use of e-cigarettes is less damaging to the body when compared to traditional cigarettes – but how true is this? Whilst it is true that vapes have a lot less chemicals in them compared to the over 7,000 that are present in

traditional cigarettes, it doesn't mean that vapes are in any way healthy.[6] E-cigarettes have no shortage of harmful chemicals too. According to the American Lung Association, e-cigarettes can contain acrolein (a herbicide primarily used to kill weeds which can cause irreversible lung damage), diacetyl (a chemical linked to a lung disease called bronchiolitis obliterans aka "popcorn lung"), diethylene glycol (a toxic chemical used in antifreeze that is linked to lung disease), as well as benzene (a volatile organic compound (VOC) found in car exhaust).[7, 8] In addition to this, ultrafine particles are also present which mean that these harmful chemicals are able to be inhaled deeper into the lungs.[9] The British Health Watchdog found that: "Almost 1,000 serious adverse reactions to e-cigs have been logged by Britain's health watchdog including blood, nervous system and respiratory disorders, as well as cancer and injuries like burns. This includes five deaths linked to the devices".[10] But this is only a handful of the adverse effects of these new devices. A study in South Korea found that e-cigarette use was significantly associated with gum disease and that vaping may not be a safe alternative to smoking for oral health.[11] Teens are also more vulnerable to nicotine addiction compared to adults – this chemical can result in an array of various other issues.[10] It is now considered the world's single biggest cause of preventable death.[12] An article written on PubMed Central titled 'Harmful effects of nicotine' listed some of the detrimental effects as "there is an increased risk of cardiovascular, respiratory, gastrointestinal disorders. There is decreased immune response and it also poses ill impacts on the reproductive health. It affects the cell proliferation, oxidative stress, apoptosis, DNA mutation by various mechanisms which leads to cancer".[13] Johns Hopkins lung cancer surgeon Stephen Broderick highlights further horrific side effects of vaping, including lipoid pneumonia (a terrible condition with no "good treatment") and lung collapses (primary spontaneous pneumothorax), as well the potential to cause cancer.[14] One study published on Medscape suggests that vaping may "worsen bronchitis and asthma, raise blood pressure, interfere with brain development in young users, suppress the immune system, and increase the risk of developing a chronic lung disease".[15] Studies of mice and cell cultures have found that the vapor or extracts from vapes damage the chemical structure of DNA.[16] Despite the damaging effects of vaping being evident, their use amongst children who have never smoked a cigarette before remains rampant.

The First Introduction of Vapes

From 2003 to 2009, vaping remained a relatively uncommon activity that was almost exclusively used by those who were once traditional cigarette smokers. Once the government took notice of the numbers of smokers making this switch, it decided to endorse the new creation as an effective method of stopping smoking. One official information video from Public Health England advertises how "smokers who use e-cigarettes and get support from their local Stop Smoking service have the highest quit rates".[17] A 2019 study of almost 900 people in the New England Journal of Medicine found that smokers who used vapes for cessation were twice as likely to have quit smoking cigarettes than those who used other nicotine replacement therapy.[18] However, 80% of people who switched to vaping were using e-cigarettes a year after they tried to quit smoking.[19] Another scheme set up by Public Health England offered smokers £25 vouchers to be used on vaping products.[20] However, statistics compiled by the charity Action on Smoking and Health (ASH) estimated that there are 4.3 million vapers in the UK and yet only about 2.4 million of these are ex-smokers.[21] The same statistics also revealed that vape use among children is increasing as, in 2023, 20.5% of children had tried vaping, up from 15.8% in 2022 and 13.9% in 2020.[21] So, what is behind this seemingly unexpected explosion in popularity for these new vapes?

The Increased Popularity of Vapes – Marketing

One factor behind this rise is the manner in which these devices are being marketed. "I think everyone agrees that marketing vaping, an addictive product, with… unknown consequences for developing minds, to children is utterly unacceptable," Prof Sir Chris Whitty told MPs. "Yet it is happening. There's no doubt it's happening because, although from a low base, the rates of vaping have doubled in the last couple of years among children. So that is an appalling situation".[22] According to a BMJ article, for its launch in 2015, JUUL (the largest and most popular vape brand in the world) spent more than $1 million to market the product on the internet.[23] Thanks to this funding, JUUL was transformed from a small, unknown vape brand into one that captured more than half of the e-cigarette market from the years 2015-7. The number of JUUL-related tweets skyrocketed from a monthly average of 765 in 2015 to a monthly average of 30,565 in 2017.[24] Additionally, vapes are available in a wide array of nicotine flavours from "cotton candy" to "lemon tart" in a clear bid to entice younger customers. Furthermore, brightly coloured packaging and devices further attract younger people to them. A King's College London and Action on Smoking and Health study of 2,469 11-to-18-year-olds and 12,026

adults found that teenagers were more likely to say their peers would have no interest in vapes when marketed in standardised white or green packaging, whereas adults said their interest was not reduced.[25] This simple statistic highlights just how instrumental vapes' marketing is when discussing children's use of vapes.

