

Scrotal point-of-care ultrasonography: a UK cross-speciality pilot training course evaluation

Spermatic cord torsion is a time-critical surgical emergency, with suspected cases typically taken directly to theatre for scrotal exploration. However, only 20%–25% of patients who undergo scrotal exploration in this setting are found to have testicular torsion [1]. Therefore, the majority of patients undergo an unnecessary operation with associated surgical and anaesthetic risks, while increasing health resource utilisation.

The diagnostic paradigm for testicular torsion has remained unchanged for decades. Scrotal ultrasonography (US) has been shown to be an imaging modality with high specificity and sensitivity for testicular torsion [2]. However, its use is limited in the UK due to concerns about introducing a time delay to surgery and accessibility of specialists who can perform the US, particularly out of hours.

One solution is for the assessing clinician to perform a scrotal point-of-care US (POCUS) at the bedside as a clinical assessment adjunct in patients with suspected testicular torsion. A retrospective study of scrotal POCUS by emergency physicians in Canada found in 120 children presenting with an acute scrotum, the sensitivity and specificity of identifying testicular torsion were 100% and 99.1%, respectively. Results were available at a median (interquartile range) of 73 (51–112) min, faster than a formal departmental US [3]. It has been shown that urology and emergency medicine residents can be taught scrotal POCUS for this purpose with focused training [4]. However, further prospective research is required to evaluate the role of POCUS in suspected torsion [5].

Our aim was to design, deliver, and optimise an easily replicable 1-day scrotal POCUS training course for cross-speciality clinicians. This will form the basis of an ethically approved clinical trial evaluating the diagnostic accuracy of POCUS in suspected testicular torsion [6].

Delegates from the UK were recruited from urology, general surgery, paediatric surgery, or emergency medicine backgrounds. The course consisted of a pre-course online module and a 1-day practical session with an assessment of competency. The online module was designed by radiologists and outlined the basic science behind US, relevant anatomy, and key features of testicular torsion detection by US with self-assessment questions at the end [7]. The 1-day practical session was delivered by expert faculty, including radiologists and emergency physicians with a specialist interest in POCUS. The course consisted of lectures and practical

sessions enabling the delegates to practise scrotal POCUS on both phantom and healthy live models with a faculty-to-delegate ratio of 1:3. The practical sessions and assessments were carried out using three different Sonosite POCUS machines (Sonosite LX, Sonosite PX and Sonosite Edge II using linear probes) to give a total of six machines.

Competency was assessed using the Objective Structured Assessment of Ultrasound Skills (OSAUS) at the end of the course (Fig. 1) [8]. This validated tool assesses applied knowledge of ultrasound equipment, image optimisation, systematic examination, interpretation of images, and documentation of examination. Competency was defined as an overall score of 80% based on expert consensus and findings in previous studies [5]. Delegates were given 8 min to perform a scrotal POCUS on a live model and 2 min to present their findings and interpret the US images. Additionally, participants completed a pre- and post-course questionnaire assessing their confidence in performing scrotal POCUS on a 5-point Likert scale (1 = 'not confident' to 5 = 'very confident'). In a co-design exercise, delegates from the course participated in an anonymous focus group with qualitative researchers to explore how training materials, course design and delivery could be adapted and enhanced to meet their training needs better.

A total of 19 delegates attended the course (14 urology, one general surgery, one paediatric surgery, and three emergency medicine). In all, 89% ($n = 17$) had never performed scrotal POCUS before. The two delegates who had performed scrotal POCUS previously were both urologists and had performed <10 scrotal POCUS each. Delegates ranged from core surgical trainees (Post-Graduate Year [PGY]3) to higher specialist trainees (PGY5+). The confidence in performing scrotal POCUS improved from a pre-course mean of 1.2 to a post-course mean of 4.2 ($P < 0.001$) on the Likert scale. The mean confidence in recognising features of testicular torsion by US increased from 1.5 pre-course to 3.9 post-course ($P < 0.001$). The mean satisfaction for the overall course was 4.4 out of 5. Overall, 74% ($n = 14$, 10 urology, one general surgery and one emergency medicine) of the delegates were deemed competent to perform scrotal POCUS after training. The mean (SD) OSAUS score for all delegates was 4.0 (0.83) out of 5. The domain with the lowest mean score was systemic US examination (3.6) and the highest was the interpretation of imaging findings (4.4). The mean score for applied knowledge of the ultrasound equipment was 3.9 out of 5, image optimisation 4.0 out of 5, and documentation 4.2 out of 5.

Fig. 1 OSAUS assessment matrix.

1. Applied knowledge of ultrasound equipment Familiarity with the equipment and its functions i.e. selecting probe, using buttons and application of gel	1 Unable to operate equipment	2	3 Operates equipment with some experience	4	5 Familiar with operating equipment
2. Image optimisation Consistently ensuring optimal image quality by adjusting gain, depth, focus, frequency etc.	1 Fails to optimise images	2	3 Competent image optimisation but not done consistently	4	5 Consistent optimisation of images
3. Systematic examination Consistently displaying systematic approach to the examination of relevant structures	1 Unsystematic approach	2	3 Displays some systematic approach	4	5 Consistently displays systematic approach
4. Interpretation of images Recognition of image pattern and interpretation of findings	1 Unable to interpret any findings	2	3 Does not consistently interpret findings correctly	4	5 Consistently interprets findings correctly
5. Documentation of examination Image recording and focused verbal/written documentation	1 Does not document any images	2	3 Documents most relevant images	4	5 Consistently documents relevant images

The post-course focus group highlighted positive feedback about the course content and delivery. Some delegates thought future refresher training would be of benefit, and others suggested a local mentor to supervise initial cases would improve early confidence. The findings showed that our scrotal POCUS course was feasible, effective, and well-received by delegates across multiple specialities and different levels of training. The majority of delegates had no previous scrotal US experience and following an online learning module and a 1-day practical course, three out of four were deemed competent by expert clinicians. Delegates commented on the efficient blend of self-directed virtual learning, didactic teaching and high-fidelity practical learning with phantom and live models and a high faculty-to-delegate ratio.

