Validation of a Bovine Rectal Palpation Simulator for Training Veterinary Students

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Abstract. Bovine rectal palpation is a necessary skill for a veterinary student to learn. However, lack of resources and welfare issues currently restrict the amount of training available to students in this procedure. Here we present a virtual reality based teaching tool - the Bovine Rectal Palpation Simulator - that has been developed as a supplement to existing training methods. When using the simulator, the student palpates virtual objects representing the bovine reproductive tract, receiving feedback from a PHANToM haptic device (inside a fibreglass model of a cow), while the teacher follows the student's actions on the monitor and gives instruction. We present a validation experiment that compares the performance of a group of traditionally trained students with a group whose training was supplemented with a simulator training session. The subsequent performance in the real task, when examining cows for the first time, was assessed with the results showing a significantly better performance for the simulator group.

1. Introduction

Bovine rectal palpation is performed by veterinarians for pregnancy diagnosis, fertility assessment and as part of a clinical examination. The procedure is difficult to learn and requires a great deal of practice to identify structures palpated. In the United Kingdom the number of veterinary undergraduates has increased in recent years and the opportunities to gain sufficient farm animal experience to develop the required skills are becoming limited [1]. Welfare guidelines limit the number of examinations allowed per cow and this further reduces the opportunities to practice.

A Bovine Rectal Palpation Simulator has been developed at the University of Glasgow as a teaching tool to supplement existing training methods [2]. An iterative design process was used to create a virtual environment with simulations of the bovine reproductive tract, including models of the cervix, uterus and ovaries positioned within the pelvis and abdomen. Nine veterinarians were involved in the development and evaluation of the simulations and this resulted in the creation of a range of realistic models. During simulator training, the student palpates the virtual objects while interacting with a PHANToM haptic device (from SensAble Technologies), which is positioned inside a model of a fibreglass rear-half of a cow (Figure 1). The teacher follows the student's action inside the virtual cow on the monitor and provides instruction. A teaching protocol has been developed where the student learns initially to locate the uterus in different positions, mastering this fundamental skill before progressing on to performing fertility examinations and diagnosing pregnancy.

Figure 1: Simulator training. The teacher provides instruction while the student palpates virtual models of the bovine reproductive tract inside the fibreglass cow using a PHANToM.

Validation is a key factor if simulators are to become widely adopted in medical and veterinary training. Without it, the benefits that simulators provide are uncertain; trainees may develop a false sense of confidence or learn techniques that actually degrade their performance in the real task. There have been previous attempts to validate virtual reality based palpation simulators, a human prostate simulator [3] and a horse ovary palpation simulator (HOPS) [4]. Both measured the performance of groups representing different skill levels but failed to differentiate between the groups during simulator tests. A comparison of students trained on HOPS with those receiving only traditional training demonstrated equal performance levels for both groups in a post-training test [5]. Additionally, assessments were made using either the simulated environment [3, 4] or when examining *in vitro* specimens [5], which are both approximations for the real task.

A preliminary evaluation of the bovine simulator has been conducted and students considered their subsequent performance examining cows had improved [2]. However, this evaluation depended on students assessing their own technique and therefore, an independent, objective assessment of performance was needed to validate the teaching tool.

2. Methods

Sixteen undergraduate veterinary students from the University of Glasgow with no prior experience of performing bovine rectal palpation were randomly selected and allocated to two groups, A and B. The students were in the third year of the veterinary course, the stage at which they were about to embark on their first placement training examining cows on farms with veterinarians. All of the students had undergone the traditional training provided in the preclinical course, consisting of anatomy lectures and laboratory practical sessions. Group A was trained with the simulator whereas Group B received only the traditional training. The students were divided into pairs, one from each group, and each pair examined four non-pregnant cows on-farm. The task was to find and identify the uterus during a five minute examination and correct identification was verified using video-recorded images from an ultrasound probe taped to the palm of the student's hand.

3. Results

All students in Group A located the uterus in one or more of the four cows examined, compared with only one student in Group B (Table 1). There were 18 successful

identifications for Group A from a maximum of 32 (8 students x 4 cows per group), verified by ultrasound, and only one for Group B. These results indicated that Group A was significantly better at finding the uterus than Group B (p-value < 0.001).

Table 1. Uterus identification rates per 4 cows examined for the eight pairs of students.

Group Pair:	1	2	3	4	5	6	7	8	Group total
Group A: Simulator trained	1	3	2	3	2	3	2	2	18 / 32
Group B: Traditional training only	0	0	0	0	0	1	0	0	1 / 32

4. Conclusion

The Bovine Rectal Palpation Simulator provided more effective training than the traditional method alone and the poor performance of Group B underlines the difficulties currently experienced by novices. The simulator-trained students had learned skills that enabled them to locate the uterus when examining cows, demonstrating the validity of the simulator as a teaching tool for one of the key components of bovine rectal palpation.

5. Discussion

There is a need to find ways of supplementing existing methods for training veterinary students to perform bovine rectal palpation and a simulator has been developed as a potential solution. The validation of the simulator was undertaken to demonstrate that students were acquiring skills that transferred to the real task and not, for example, just learning to use the simulator. As part of the preparation for clinical placement training, equipping students with basic skills using the simulator will enable them to make more effective use of animals as a learning resource. This is important when the opportunities to practice on farms are increasingly limited. Additionally, training novices for an invasive procedure in a virtual environment prior to the first real examination has benefits for animal welfare. During the simulator sessions, the teacher has the advantage of being able to see the student's actions, which is not possible in the real cow. Therefore, the teacher is able to provide more effective training, guiding movements, identifying structures palpated and providing feedback on performance.

The bovine simulator provides a complement to existing training methods. Additional models have been developed including a wide range of fertility cases and some examples of pathology and the training sessions can be customised to individual student's learning needs. The simulator also has potential to provide training for clinical scenarios in other species and further developments are planned.

References

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