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Intravenous catheter placement in the marginal ear vein of rabbits (*Oryctolagus cuniculus*) is achievable by final-year veterinary students, with clinical exposure improving confidence

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Objective
To identify if rabbit IV catheter placement (ICP) in the marginal ear vein was readily achievable for veterinary students and whether student confidence improved with ICP experience. We hypothesized that students would achieve successful ICP placement on their first attempt and that student confidence would increase after ICP.

Methods
Final-year undergraduate veterinary students on clinical rotations at the University of Edinburgh Hospital for Small Animals participated over a 1-year period. The prospective observational study involved completion of an anonymized questionnaire with 2 parts, completed before ICP and after ICP. The time taken for successful placement and the number of attempts were recorded.

Results
70 students participated in this study. Intravenous catheter placement was successful on the first attempt in 78.5% of students; the mean time for successful ICP was 4 minutes and 10 seconds. After ICP placement, students had a statistically significant increase in confidence in rabbit ICP, scoring a median of 2.5 points higher in confidence on a 10-point scale. There was no significant correlation between previous ICP experience or preprocedure confidence score and speed of ICP.

Conclusions
ICP of the rabbit marginal ear vein is highly achievable for veterinary students, with most students achieving ICP on their first attempt. Following successful ICP, student confidence in this procedure in rabbits increased.

Clinical Relevance
Rabbit ICP is readily achievable by veterinary students and should be included as a core clinical skill in undergraduate veterinary education, promoting confidence in students interacting with this species.

Keywords: veterinary education, veterinary student, *Oryctolagus cuniculus*, rabbit, intravenous catheter placement

Intravenous catheter placement (ICP) is a key clinical skill in veterinary medicine. Secure IV access is essential for many veterinary procedures and treatments in both traditional companion animal and exotic animal species. Intravenous catheter placement can facilitate delivery of sedative drugs, anesthetic drugs, IV fluid therapy (IVFT), IV medications, IV contrast medium administration, and blood transfusions or assist in performing humane euthanasia.[1–3]

Anesthetic-related mortality in rabbits is well documented, with rabbit-specific physiological and anatomical traits often considered contributing factors. One study[4] reported perianesthetic mortality occurring in 0.73% of perceived "healthy" and 7.37% of known "sick" rabbit patients compared to 0.05% and 1.33% of dogs and 0.11% and 1.4% of cats, respectively. Obtaining IV access in rabbits undergoing an

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anesthetic procedure is therefore recommended to facilitate "to-effect" administration of IV induction agent, permit provision of intraoperative IVFT to promote normotension and maintain hydration, and allow administration of IV reversal agents and, if required, IV emergency drugs.[4–6] Intravenous catheter placement is also required for supportive medical IVFT, often a key component in the treatment of many emergency presentations, including rabbit gastrointestinal syndrome, gastric bloat, and liver lobe torsion.[7,8]

In 2025, the United Kingdom pet rabbit population was estimated at 700,000, with 2% of adults owning at least 1 rabbit.[9] Despite this, when compared with dogs and cats, some veterinary surgeons (VSs) are significantly less confident in performing anesthesia or diagnostic investigations and treatment in pet rabbits.[10] In some veterinary clinics, ICP in rabbits may be perceived as more challenging.[5,11,12]

Several sites are available for ICP in rabbits **(Figure 1)**. The authors' preferred site for ICP in rabbits is the lateral marginal ear vein, allowing excellent vessel visualization and empathetic restraint of the patient in a normal seated position, minimizing handling-related stress.[5,6,13,14] Although a medial marginal vein is also present, given the rarity of use of this vein for ICP or other procedures the lateral marginal vein is most commonly referred to as the "marginal ear vein." Recent literature has shown that complications such as phlebitis, thrombosis, and hematoma formation are uncommon in clinical practice, with incidents primarily reported in experimental settings.[15,16] Peripheral vascular necrosis associated with this catheter site is anecdotally reported; however, in clinical practice it is rare.[15] The marginal ear vein should not be confused for the central auricular artery as catheterization of the artery carries a risk of hematoma formation and ischemic injury with ear necrosis. Arterial catheterization in rabbits is not routinely performed in clinical settings but has been described in clinical research.[17,18]