The Increased Popularity of Vapes – Access

Another factor that enables the youth to continue their new nicotine addiction is the ease at which they are able to access vapes. They are widely available to purchase online even through reputable sellers such as Amazon and eBay. Online, these e-cigarette products are often even mischaracterised as items that require no age verification, meaning that effectively anybody of any age would be able to acquire these devices inconspicuously. An Action on Smoking and Health study found that 10% of the vapes that were being used by children were purchased online.[21] However, surprisingly, the most common way that children got their hands on these devices was actually by simply purchasing them from a shop. But how were 46.5% of underage vapers able to purchase these devices despite the sale of e-cigarettes containing nicotine to under-18s being banned?[21] Firstly, some shops may simply choose to ignore the age-requirements or not pay attention to dubious fake IDs purely because the economic incentive is too great. Conversely, according to an article published in the House of Lords Library, "Trading standards officers have noted that e-cigarettes are sold in shops that have not previously sold alcohol or tobacco and staff were not always aware of age-verification requirements".[26] Once vapes are purchased, either through legal or illegal means, it is common for these vapes to find themselves in the hands of other younger users. In fact, the second most common way that children got access to vapes (43% of underage users) was by simply just being given them.[21] Interestingly, quite a few vaping brands are owned by the tobacco companies they're trying to steer customers away from. For example, Blu and 10 Motives are actually owned by Big Tobacco, and Japan Tobacco International (JTI) bought UK e-cigarette brand E-lites in June 2014 from Zandera.[27] These aforementioned issues mean that it is easier than ever for young people to access vapes and consequentially develop a nicotine addiction.

The Increased Popularity of Vapes – Government Action

The lack of government action and regulations further means that the 'epidemic' of children vaping has no end in clear sight. In 2019, the UK government revealed its ambition for a 'smoke-free' England by 2030 – meaning that only 5% of the population would be smoking cigarettes.[28] However, crucially, those who used vapes were not included in this statistic: this means that the government has no real ambition to cut the steeply rising number of vapers in the country. An independent government review into this 'smoke-free' ambition was published in June 2022. In it, it was said that "offering vaping as an alternative to smoking" was a "must do" to achieve 'smoke-free' by 2030.[29] This statement highlights the government's hesitancy to do anything about this emerging crisis. This British inaction is in stark contrast to the actions of other countries' governments. Several countries (Argentina, Brazil, North Korea, and Nepal) have outright banned vaping out of fears of it resulting in a new epidemic of young nicotine addicts. In the USA, one major vape brand, JUUL, was recently banned.[30] The Australian government made the radical decision to ban all vapes except on prescription to stem use in children. But here the government does not seem to do anything.

Conclusion

Vaping truly appears to be the biggest threat that faces this generation. However, governments and parents alike are seemingly unbothered by this new addiction. E-cigarette companies seem to view the youngest, most vulnerable people in society as nothing more than potential customers : the more vapour that these children inhale, the more money lines their pockets. Children are becoming dependant on these new devices, unable to stand the idea of going a mere few hours without the flavoured vapour flooding their body. The House of Lords Library article further states that "Chronic nicotine exposure can impact brain development. This can contribute to cognitive and attention deficit conditions and worsen mood disorders, including depression and suicidal thoughts".[26] It is clear that the use of vapes should be strongly discouraged at least, if not outrightly banned. This new craze is harming our children – when will we let it stop?

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World Journal of Medical Education and Research:
An Official Publication of the Education and Research Division of Doctors Academy

The Effect of a Surgical Skills Course on the Self-Evaluated Competency Levels of Medical Students and Junior Doctors: A Prospective Study

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WJMER, Vol 29: Issue 1, 2023

