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Evaluation of psychomotor skills acquired for surgery by veterinary students using biological simulators
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SUMMARY

This study aimed to evaluate the acquisition of psychomotor skills using biological simulators in surgical practices by third-year students of Veterinary Medicine at the Autonomous Metropolitan University, Mexico City. The Gibson Spiral Test was applied pre- and post-practice to 171 students (92 women, 79 men) between 18 and 38 years old. The techniques practiced were: ligature, synthetic skin, enterotomy, enterectomy, gastrotomy, cystotomy, endotracheal tube placement, permanent intravenous catheter. Students were classified as fast-accurate (FA), fast-inaccurate (FI), slow-accurate (SA), and slow-inaccurate (SI). The test duration decreased by 7.91 s (P<0.05) post-practice compared to pre-practice, and there was no difference in the number of errors pre- and post-practice (P>0.10). There were differences among the fast (F) and slow (S) students pre-practice (P<0.0001). In post-practice the students for FI (4.23) presented more errors than SI (3.40) (P<0.0001). In pre-practice results also were differences (P<0.0001) between the fast and the slow; in the slow, less time was used by the SA (49.38 s). There were no differences (P>0.0001) in post practice between accurate (FA and SA) and against inaccurate (FI and SI) students, nor regarding gender (P>0.10). Comparing practice time difference (P=0.007) between slow and fast in the pre-practice, men performed more quickly in pre-practice and after practice (P<0.0001), with no differences in mean number of errors pre- (P=0.662) and post-practice (P=0.962). We conclude that students showed progress in acquiring motor skills, by increasing their speed and reducing errors, thus increasing the number of fast and accurate students. Men out-performed women.

Introduction

Universities with veterinary medicine programs frequently use live animals for teaching surgical techniques, for the student to learn the practice in surgery courses (Smeak et al., 1994). The limitations of using live animals and the need to train veterinary surgeons have modified teaching techniques (Smeak, 1989), with technological advances that have replaced live animals to meet the requirements of animal care and ethics, and to deal with objections towards using healthy animals for developing surgical skills. In this regard, different simulated biological models have been developed (Anastakis et al., 2000). These may be virtual simulators for basic surgical skills (Felsher et al., 2005; Aggarwal et al., 2006; Windsor et al., 2008), or tissues collected from ethically slaughtered animals (Debes et al., 2010). The models are used to develop and refine the technical skills of students to the appropriate level of learning and preparation to allow the treatment of live patients (Smeak et al., 1991; HSVMA, 2009).

The key advantage of these models is the generation of basic surgical skills and abilities (Torres et al., 2003; Tefera, 2011). The benefits of biological models are that the student can spend more time learning about important aspects of the techniques and surgical procedures, repeating the procedure as many times as is necessary in order to obtain the required skill. This has the advantage of minimizing the amount of experience gained on live animals (Smeak et al., 1994). The interest in developing biological models using anatomical parts lies in the possibility of directly using these analogies in biological processes, describing performance, and also reducing operational costs and time, compared with the use of living animals (Archundia, 1992; Knight, 2011, 2012b).

In order to assess surgical skills in students, psychomotor tests that measure the speed, accuracy, and muscle response to a controlled stimulus have been used (Gibson, 1964; Harris et al., 1994). In this study we utilised the Gibson Spiral Maze Test, because it has the advantage of having little connection with the degree of
EVALUACIÓN DE HABILIDADES PSICOMOTORAS PARA CIRUGÍA ADQUIRIDAS POR ESTUDIANTES DE VETERINARIA UTILIZANDO SIMULADORES BIOLÓGICOS
Camilo Romero, Germán D. Mendoza, José Antonio Martínez, Pedro A. Hernández, Elena Magallón, Adelfa del Carmen García

RESUMEN
Este estudio pretende evaluar la adquisición de habilidades psicomotoras utilizando simuladores biológicos en prácticas quirúrgicas de estudiantes de tercer año de Medicina Veterinaria en la Universidad Autónoma Metropolitana, Ciudad de México. El Test de la Espiral de Gibson fue aplicado pre- y post-práctica a 171 estudiantes (92 mujeres, 79 hombres) de 18-38 años de edad. Las técnicas practicadas fueron: ligadura, piel sintética, enterotomía, gastrostomía, cistostomía, colocación de tubo endotraqueal y catéter venoso permanente. Se clasificó los estudiantes como rápido-preciso (RP), rápido-impreciso (RI), lento-preciso (LP) y lento-impreciso (LI). La duración del test disminuyó en 791s (P<0,05) en post-práctica (comparado a pre-práctica), y no hubo diferencia en el número de errores en pre- y post-práctica (P>0,10). Hubo diferencias entre estudiantes rápidos ® y lentos (L) en pre-práctica (P<0,0001). En post-práctica los estudiantes RI presentaron menos (P<0,0001) errores (4,23) que LI (3,40). En pre-práctica también hubo diferencias (P<0,0001) entre R y L; en los L menos tiempo emplearon los LP (49,38s). No hubo diferencias (P>0,0001) en errores post-práctica entre estudiantes precisos (LP, RP) e imprecisos (LI, RI), ni entre géneros (P>0,10). Comparando la diferencia en tiempo de práctica (P=0,007) entre lentos y rápidos en pre-práctica, los hombres fueron más rápidos en pre- y post-práctica (P<0,0001), sin diferencias en el promedio de errores pre- (P=0,662) y post-práctica (P=0,962). Se concluye que los estudiantes mostraron progresos en la adquisición de habilidades motores al aumentar su velocidad y reducir errores, aumentando así el número de estudiantes rápidos y precisos. Los hombres superaron a las mujeres.