The cephalic vein can act as an alternative ICP site but is often reserved for breeds with short ears, such as Netherland dwarf rabbits, where marginal ear vein placement can be more problematic. Shorter ear length has been found to correlate directly with higher risk of ICP placement failure.[15] The cephalic vein carries a higher risk of catheter placement failure than the marginal ear vein and lateral saphenous vein—this is in part attributed to its short length and proximity to the bend of the elbow and the tendency of the rabbit to retract the limb during placement.[15] Access to the cephalic vein requires full extension of the elbow, which many patients resent, especially if osteoarthritic. The patient is likely to experience increased stress levels associated with being maintained in this position.[15] This site is therefore not recommended by the authors in aged animals with potential underlying degenerative joint disease of the elbow joint.

The lateral saphenous vein, visible on the lateral aspect of the tibia, proximal to the tibiotarsus joint and running superficial to the digital flexor muscles, is readily accessible in rabbits. The vessel, however, is mobile, and due to the "cone shape" of the rabbit hind limb, securing a catheter in place with tape is challenging.[5,6,15] The vessel is therefore commonly used for venipuncture but less commonly used for ICP in rabbits. Restraint for lateral saphenous vein access requires an experienced handler(s) to reduce the risk of injury from improper handling.

The jugular vein for ICP is impractical in rabbits due to the need for sedation to ensure adequate restraint and the impracticality of securing the catheter at this site; consequently, this site is rarely used outside a laboratory setting.[15]

The Royal College of Veterinary Surgeons has established "Day One Competencies" to highlight the expected standard of all newly graduating VSs in the United Kingdom.[19] Included is the capability to "attend all species in an emergency and perform first aid," and, specifically, skills that require IV access, such as sedation, general anesthesia, and humane euthanasia, are cited.[19] It is therefore critical that ICP theory and practical skill is included in the undergraduate veterinary curriculum as a "Day One Competency" for clinical practice.

At many universities in the United Kingdom, veterinary students learn incrementally throughout their undergraduate curriculum, building from previous knowledge using a "spiral curriculum" design. Topics are frequently revisited, with increasing depth and complexity in order to consolidate and deepen understanding of the subject.[20] At veterinary

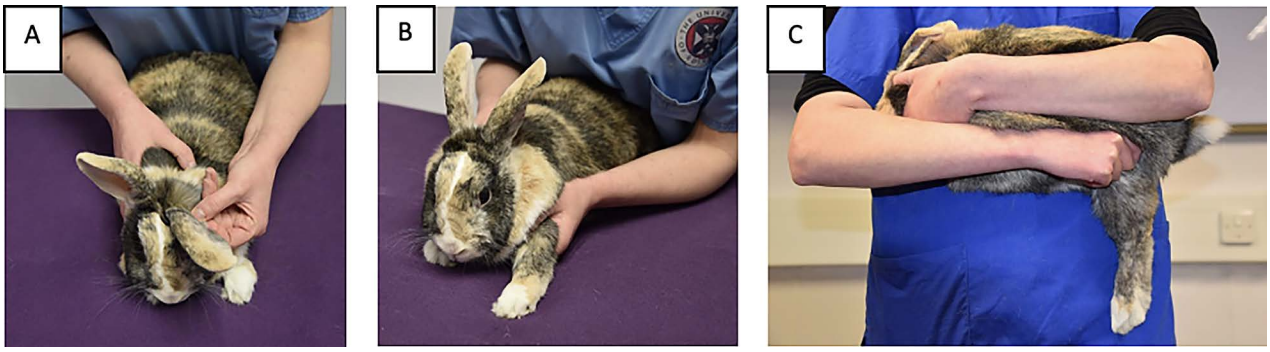


Figure 1—A–C—With appropriate restraint, rabbit IV catheter placement (ICP) can be achieved via the lateral marginal ear vein (A), cephalic vein (B), or lateral saphenous vein (C).