Abstract
Purpose: This prospective study examines the effect of a one-day surgical skills course on the self-evaluated competency levels of medical students and junior doctors in essential surgical skills pertinent to their level.
Methods: One hundred and one medical students and junior doctors from various Medical Schools and NHS Foundation Trusts across the UK who attended the 'Essential Surgical Skills and Principles for Aspiring Surgeons (ESSPAS) Course' in May 2021 and October 2022 completed a pre-course and post-course questionnaire on the day of the course. They rated their self-evaluated competency in the skills taught and practised on a Likert scale of '0' to '10'. The mean score for each skill pre-course and post-course was compared. The Wilcoxon signed-rank test was also used to determine if there were any statistically significant changes in attendees' self-evaluated competency levels after the course ($p = <0.05$).
Results: There was a statistically significant increase in participants' self-evaluated competency levels in all skills practised ($p = <0.001$). Additionally, an increase in the mean score after the course was seen across all the 10 domains.
Conclusion: A one-day surgical skills course resulted in a statistically significant improvement in the self-evaluated competency levels of medical students and junior doctors in essential surgical skills pertinent to their level. It has been demonstrated that such courses provide trainees with a strong foundation on which to develop the basic skills required to be competent in the operative theatre. This study has thus evidenced the ability of a short surgical skills course to prepare medical students and junior doctors for clinical practice.

Key Words:
Medical Education; Surgical Education; Surgical Skills; Medical Students; Junior Doctors

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Introduction

The current structure of surgical training in the United Kingdom (UK) places an emphasis on practical courses.[1,2] They provide surgical trainees with a structured platform through which to develop new technical skills, as well as to practise and enhance their existing abilities. The willingness to attend such courses also allows surgical trainees to demonstrate their commitment to the field of surgery.[1]

Simulation is an established and well-regarded tool through which technical and non-technical skills that are essential for healthcare professionals are taught.[3] It enables conceptual knowledge to be integrated with practical ability,[4] facilitating learning without posing any risk to patients.[5] A collegial environment that enables a skill to be practiced and feedback to be received allows trainees to develop important expertise and ensures that the skill is learnt correctly.[6] It can also be argued that practising skills in a simulated environment gives surgical trainees more confidence to attend and assist in theatre, as well as to care for patients.

The broad curriculum implemented by Medical Schools in the UK does not allocate time to teach medical students surgical skills. However, a basic understanding of how to perform skills such as suturing, excising a suspicious skin lesion for biopsy,

and draining an abscess is not specific to surgery; it is required in multiple specialties, from General Practice to Emergency Medicine. Indeed, surgical conditions account for a significant proportion of referrals, both elective and emergency, within the National Health Service (NHS).[7] The General Medical Council's 'Outcomes for Graduates', which outlines what newly qualified doctors with a primary medical degree from any of the UK's Medical Schools must be able to do as they start their Foundation Training, highlights that newly qualified doctors should be able to scrub, carry out basic wound closure, and administer local anaesthetic under direct supervision.[8] These skills tend to be taught or revised in surgical skills courses.

The Royal College of Surgeons of England (RCSEng) proposed a 'National Undergraduate Curriculum in Surgery' in 2015 in an attempt to support medical students considering a career in surgery.[9] This curriculum illustrated the level of surgical competence that those who wish to pursue a career in surgery should aim to attain on completion of Medical School, identifying skills such as the assessment of a wound, the administration of local anaesthetic, the closure of a wound, the safe disposal of sharps, and surgical scrubbing. Since the UK's Medical Schools do not formally teach these surgical skills, those who intend to become surgeons must actively seek opportunities to develop them before or as they become junior doctors. They must, therefore, attend short courses.

RCSEng's report 'Improving Surgical Training', which was also published in 2015, found that general surgical training could be improved if trainees developed surgical skills at an early stage in their career.[10] As a structured and formal method of instruction, courses inevitably play a fundamental role in surgical trainees' mastery of essential surgical skills and, in turn, their confidence in performing them in clinical practice. This study therefore examines the ability of a short surgical skills course to enhance the self-evaluated competency levels of medical students and junior doctors to perform certain surgical skills.

Methods

This prospective study tested the hypothesis that the self-evaluated competency levels of medical students and junior doctors to perform certain skills improve after they participate in a one-day surgical skills course.

The Essential Surgical Skills and Principles for Aspiring Surgeons (ESSPAS) Course, which was developed in 2017, is aimed at medical students, foundation year doctors, early core surgical trainees, and those working at an equivalent level who are not in the National Training Programme. This annually delivered course intends to provide attendees with an overview of the core concepts, essential principles, and fundamental skills relevant at the level of a foundation year doctor and a core surgical trainee. The course uses animal tissue and simulated models, interspersed with structured and focused presentations delivered by consultant surgeons, to explain and demonstrate a number of essential surgical skills. Attendees practise all of the skills independently. The topics covered in the course are outlined in ***Figure 1***.

