Can high fidelity human patient simulators help biomedical science students better understand complex concepts such as anticholinergic burden?

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Introduction

- High-Fidelity Human Simulators (HFHS) are life-like mannequins used extensively for teaching within the clinical setting [1].
- They offer an exciting method of learning compared to conventional passive approaches to learning (e.g. lectures) where students may have little opportunity to engage with the material.
- This pilot study investigated whether HFHS could be an effective educational tool within medical sciences teaching.
- It was also designed to help students think more deeply about the concept of physiological 'normality' in different populations, hence why the responses of an elderly subject were simulated.
- It explored whether simulators could enable students to better understand complex concepts such as anticholinergic burden that involve a knowledge of both physiology and pharmacology.
- Anticholinergic burden was chosen as a good example of a clinical condition often caused by poor awareness of fundamental physiological and pharmacological concepts in real-life situations (Figs 1-3).
- Anticholinergic burden may be defined as the inappropriate blockade of muscarinic cholinergic receptors in the body by medications and commonly occurs in the elderly [2].

Anticholinergic Burden and the Elderly

Figure 1. Factors that predispose the elderly to experiencing anticholinergic burden.

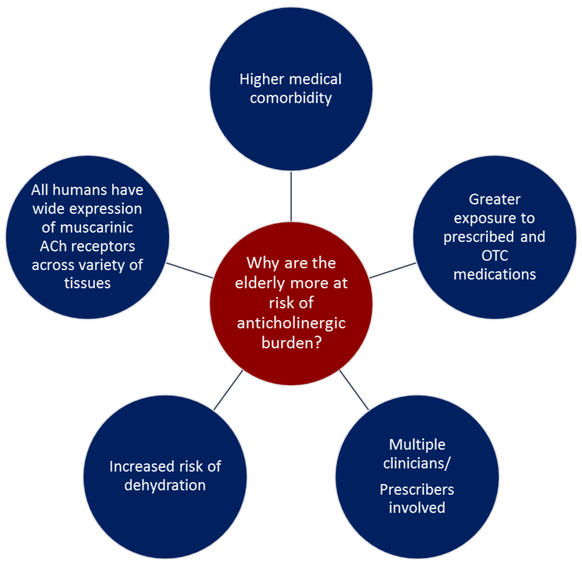


Figure 2. Symptoms and issues relating to anticholinergic burden in the elderly.

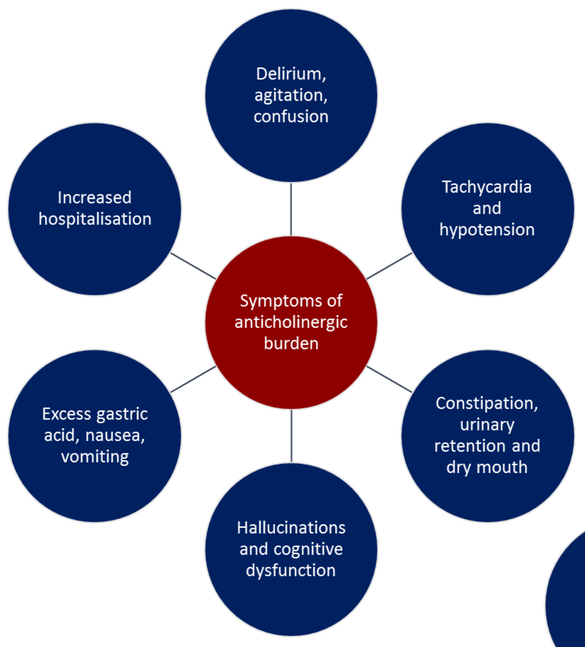
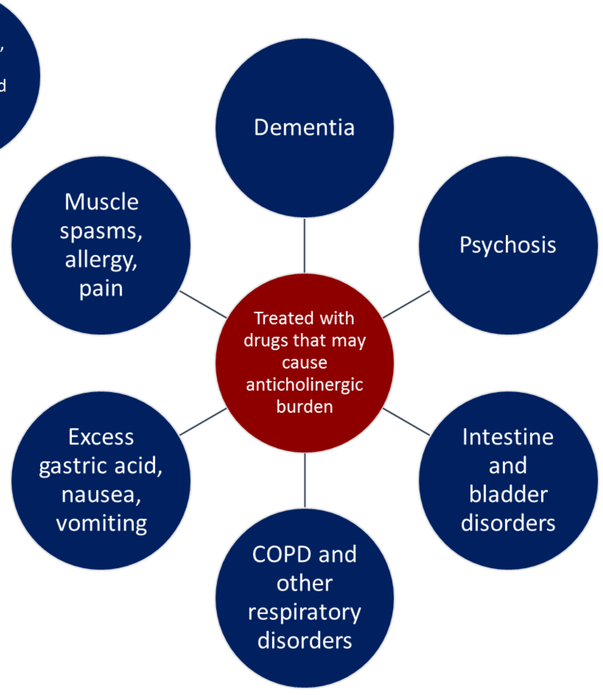


Figure 3. Disorders that are commonly treated with medications that contribute to anticholinergic burden.