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education institutions, ICP is recognized as a key skill initially taught with the aid of veterinary simulators and mannequins before progressing to clinical patients.[1,21] The student learning environment can promote or reduce confidence depending on whether the interaction is a positive or negative experience.[22] Additionally, in some programs, graduate entry students may benefit from prior skills gained during previous employment as a veterinary nurse or technician.[3,21,23,24]

This study aimed to identify if rabbit ICP, in the marginal ear vein, was readily achievable for final-year veterinary students and whether student confidence would improve with ICP experience. We hypothesized that most students would, with guided supervision from a veterinary surgeon (VS) or registered veterinary nurse (RVN), achieve successful ICP placement on their first or second attempt and that perceived confidence would increase after this practical clinical experience. We further hypothesized that students with previous ICP experience would be both faster in their placement and more confident in their approach to this task.

Methods

Seventy final-year undergraduate veterinary students participated in this prospective rabbit catheter placement study during a 1-year period. All participating students were partaking in a 1-week clinical rabbit and exotic animal practice core rotation at the University of Edinburgh Small Animal Hospital. The prospective observational study involved completion of an anonymized questionnaire with 2 parts, 1 completed before ICP and 1 completed after ICP. The study protocol was reviewed and approved by the University of Edinburgh Veterinary Ethical Review Committee and the University of Edinburgh Human Ethical Review Committee.

Participating rabbits were patients that required ICP for a variety of clinical reasons. Each student was assigned 1 rabbit patient. All patients were examined by a VS prior to ICP to determine suitability for inclusion, with assessment of vital parameters, hydration status (on the basis of skin turgor and mucous membrane assessment), and overall patient condition. As per standard hospital practice, students did not perform ICP in unstable or any moderately to markedly dehydrated patients. The procedure was stopped if the patient showed any signs of distress (such as resentment of restraint or increased respiratory effort). Lidocaine and prilocaine cream (Emla) was applied for 15 minutes prior to ICP for all patients, and in all cases rabbits were not sedated for ICP. All dwarf breeds (regardless of weight) were excluded from student involvement alongside patients with visibly stenosed/collapsed or constricted marginal ear veins as this was thought to exceed beginner-level ICP. Following hand disinfection, all students attempted ICP using a standardized technique with standardized materials and with the rabbit restrained by a VS or RVN **(Figure 2; Supplementary Materials S1)**. A VS or RVN provided step-by-step verbal guidance, with the student under direct supervision throughout the ICP. Intravenous catheter placement was capped at a maximum of 3 attempts/patient before ICP was completed by a VS or RVN. Subsequent attempts were performed at the same site if no bruising was present or at the contralateral marginal ear vein if there was any damage to the catheterized vein during the previous ICP attempt.

Before and after ICP, students completed 1 section of an anonymized questionnaire. Before ICP, students self-evaluated their previous experience and pre-ICP confidence, providing the number of catheters they had previously placed and rating their confidence levels on 10-point Likert scales for dogs, cats, and rabbits. Reasons for ICP placement were also recorded. Time for ICP was measured using a stopwatch and recorded to the nearest second. The clock was started when the skin was wiped with an alcohol wipe and stopped when bandaging of the ear had been completed.

The post-ICP placement questionnaire focused on the students' confidence levels after catheter placement. Free-text questions identified if the student had been successful with placement, which attempt this had been, and the time taken for ICP. Reasons for ICP were categorized as "Routine neutering," "Dental procedure," "Computed tomography (CT) scan," and "Other."

Statistical analysis

Statistical analysis was performed with Minitab Statistical Software, version 21.1.0 (Penn State University). Time taken to ICP placement, student confidence values, number of attempts, and number of previous ICP experiences were tested for normality using the Shapiro-Wilk test and were found to be normally distributed. Wilcoxon signed-rank tests with a 95% CI were used to compare student confidence before and after ICP and to compare student pre-ICP confidence for dogs, cats, and rabbits. The Pearson correlation test assessed whether ICP time was quicker for students with previous experience of the procedure. The Spearman correlation test was also used to test if increased pre-ICP confidence correlated with a reduction in the time taken to successful ICP. Values of $P < .05$ were considered significant.