Topics Covered in the ESSPAS Course

- Aseptic Precautions in the Operating Theatre
- Surgical Gowning and Closed Method of Gloving
- Knot Tying (Reef Knot; Surgeon's Knot; Instrument Tie; Tying at Depth; Aberdeen Knot)
- Handling Surgical Instruments
- Safe and Effective Infiltration of Local Anaesthetic
- Basic Suturing Techniques (1): Simple Interrupted and Simple Continuous
- Basic Suturing Techniques (2): Vertical Mattress, Horizontal Mattress, and Intradermal
- Excision Biopsy of a Cutaneous Pigmented Lesion and Closure of an Ellipse
- Removal of a Subcutaneous (Epidermoid) Cyst
- Drainage of an Abscess
- Debridement of a Contaminated Traumatic Wound
- Principles of Wound Healing and Reconstructive Surgery
- Role of Antibiotics in Trauma and Surgery
- Principles of Surgical Diathermy
- Fundamentals of Laparoscopic Surgery

Figure 1*: Topics Covered in the ESSPAS Course*

The ESSPAS Course is delivered by consultant surgeons and surgical registrars. Each course has a high tutor-to-delegate ratio to ensure that attendees receive sufficient support, guidance, and individualised feedback. The skills are demonstrated live and projected onto screens using a visualiser, following which the attendees practise each technique with assistance from the tutors. Didactic presentations on key concepts, such as the principles of reconstructive surgery, are also given. The course is accredited by the College of Physicians and Surgeons of Cardiff.

The participants of this study were those who attended the one-day ESSPAS Course on either 22nd May 2021, 23rd May 2021, 29th October 2022 or 30th October 2022. The data were, therefore, collected at four ESSPAS Courses. The courses were conducted at the International Surgical Education and Training Centre in Cardiff Bay, Cardiff, UK.

A total of 101 individuals attended the ESSPAS Course on these four dates, 40 of whom were medical students and 61 of whom were junior doctors. All the participants were either studying in one of the UK's Medical Schools or working in the UK's NHS. ***Table 1*** details the year of study or level of training of each participant. ***Figure 2*** illustrates the distribution of the medical students who attended these courses by the Medical School in which they study. Eighteen of the UK's Medical Schools were represented. ***Figure 3*** illustrates the distribution of the junior doctors who attended these courses by the region of the NHS in which they work. All seven regions of NHS England, as well as Wales and Northern Ireland, were represented. ***Table 2*** sets out the hospitals or trusts within those regions in which the participants work.

Year (Medical Student)	**Number**
Year 2	6
Year 3	11
Year 4	11
Year 5	12
Level (Junior Doctor)	
Foundation Year 1	18
Foundation Year 2	20
Foundation Year 3	1
Specialty Trainee 3	1
Trust Grade Doctor	21