Methods

- Volunteers (n=28) were biomedical science undergraduates and teaching staff (n = 4).
- Small teams (3-4 students) worked through the simulation and had to respond to the dynamically changing physiological responses and discuss why events occurred and how these might be dealt with.
- The SimMan 3G (Laerdal, Norway) HFHS was used to simulate responses observed in an elderly patient experiencing anticholinergic burden due to inappropriate prescribing.
- Before commencing, participants were given a scenario and revision sheet covering areas (autonomic physiology, opioids and a brief explanation of anticholinergic burden) relevant to the simulation to assist them in their understanding and to help them 'recap' previously studied material.
- Multiple Choice Questions (MCQs) were completed prior to and following the simulation to allow some assessment of participants' knowledge and understanding.
- Participants also completed an anonymous questionnaire which asked them to grade aspects of the simulation on a Likert scale (0-10), with the option to provide free text feedback relating to any aspect of the experience they wished to comment upon.
- Themes were identified from the free text comments provided.

Results

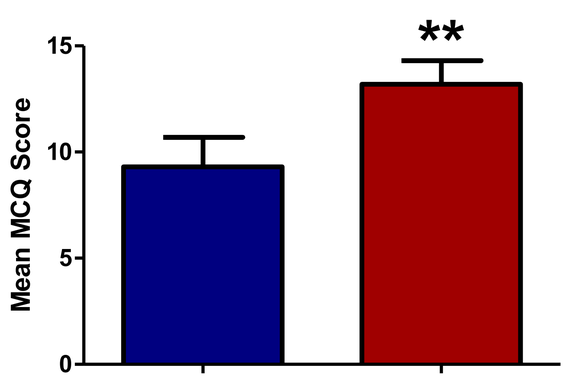


Figure 4. Mean MCQ score before and after anticholinergic burden simulation.

Participants scored significantly higher in MCQs (P = 0.0057, Wilcoxon matched pairs test) following the simulation compared to pre-simulation (Increase in mean score achieved from 9.3 ± 1.4 to 13.2 ± 1.1, n = 16 since not all students completed the questionnaires, error values represent SEM).

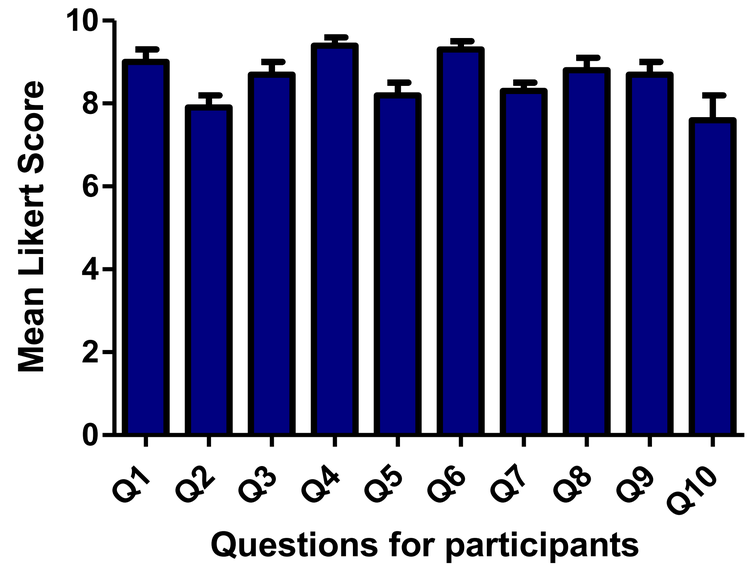


Figure 5. Student participant views of different aspects of the simulation.

Higher scores indicate a more positive response (n = 24).

Details of concepts assessed by each question given in table below graph.

Data represent mean ± SEM for Likert scores.

Q. No.	Concept Assessed
1	Interactivity of simulation
2	Participants' confidence and understanding
3	How does simulation rate vs. tutorial?
4	Would simulations be useful for future classes?
5	Was the simulation well-delivered?
6	Would participants recommend simulation to peers/staff?
7	How realistic was the simulation?
8	Did participants think they learned more from a simulation-style class?
9	How does simulation rate vs. lecture?
10	Did simulation help participants develop their problem-solving/ practical skills?

Themes	Other feedback
• Enjoyable, helps students see real-life applications and dynamic nature of physiology. • Caters for visual and experiential learners. • Uses knowledge, understanding, problem-solving, teamwork. • Engaging/Interactive.	• Don't rush the simulation or cram too much in. • Why can't we have these types of assessments instead of essays/practical reports? • Additional very basic handouts/posters can be useful. • Recap of basic knowledge at start and debrief at end are essential.

Figure 6. Themes and feedback derived from free text comments.

As well as these free text comments, both students and staff provided oral anecdotal feedback in support of these comments.

In general, all participants saw high-fidelity simulators as having great potential in physiology education.

Discussion & Conclusions

- Simulation is a novel teaching method that enables clinically-related students to critically think beyond the textbook/lecture theatre, by demonstrating dynamic real-life physiology in a controlled manner.
- This pilot study indicates that students would appear to value simulations as an integrated part of their educational experience and that they are an effective learning experience.
- Students who learn in different ways (e.g. visual or kinaesthetic learners) may find simulation a more effective style of learning and assessment [3], and the general opinion was that it encouraged deeper learning.
- The style, timing, delivery and planning of a simulation seems to be just as important as the scientific content. A clear, concise debrief with feedback is essential.
- Current work is ongoing to develop simulations focusing on renal function, pharmacokinetics, infection and cardiovascular measurements.

References

[1] Waite, G.N. *et al.* (2013) Human patient simulation to teach medical physiology concepts: A model evolved during eight years. J. *Teach. Learn. Teach.* **2**(2): 79-89.

[2] Tune, L.E. (2001) Anticholinergic effects of medication in elderly patients. *J. Clin. Psych*. **62**(suppl 21): 11-14.

[3] Breckler, J. *et al.* (2009) Learning styles of physiology students interested in the health professions. *Adv. Physiol. Educ*. **33**(1): 30-36