Results

Of the 70 students, ICP was successfully achieved by 69, with success on the first attempt in 55 of 70 students (78.5%) and the second attempt in 13 of 70 students (18.6%). Of the 2 remaining students, 1 (1 of 70 [1.4%]) placed the catheter on their third attempt, and 1 (1 of 70 [1.4%]) was unsuccessful in performing the procedure after 3 attempts **(Figure 3)**.

Prior to ICP, students had a significantly decreased median confidence score (4/10) in rabbit ICP compared to dog ICP ($Z = 2{,}278$; $P < .001$). Similarly, students also had a significantly decreased median confidence score (2/10) in rabbit ICP compared to cat ICP ($Z = 1{,}926.50$; $P < .001$). There was a statistically significant increase in median confidence

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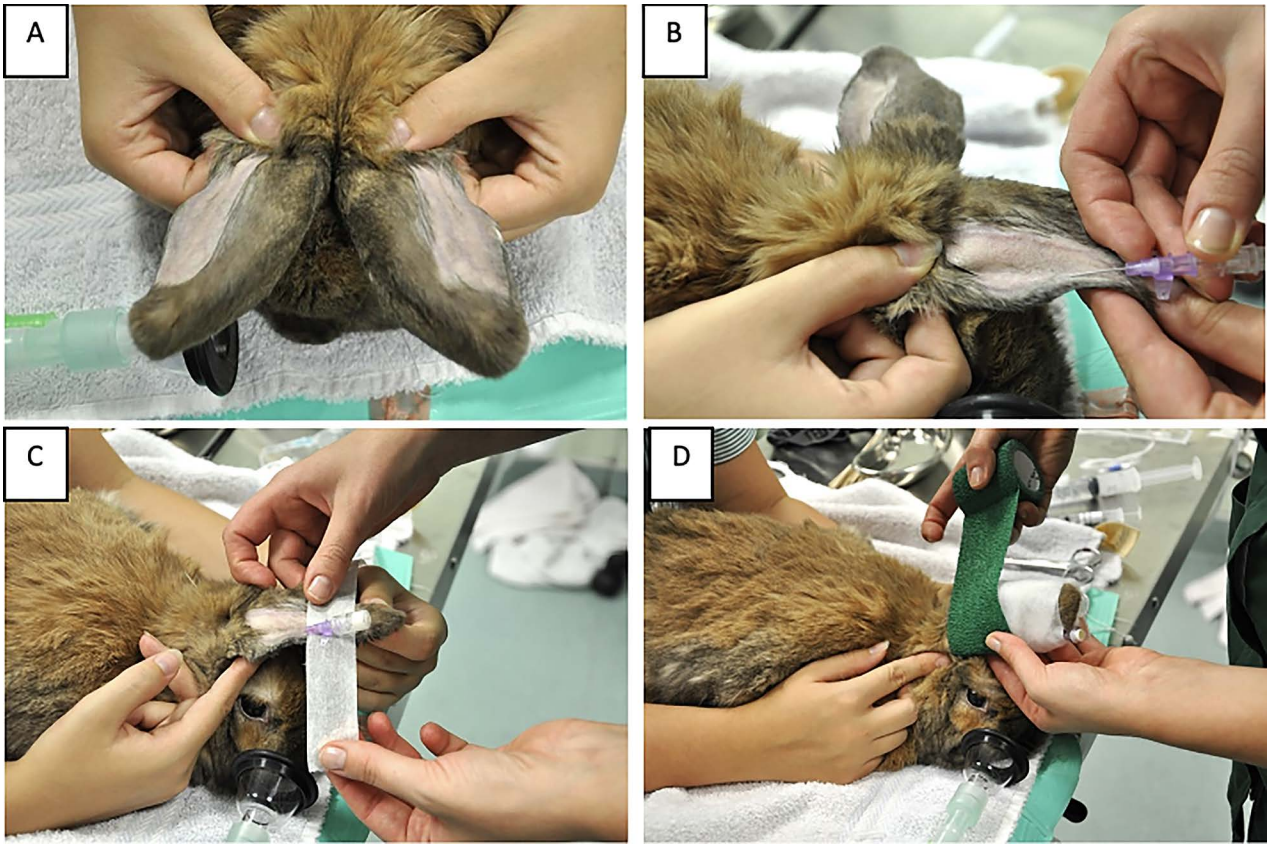


Figure 2—A–D—Standardized procedural steps were followed for rabbit ICP for all cases, including preparation of the site, appropriate restraint and raising the vein (A), insertion of the catheter (B), removal of the stylet and securing the catheter with tape (C), and bandaging (D; Supplementary Material S1). Note: this animal is receiving flow-by oxygen via a face mask and was not included in the study.