Table 1*: Level of Attendees of the ESSPAS Courses in May 2021 and October 2022*

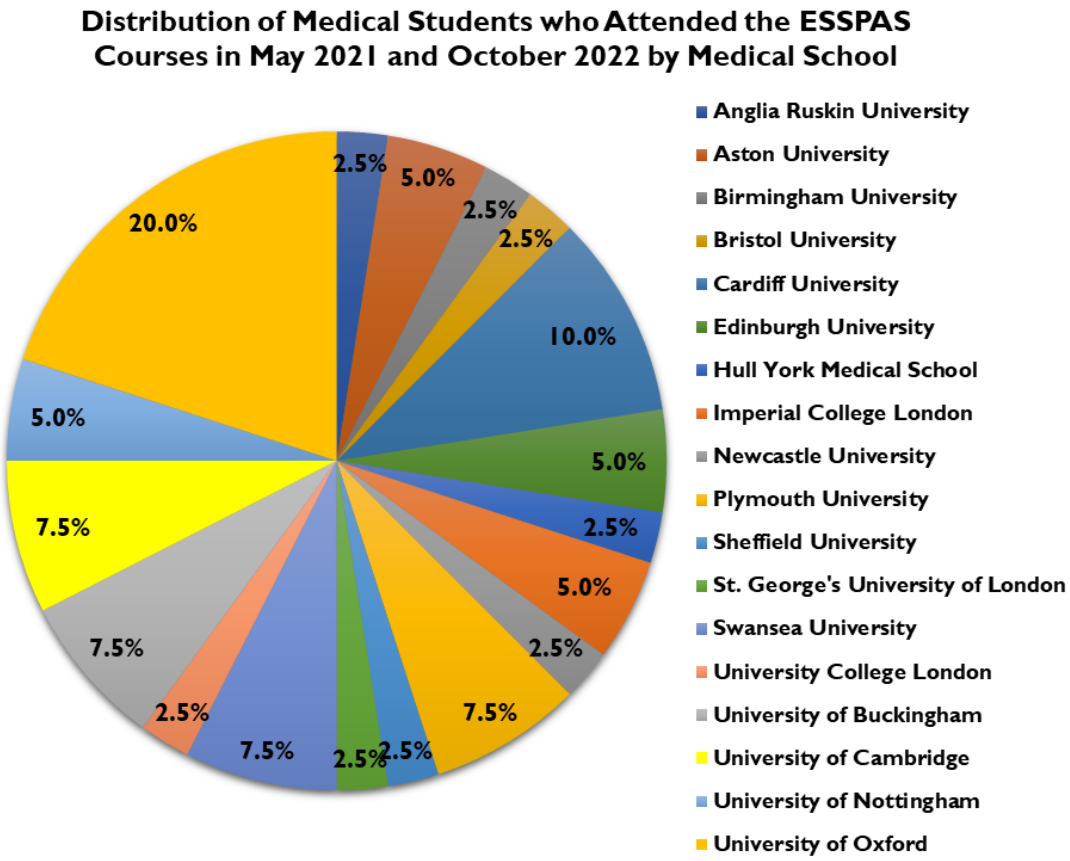

***Figure 2**: Distribution of Medical Students who Attended the ESSPAS Courses in May 2021 and October 2022 by Medical School*

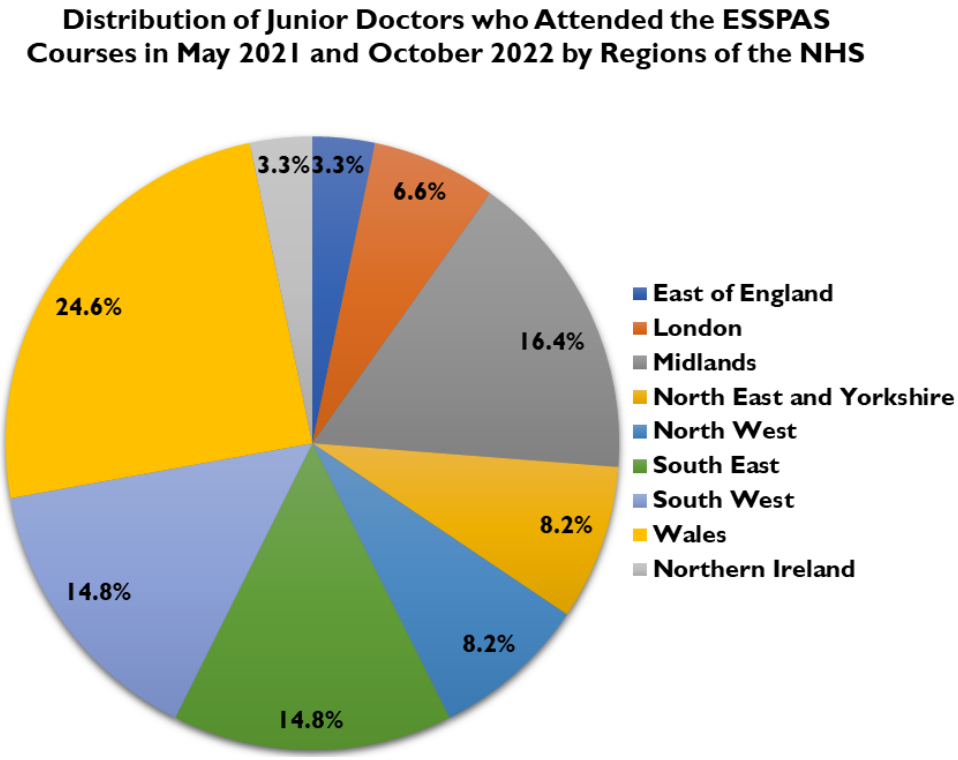

***Figure 3**: Distribution of Junior Doctors who Attended the ESSPAS Courses in May 2021 and October 2022 by Regions of the NHS*