Nonetheless, a minority of the participants (five) did not achieve competency following our pilot course. This is in contrast to Stringer et al. [4] where 96% were deemed competent following a shorter (2 h) training workshop. A possible reason for the difference in competency rates is the short time frame (8 min) available to our delegates to complete scrotal POCUS during the assessment. In addition, the feedback we received highlighted that the ultrasound machines in the OSAUS were different models than those used whilst practising.

The main area of course improvement will be emphasising a stepwise, systematic approach to performing POCUS, an additional training station where delegates can familiarise themselves with different machines and models, and additional training time on multiple live models. We plan to incorporate a demonstration video into the online module that will showcase a 'gold standard' systematic technique for scrotal POCUS and allow the delegates to refer to it in their own time before and after the course.

Limitations of the pilot course include the small sample size consisting of mainly urology trainees, lack of assessment of skill retention, the learning curve in clinical practice, and the lack of live or phantom models with findings consistent with acute testicular torsion. One suggestion made by the participants was to make a bank of torsion and non-torsion US images available on demand.

We have demonstrated an effective, feasible and replicable method of training cross-speciality doctors in scrotal POCUS. With a short training course and a high competency rate achieved, this course could support a future interventional trial assessing the diagnostic accuracy of scrotal POCUS in the assessment of suspected testicular torsion. This forms the basis of our onward work, with the aim of reducing the negative scrotal exploration rate.

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Declaration of Interests

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Abbreviations: OSAUS, Objective Structured Assessment of Ultrasound Skills; PGY, Post-Graduate Year; POCUS, point-of-care US; US, ultrasonography.

Energy use in moderate hypofractionation and stereotactic body radiotherapy for prostate cancer

Climate change is a global challenge with significant future implications [1]. While there is an understanding of the dangers of climate change, there is limited knowledge regarding how to affect climate change, especially in the field of radiation oncology. There were nearly 2 million anticipated new cancer diagnoses in the United States, 17 million new cases of cancer worldwide, and nearly 10 million associated deaths in 2017 [2]. The intricate relationship between climate change and oncology spans from environmental risk factors for cancer to requirements for sustainable cancer prevention, screening, diagnosis, treatment, and survivorship programs [3]. Radiotherapy (RT) is a critical component of cancer care, with approximately 50% of patients requiring RT [4]. Improved efforts for understanding current energy consumption and novel methods to reduce RT energy expenditure without compromising treatment outcomes are needed.

There are little data regarding energy expenditure in radiation oncology. There has been a call to action for climate-smart decisions in radiation oncology [1,3]. In this study, we evaluated the energy expenditure of patients with prostate cancer undergoing definitive RT with moderate hypofractionation (HF) and stereotactic body RT (SBRT).

The Institutional Review Board approved this self-controlled study. The RT treatment plans utilising moderate HF (70 Gy in 28 daily fractions) and SBRT (36.25 Gy in five daily fractions) were created for nine patients with prostate cancer (18 plans in total). Linear accelerators were metered during quality assurance of each plan to compare daily energy consumption in kilowatt hours (kWh). A calibrated three-phase power line analyser (PowerSight, Pleasant Hill, CA, USA) was connected to the three input phases of a TrueBeam linear accelerator (Varian Medical Systems, Palo Alto, CA, USA) at the machine circuit breaker panel. The power line analyser calibration was current within

the manufacturers recommended biennial calibration period. Each treatment course's total energy expenditure was calculated. The kilogrammes of CO₂ emission (kgCO₂e)/day were calculated using the Environmental Protection Agency (EPA) Greenhouse Gas Equivalencies calculator [5]. Extrapolating from daily energy consumption, kgCO₂e over the complete treatment course was calculated. Additionally, the calculator was used to convert daily energy expenditure (kWh) into additional metrics. Kruskal–Wallis rank-sum tests were used to compare distributions of continuous variables. A *P* < 0.05 was considered to be statistically significant.

The mean (range) treatment time for HF and SBRT was 164 (156–192) s and 170 (160–197) s, respectively (*P* = 0.077). The median (range) monitor units (MUs) delivered for HF and SBRT was 820.1 (609.7–967.1) and 2815.5 (2061.3–3148.9), respectively (*P* < 0.001). The median total energy utilised per treatment was similar for HF and SBRT (median [range] 1.4 [1.3–1.7] and 1.4 [1.3–1.4] kWh, respectively; *P* = 0.63). The median total energy utilised per RT course was higher with HF than SBRT (median [range] 39.2 [36.4–42.0] vs 7 [1–7] kWh; *P* < 0.01). There was an 82% reduction in energy expenditure with SBRT compared with HF. There was a significant reduction in kgCO₂e with a course of SBRT compared to HF (median [range] 3.03 [2.81–3.03] vs 17.0 [15.7–18.2] kgCO₂e; *P* < 0.01). With energy expenditure expressed as average kilometres/miles driven, HF (median [range] 72.1 [63.1–76.6] km / 44.8 [39.2–47.6] miles) was associated with a larger carbon footprint than SBRT (median [range] 11.3 [11.3–12.9] km / 7.0 [7–8] miles; *P* < 0.01). Figure 1 demonstrates real-world correlates of energy savings between SBRT vs HF when treating 300 patients with prostate cancer, an estimated annual volume at an average radiation centre.