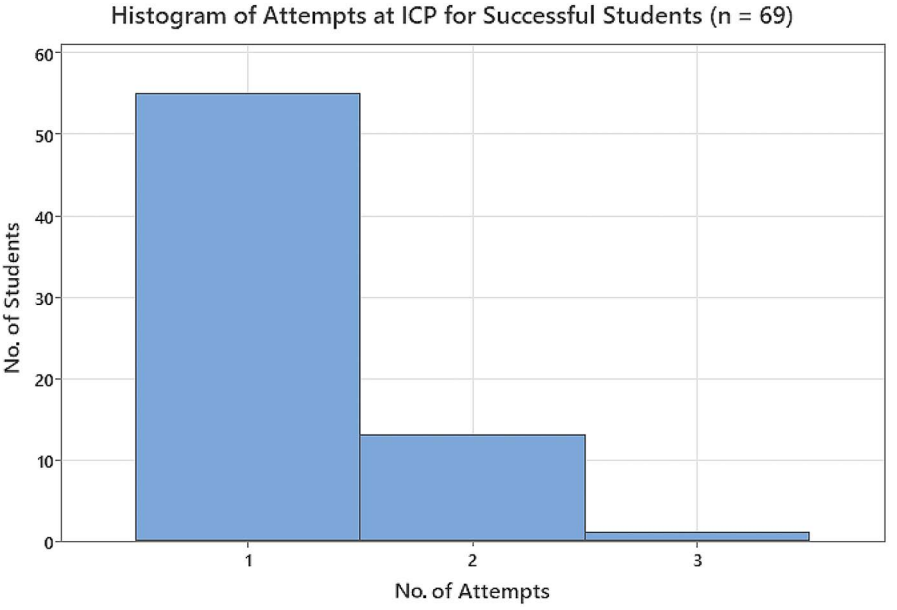


Figure 3—Students performed rabbit ICP under veterinary guidance. Most of the students (78.5%) were successful on their first attempt.

score (2.5/10) after ICP compared to before (Z = 1,812; P < .001).

For successful ICP students (n = 69), there was a weak to negligible negative correlation between the number of previous ICP experiences on student clinical placement and the time taken to achieve successful ICP, but this was not significant (69; r = −0.207; P = .088; 95% CI, −0.423, 0.031). There was

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no correlation between pre-ICP confidence and the time taken to achieve successful ICP (r = −0.064; P = .603; 95% CI, −0.296, 0.176).

The mean time taken for ICP was 250 seconds, or 4 minutes and 10 seconds (range, 64 to 600 seconds; **Figure 4**). Of the rabbits in this study, 29 of 70 (41.4%) required ICP to facilitate IV contrast administration during a conscious CT scan performed either as part of medical investigation or surgical planning. Intravenous catheter placement was required to promote patient safety during anesthesia for routine neutering in 15 of 70 patients (21.4%) and dental procedures in 5 of 70 patients (7.1%). The remaining 21 of 70 rabbits (30%) required ICP for other reasons, such as medication/fluid administration as a part of hospitalization treatments or for other nonroutine procedures **(Figure 5)**.

Of the 70 students, 48 (68.6%) reported previous observation of rabbit sedation/general anesthesia when on clinical placements. Of these, 34 of 48 (70.8%) reported ICP being utilized, with 14 of 48 (29.2%) reporting ICP was not utilized. For those students who had seen rabbit sedation/general anesthesia and reported ICP being utilized, only 7 of 34 (20.6%) reported that ICP was utilized for all cases. For most cases where ICP was not utilized, the reason for lack of ICP was unknown (10 of 14 [71.4%]). For the 4 cases where a perceived reason was given, these included technical difficulty (2 of 14 [14.4%]), the procedure being considered low risk (1 of 14 [7.1%]), and "practice policy" (1 of 14 [7.1%]).