Region of the NHS	NHS Hospital or Trust
East of England	• Lister Hospital, Stevenage
London	• North Middlesex University Hospital NHS Trust • Royal Free London NHS Foundation Trust • St. Mary's Hospital, London
Midlands	• King's Mill Hospital, Sutton-in-Ashfield • Leicester Royal Infirmary, Leicester • Queen Elizabeth Hospital Birmingham, Birmingham • Sandwell and West Birmingham Hospitals NHS Trust • Shrewsbury and Telford Hospital NHS Trust • Worcestershire Acute Hospital NHS Trust • University Hospitals Coventry and Warwickshire NHS Trust • University Hospitals of Derby and Burton NHS Foundation Trust
North East and Yorkshire	• Airedale NHS Foundation Trust • Bradford Teaching Hospitals NHS Foundation Trust • County Durham and Darlington NHS Foundation Trust • Leeds Teaching Hospitals NHS Trust
North West	• Aintree University Hospital, Liverpool • Manchester Royal Infirmary, Manchester • St. Helen's and Knowsley Teaching Hospitals NHS Trust • Warrington and Halton NHS Foundation Trust • Wirral University Teaching Hospital NHS Foundation Trust
South East	• Ashford and St. Peter's Hospitals NHS Foundation Trust • East Kent Hospitals University NHS Foundation Trust • Oxford University Hospitals NHS Foundation Trust • University Hospital Southampton NHS Foundation Trust
South West	• Musgrove Park Hospital, Taunton • Poole Hospital NHS Foundation Trust • Royal Cornwall Hospitals NHS Trust • Royal United Hospitals Bath NHS Foundation Trust • Southmead Hospital, Bristol
Wales	• Bronglais General Hospital, Aberystwyth • Cwm Taf Morgannwg University Health Board • Grange University Hospital, Cwmbran • Morriston Hospital, Swansea • Royal Gwent Hospital, Newport • University Hospital of Wales, Cardiff • Withybush General Hospital, Haverfordwest
Northern Ireland	• Belfast Health and Social Care Trust

***Table 2**: NHS Hospitals and Trusts in which Junior Doctors who Attended the ESSPAS Courses in May 2021 and October 2022 Work*

Each attendee was asked to complete a pre-course and a post-course questionnaire at the course. They were required to rate their self-evaluated competency in 10 skills taught at the course on an 11-point Likert scale (0-10). Each attendee was randomly assigned a number to allow the researchers to match his/her pre-course responses with his/her post-course responses. The responses were, therefore, anonymous. Data were collected and analysed from all 101 attendees. Informed consent was obtained. Ethical approval had been granted by Doctors Academy Academic Research Ethics Committee (DAAREC) (No:2021SS02).

IBM SPSS Version 28 was used to analyse the data. The Wilcoxon signed-rank test was used to determine if there were any statistically significant changes in attendees' self-evaluated competency levels after the course. The level of statistical significance was set at 5% (p = <0.05).

Results

Participants rated 10 items on a scale of 0 to 10: 0 indicated no self-evaluated competency, and 10 indicated complete self-evaluated competency. Improvements in self-evaluated competency levels after the course were present in all 10 items. ***Table 3*** presents the mean score for each skill in the pre-course questionnaire and the post-course questionnaire.

Skill	Pre-Course Score (Mean)	Pre-Course Score (SD)	Post-Course Score (Mean)	Post-Course Score (SD)
Surgical Gowning and Closed Method of Gloving	6.71	2.238	9.04	0.916
Knot Tying (Reef Knot; Surgeon's Knot; Instrument Tie; Tying at Depth; Aberdeen Knot)	4.85	2.032	8.19	1.206
Basic Suturing Techniques (1): Simple Interrupted and Simple Continuous	5.37	2.043	8.43	1.134
Basic Suturing Techniques (2): Vertical Mattress, Horizontal Mattress, and Intradermal	3.89	2.059	7.99	1.315
Safe and Effective Infiltration of Local Anaesthetic	5.46	2.468	8.42	1.314
Excision Biopsy of a Cutaneous Pigmented Lesion and Closure of an Ellipse	3.64	2.129	7.90	1.368
Removal of a Subcutaneous (Epidermoid) Cyst and Drainage of an Abscess	3.50	2.279	7.92	1.254
Debridement of a Contaminated Traumatic Wound	3.46	2.076	7.87	1.246
Principles of Surgical Diathermy	3.17	1.995	7.70	1.331
Fundamentals of Laparoscopic Surgery	3.03	1.884	7.31	1.580

Table 3*: Mean Scores on Pre- and Post-Course Questionnaire for ESSPAS Courses in May 2021 and October 2022*

Table 3 illustrates that an increase in the mean score after the course was seen in all 10 skills: Surgical Gowning and Closed Method of Gloving (+2.33); Knot Tying [Reef Knot; Surgeon's Knot; Instrument Tie; Tying at Depth; Aberdeen Knot] (+3.34); Basic Suturing Techniques (1): Simple Interrupted and Simple Continuous (+3.06); Basic Suturing Techniques (2): Vertical Mattress, Horizontal Mattress, and Intradermal (+4.10); Safe and Effective Infiltration of Local Anaesthetic (+2.96); Excision Biopsy of a Cutaneous Pigmented Lesion and Closure of an Ellipse (+4.26); Removal of a Subcutaneous (Epidermoid) Cyst and Drainage of an Abscess (+4.42); Debridement of a Contaminated Traumatic Wound (+4.41); Principles of Surgical Diathermy (+4.53); and Fundamentals of Laparoscopic Surgery (+4.28).