Prior to their study involvement, most students (49 of 70 [70%]) were inexperienced in performing ICP in rabbits. Only 21 of 70 students (30%) had

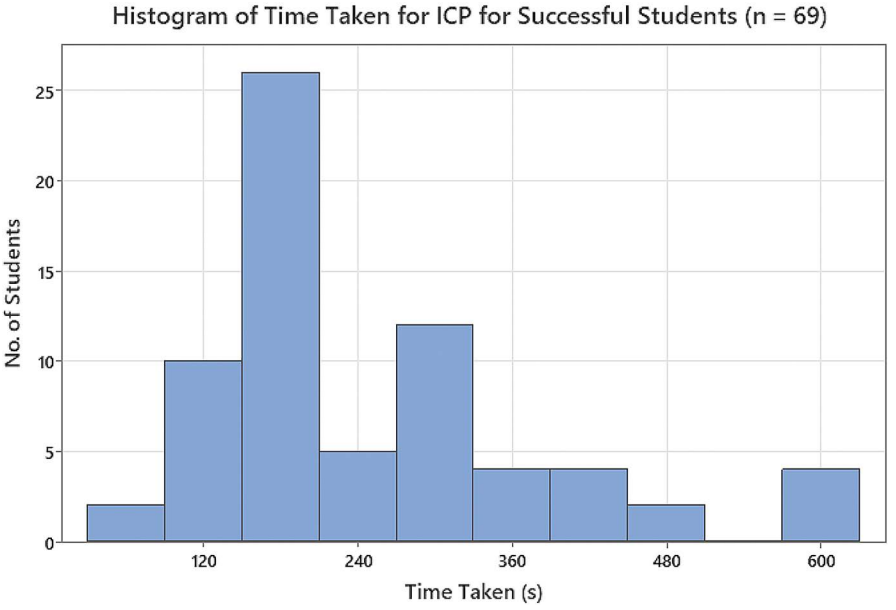


Figure 4—The time taken for rabbit ICP was recorded for all students. The mean time taken was 250 seconds, or 4 minutes and 10 seconds (range, 64 to 600 seconds).

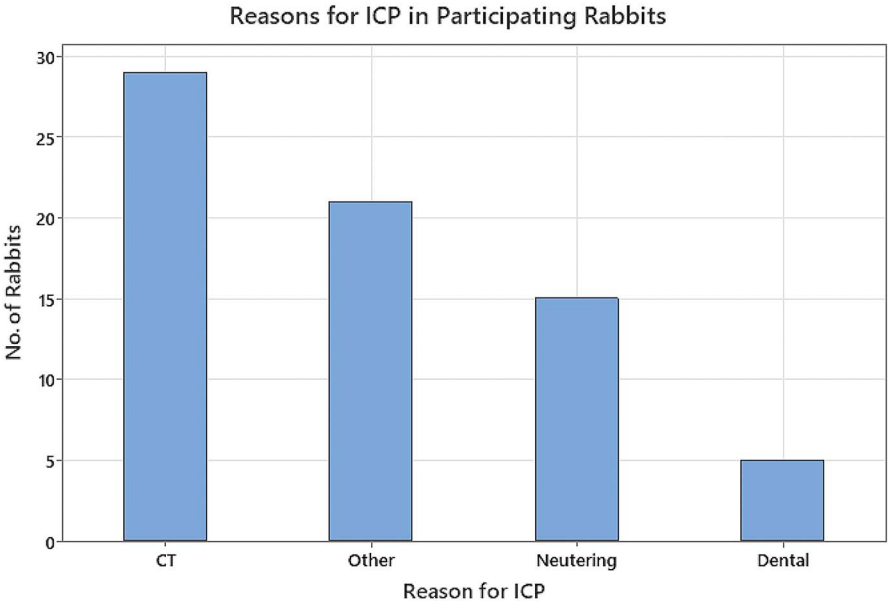


Figure 5—Reasons for rabbit ICP in the study were varied and included facilitation of IV contrast administration during a conscious CT scan or as a part of medical investigations or surgical planning to promote patient safety during anesthesia or for other procedures.

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previously performed ICP at any site in rabbits compared to 69 of 70 in dogs (98.5%) and 58 of 70 in cats (82.9%). Among those who had performed ICP in rabbits (21 of 70 [30%]), the mean number of catheters placed prior to the study was 1.57.

Discussion

Intravenous catheter placement in the marginal ear vein of long-eared and noncritical rabbits was readily achievable for most undergraduate final-year veterinary students, with more than three-fourths successfully performing the procedure on their first attempt. This supports the study's hypothesis that with appropriate instruction, ICP in the marginal ear vein in rabbits is a readily achievable clinical skill, with most students achieving successful placement on their first or second attempt.

The first-attempt failure rate in this study was 21.4%, which is lower than that reported in previous studies, one of which documented a failure rate of 27.8% for catheterization of the marginal ear vein.[15] Another recent study[25] documented an even higher failure rate of between 45% (topical local anesthesia using Emla cream) and 90% (without Emla cream). The absence of application of topical local anesthetic to the catheter site, the inclusion of short-eared rabbits, and the inclusion of dehydrated animals in the case of the 27.8% failure rate could account for increased ICP difficulty due to reduced rabbit compliance and increased procedure difficulty. The lack of topical local anesthetic application was similarly the case for the 90% failure rate group in the second study. This study had a small population (n = 10) of 4-month-old laboratory rabbits; therefore, it is possible that these animals were less habituated to handling, resulting in an increased number of catheter failures compared to what would be likely for pet animals even where Emla cream application was utilized and ear length was standardized and not short. In addition, direct comparison to either of these studies is limited as in both studies ICP was performed by veterinary personnel as opposed to veterinary students.

Within this study's clinic, it is routine practice for VSs and RVNs to place marginal ear vein catheters, where there is a clinical need, in all breeds of rabbits, including dwarf breeds, though arguably more technical skill is required for shorter/smaller ears.[15] For parity of the student learning experience, only average-sized, well-hydrated rabbits were included in the study, with exclusion of dwarf rabbit breeds, rabbits with visibly stenosed veins, and rabbits with more collapsed/constricted veins. These selection criteria may have artificially elevated the success rate achieved in our study compared to those cases presenting in clinical practice. The gauge of IV catheter was also standardized at 26. While it is possible that the use of larger catheters may affect success rates, a previous study[22] of dog ICP by veterinary students showed that catheter size selection for an individual patient did not affect the success rate of student catheter placement. This is also unlikely to have affected the clinical applicability of our results since catheter size is more limited in rabbits due to small vein size, meaning that for most rabbits only a 24- or 26-gauge catheter is appropriate in clinical practice.[22]

Student confidence significantly improved following ICP placement, supporting the hypothesis that confidence in ICP of the marginal ear vein is increased with a single session of taught practical experience. This demonstrates the positive effects of learning by deliberate practice as opposed to rote repetition, the former of which has been proven to be more effective in developing complex skills and knowledge.[26]

Previous ICP experience did not influence the success rate, time for placement of the catheter, or initial student confidence for catheter placement in our study, disproving our hypothesis that students with prior experience of this technique would be both faster in their placement and more confident in their approach. The speed of placement was influenced by the VS or RVN's systematic, stepwise instructional process, ensuring a standard approach under direct instruction. This educational methodology has been shown to enhance student learning and increase the success of short clinical procedures, such as ICP.[24,27,28] To maintain and grow confidence levels, regular, repeated ICP in rabbits should be performed. Interestingly, a recent study[29] showed that approximately 45% of veterinary students have falsely elevated levels of confidence with regard to clinical skill abilities. Students' perception of their own confidence will vary greatly between individuals and is highly subjective. Previous negative experiences or lack of experiences are also likely to affect pre-ICP student confidence scores to lower confidence scoring.[30]