The Wilcoxon signed-rank test showed that this one-day course elicited a statistically significant difference in the self-evaluated competency levels of medical students and junior doctors to perform certain surgical skills (p = <0.001 for all 10 items). ***Table 4*** provides the z-scores and p values of the Wilcoxon signed-rank test.

The ranks that the Wilcoxon signed-rank test produced reveal interesting data about participants' self-evaluated competency levels in certain skills before and after the ESSPAS Course. ***Table 5*** outlines the number of participants who reported a higher self-evaluated competency level, a lower self-evaluated competency level, and no change in level of self-evaluated competency in each skill following the course.

Skill	*Z*-Score	*P* Value
Surgical Gowning and Closed Method of Gloving	-8.249	<0.001
Knot Tying (Reef Knot; Surgeon's Knot; Instrument Tie; Tying at Depth; Aberdeen Knot)	-8.671	<0.001
Basic Suturing Techniques (1): Simple Interrupted and Simple Continuous	-8.409	<0.001
Basic Suturing Techniques (2): Vertical Mattress, Horizontal Mattress, and Intradermal	-8.640	<0.001
Safe and Effective Infiltration of Local Anaesthetic	-8.091	<0.001
Excision Biopsy of a Cutaneous Pigmented Lesion and Closure of an Ellipse	-8.672	<0.001
Removal of a Subcutaneous (Epidermoid) Cyst and Drainage of an Abscess	-8.582	<0.001
Debridement of a Contaminated Traumatic Wound	-8.496	<0.001
Principles of Surgical Diathermy	-8.663	<0.001
Fundamentals of Laparoscopic Surgery	-8.534	<0.001

Table 4: *Results of Wilcoxon Signed-Rank Test*

Skill	No. of Participants with a Lower Post-Course Score	No. of Participants with a Higher Post-Course Score	No. of Participants with No Change
Surgical Gowning and Closed Method of Gloving	0	89	12
Knot Tying (Reef Knot; Surgeon's Knot; Instrument Tie; Tying at Depth; Aberdeen Knot)	0	99	2
Basic Suturing Techniques (1): Simple Interrupted and Simple Continuous	0	93	8
Basic Suturing Techniques (2): Vertical Mattress, Horizontal Mattress, and Intradermal	0	98	3
Safe and Effective Infiltration of Local Anaesthetic	1	87	13
Excision Biopsy of a Cutaneous Pigmented Lesion and Closure of an Ellipse	0	99	2
Removal of a Subcutaneous (Epidermoid) Cyst and Drainage of an Abscess	0	97	4
Debridement of a Contaminated Traumatic Wound	0	95	6
Principles of Surgical Diathermy	0	99	2
Fundamentals of Laparoscopic Surgery	0	96	5

***Table 5**: Table of Ranks for ESSPAS Courses in May 2021 and October 2022*

Discussion

A statistically significant difference in attendees' self-evaluated competency levels before and after the ESSPAS Course was noted for every skill about which participants were asked, including those that are outlined in the GMC's 'Outcomes for Graduates' and RCSEng's 'National Undergraduate Curriculum in Surgery'.[8,9] That the majority of participants reported increased self-evaluated competency in each skill following the course evidences the ability of a short surgical skills course to contribute to medical students' and junior doctors' preparation for clinical practice. The results of this study support the assertion that such experimental learning helps trainees to advance their skills and, therefore, contributes to safe and accurate patient care.[11]

The ability to effectively and efficiently knot tie and suture is a fundamental aptitude that all surgical trainees must possess. Indeed, the closure of a wound is outlined in the GMC's 'Outcomes for Graduates' as a skill that all newly qualified doctors should be able to perform.[8] The fact that almost all the attendees rated their self-evaluated competency in knot tying and various types of suturing higher after the course emphasises the capability of short surgical skills courses to help individuals to harness important skills that will be essential for their career, regardless of the specialty they choose. If an individual's confidence is enhanced after he/she has undertaken a surgical skills course, he/she will arguably feel more assured to perform, or at least assist in, this skill in real clinical practice. This should prompt him/her to maximise the opportunities presented to him/her and to, therefore, progress in his/her career.