Traditionally, rabbit medicine and surgery have not been a major focus within the veterinary undergraduate curriculum in the United Kingdom, with greatly variable emphasis on teaching about this species across veterinary institutions. Experiences during undergraduate clinical placements therefore help to supplement and reinforce structured learning. Nearly a third of students in this study, involved with procedures in pet rabbits on clinical placement, did not observe catheter placement in this species. This could indicate that ICP may not be standard practice in many veterinary practices as this study was performed within a single teaching hospital; further multi-institutional studies with a larger sample size could be helpful, focusing on general practices to investigate the prevalence of ICP for sedation and anesthesia in rabbits. In our study, nearly a third of students had no previous exposure to rabbit sedation/anesthesia during their clinical placements. Placements are arranged by students, so this could reflect a lack of student interest in seeking specific rabbit-friendly practices or a lack of availability of placements at a limited number of rabbit-friendly practices. In general practice, this could also reflect a lack of rabbits presenting to veterinary practices for examination, with one study[9] reporting that while 79% of the pet rabbit population in the United Kingdom are registered with a vet, only 56% receive annual vaccinations.

This study found that rabbit ICP is a readily achievable clinical technique in long-eared, clinically

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stable rabbits, which should be performed where clinically indicated in general practice. To promote student and therefore new graduate confidence levels in rabbit ICP, greater emphasis should be placed on teaching rabbit ICP in undergraduate veterinary student training.

In this study, participating students were final-year veterinary students completing their clinical rotations; therefore, live animals were used. Earlier introduction of the technique in the "preclinical" veterinary school years could be achieved utilizing mannequins and models with simulated training, such as the "Lagolearn" Rabbit Ear Model (Lagolearn Ltd). This has the benefit of students acquiring and developing practical skills prior to training on live animals.[23,26,28,31,32] Other training techniques could include development of modified computerized training models, which have proved effective in clinical skills in other species.[33] Given the increase in confidence with practical training, our findings strongly support the importance of teaching ICP of the rabbit as a core clinical skill to undergraduate veterinary students.

The main limitation of this study was the single-institutional nature with a moderately small sample size of students. As a university hospital with a busy exotic animal clinical service and a focus on exotic animal medicine during clinical training, it is possible that students surveyed would be more likely to have experience and/or confidence in ICP in rabbit patients. Further studies involving larger student cohorts, multiple institutions, and analysis of new veterinary graduate confidence in rabbit ICP in clinical practice would be useful to further validate the findings of this study.

The rabbit case selection satisfied the needs of the study to simulate "beginner" or foundation-level ICP in rabbits but could make the results less applicable to clinical practice as some of the patients requiring ICP in clinical practice will include critical, hypovolemic animals, for whom ICP may be more challenging. Case selection criteria could also introduce a degree of bias to our results; for example, the exclusion of "short-eared" dwarf rabbits, who can be more challenging to cannulate, may have resulted in artificially elevated success rates. In addition, although Emla was applied to the ears of all patients, this was applied for 10 minutes in accordance with anecdotal success rather than the full 60-minute interval that has been shown to significantly improve ICP success rates in laboratory rabbits.[25] In this study, a 60-minute interval was considered an impractical wait time for a busy clinical practice. Intravenous catheter placement procedure technique was standardized using the same duration of application of local anesthetic; this is unlikely, therefore, to have been a confounding factor. Although short-term side effects of ICP were recorded for all cases, long-term follow-up was not pursued. Any delayed-onset or longer-term adverse effects of ICP, although unlikely, are out of the scope of this paper.

For future studies, inclusion of live-patient dog and cat ICPs, alongside rabbit ICPs, in the same cohort of students would provide further evidence of difference in interspecies ICP student capabilities and confidence.

Intravenous catheter placement of the marginal ear vein in long-eared, clinically stable rabbits is highly achievable for final-year undergraduate veterinary students when provided with stepwise instruction. Rabbit ICP, in general practice, is therefore also highly achievable and should be considered standard protocol for any rabbit undergoing sedation or general anesthesia or requiring medical management with IVFT. This study further highlights the ongoing need for inclusion and promotion of rabbit medicine in the undergraduate veterinary curriculum, with the addition of practical clinical skills to promote confidence in treating this species.

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Disclosures

The authors have nothing to disclose. No AI-assisted technologies were used in the composition of this manuscript.

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