It is particularly noteworthy that, whilst the attendees rated their competency the lowest in principles of surgical diathermy and fundamentals of laparoscopic surgery at the beginning of the course, their self-evaluated competency in these two skills had significantly increased at the end the course to match their self-evaluated competency in the other skills encountered. In fact, the increase between the mean pre-course score and post-course score for principles of surgical diathermy was the greatest of all the skills. Whilst medical students and junior doctors often observe surgical diathermy being used in the operating theatre, they typically do not control it, and they might not have a sound understanding of how it functions or the dangers associated with it. Additionally, they might not appreciate the complexity of laparoscopic surgery and the skills that a laparoscopic surgeon must possess, such as hand-eye coordination, depth perception and dexterity. Yet, if they use a

laparoscopic simulator to carry out simulated exercises in a simulated environment, they are able to acknowledge the technical aptitude that is required to operate laparoscopically. The results of this study therefore reveal that, through providing an insight into how common operative technologies function, surgical skills courses can enhance attendees' familiarity and confidence with them and, in turn, strengthen how proficient they feel.

It is worthy of note that the self-evaluated competency of one participant in the infiltration of local anaesthetic decreased after the course. While the results of this quantitative research do not explicate the reason for this, it is plausible that, after having practised this skill in a simulated environment, this participant realised that he/she was not as competent as he/she originally thought. It must be highlighted that short surgical skills courses do not create a fully competent surgical trainee. Attendees are taught new skills and provided with a platform on which to refine their existing skills, but they must continue to practise after the course, as well as acquire experience in a real clinical environment, to attain complete proficiency. The ESSPAS Course has a high faculty-to-delegate ratio, and the faculty confirm that every attendee is able to perform each simulated skill. If an attendee struggles, a member of the faculty will offer additional support to ensure that he/she is able to complete the exercise. While this participant would have demonstrated the ability to infiltrate local anaesthetic on animal tissue at the course, he/she recognised that more practice is required in order for him/her to feel competent to perform this procedure on a patient. The acts of thought and reflection are the cornerstone of effective teaching practice.[12] If such surgical skills courses can encourage learners to reflect on the skills with which they require help to develop, trainees can work on those skills and therefore progress in their surgical careers.

It is perhaps not unexpected that the self-evaluated competency level of 12 participants in surgical gowning and gloving did not alter significantly after the course. Medical students and, particularly, junior doctors often gown and glove in order to enter theatre, and many will arguably feel proficient in this exercise. However, it remains essential to discuss this fundamental element of surgical practice in such a course. Indeed, some medical students would not yet have had the opportunity to scrub, gown and glove, and certain junior doctors might lack confidence in certain steps.

Those who attended the ESSPAS Course might observe the surgical procedures simulated at the course in the operating theatre, such as the debridement of a contaminated traumatic wound, but they would not necessarily be permitted to independently perform such procedures themselves at their level of training. This study does not intend to suggest that those who attend a short surgical skills course are able to independently carry out each skill practised in a real clinical environment. However, it does argue that, now that they have attempted to perform a simulated version on animal tissue, they can appreciate the procedures and their complexities, which makes them more confident in assisting their seniors to conduct these surgical procedures. Indeed, it has been indicated that attending a surgical skills course prior to a surgical placement can maximise the educational benefit that medical students gain from that placement.[13] Their development of basic skills before the placement can increase their confidence which, in turn, allows them to maximise their learning opportunities.[13] We can also apply this principle to junior doctors before their rotations in certain surgical specialties.

A limitation of this study is that it is centred on the perceptions of medical students and junior doctors, which are subjective; one individual's definition of 'competent' might not mirror another individual's definition of the concept. It should also be highlighted that there was a potential selection bias of the participants. The participants were self-motivated medical students and junior doctors who voluntarily chose to attend a non-mandatory surgical skills course on a weekend. They were, therefore, arguably rather incentivised to become more competent in performing the surgical skills practised at the course. However, this does not undermine the evidence outlined above that short surgical skills courses have the ability to enhance medical students' and junior doctors' self-evaluated proficiency in fundamental surgical skills.

Conclusion

This study examined if a one-day surgical skills course can enhance the self-evaluated competency of medical students and junior doctors to perform certain essential surgical skills. It found that the majority of participants experienced an increase in their self-evaluated competency levels after the course in every skill about which they were asked. This study has thus evidenced the ability of a short surgical skills course to prepare medical students and junior doctors for clinical practice. That reference is made to some of these skills in the GMC's 'Outcomes for Graduates' and RCSEng's 'National Undergraduate Curriculum in Surgery' highlights the relevance of such courses in surgical trainees' development.

It is important to highlight that a short surgical skills course does not produce a fully competent surgeon;

this competency is attained through exposure in the operating theatre, practice, and experience. However, as the results of this study have revealed, such courses can help medical students and junior doctors enhance their skills, which will arguably be beneficial to patient care.

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