AVALIAÇÃO DE HABILIDADES PSICOMOTORAS PARA CIRURGIA ADQUIRIDAS POR ESTUDIANTES DE VETERINÁRIA UTILIZANDO SIMULADORES BIOLÓGICOS
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RESUMO
Este estudo pretende avaliar a aquisição de habilidades psicomotoras utilizando simuladores biológicos em práticas cirúrgicas de estudantes de terceiro ano de Medicina Veterinária na Universidade Autónoma Metropolitana, Cidade do México. O Teste da Espiral de Gibson foi aplicado pré e pós-prática a 171 estudantes (92 mulheres, 79 homens) de 18 a 38 anos de idade. As técnicas praticadas foram: ligadura, pele sintética, enterotomia, gastrostomia, cistostomia, colocação de tubo endotraqueal e cateter venoso permanente. Classificaram-se os estudantes como rápido-preciso (RP), rápido-impreciso (RI), lento-preciso (LP) e lento-impreciso (LI). A duração do teste diminuiu em 791s (P<0,05) em pós-prática (comparado a pré-prática), e não houve diferença no número de erros em pré- e pós-prática (P>0,10). Houve diferenças entre estudantes rápidos ® e lentos (L) em pré-prática (P<0,0001). Em pós-prática os estudantes RI apresentaram menos (P<0,0001) erros (4,23) que LI (3,40). Em pré-prática também houve diferenças (P<0,0001) entre R e L; nos L menos tempo empregaram os LP (49,38s). Não houve diferenças (P>0,0001) em erros pós-prática entre estudantes precisos (LP, RP) e imprecisos (LI, RI), nem entre gêneros (P>0,10). Comparando a diferença em tempo de prática (P=0,007) entre lentos e rápidos em pré-prática, os homens foram mais rápidos em pré e pós-prática (P<0,0001), sem diferenças na média de erros pré (P=0,662) e pós-prática (P=0,962). Conclui-se que os estudantes mostraram progresos na aquisição de habilidades motoras ao aumentar sua velocidade e reduzir erros, aumentando assim o número de estudantes rápidos e precisos. Os homens superaram as mulheres.
TABLE I
TIME TAKEN TO PERFORM THE GIBSON SPIRAL MAZE TEST AND NUMBER OF ERRORS BEFORE AND AFTER SURGICAL PRACTICE USING BIOLOGICAL SIMULATORS

<table>
<thead>
<tr>
<th>Practice</th>
<th>Time (sec)</th>
<th>Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>39.34 a</td>
<td>1.74 b</td>
</tr>
<tr>
<td>After</td>
<td>31.43 b</td>
<td>1.53 a</td>
</tr>
</tbody>
</table>

Kruskal Wallis Test
\[ \chi^2 = 29.14, \quad DF = 1 \quad P < 0.0001 \]

Coefficients of variation:
- FI: 0.007
- SI: 125.49

\[ P > \chi^2 = 0.97 \]

\[^{a,b}\text{Values are considered statistically significant (P<0.05).}\]

TABLE II
TIME TAKEN TO PERFORM THE GIBSON SPIRAL MAZE TEST AND NUMBER OF ERRORS ACCORDING TO CLASSIFICATION GROUP * BEFORE AND AFTER PRACTICE WITH BIOLOGICAL SIMULATORS

<table>
<thead>
<tr>
<th>Classification</th>
<th>Time (sec)</th>
<th>Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast – Accurate (n=52)</td>
<td>32.57 a</td>
<td>0.42 c</td>
</tr>
<tr>
<td>Fast – Inaccurate (n=47)</td>
<td>29. b</td>
<td>4.23 a</td>
</tr>
<tr>
<td>Slow – Accurate (n=52)</td>
<td>49.38 b</td>
<td>0.19 c</td>
</tr>
<tr>
<td>Slow – Inaccurate (n=20)</td>
<td>52.82 b</td>
<td>3.40 b</td>
</tr>
</tbody>
</table>

Kruskal Wallis Test

\[ \chi^2 = 126.52, \quad DF = 3 \quad P < 0.0001 \]

\[ P > \chi^2 = 0.9628 \]

\[ ^{a,b}\text{Values are considered statistically significant (P<0.05).}\]

TABLE III
TIME TAKEN TO PERFORM THE GIBSON SPIRAL MAZE TEST AND NUMBER OF ERRORS ACCORDING TO GENDER BEFORE AND AFTER PRACTICE WITH BIOLOGICAL SIMULATORS

<table>
<thead>
<tr>
<th>Classification</th>
<th>Time (sec)</th>
<th>Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>After practice</td>
<td>125.7057</td>
<td>132.41</td>
</tr>
</tbody>
</table>

Kruskal Wallis Test

\[ \chi^2 = 126.52, \quad DF = 3 \quad P < 0.0001 \]

\[ P > \chi^2 = 0.9628 \]

\[^{a,b}\text{Values are considered statistically significant (P<0.05).}\]

The number of errors (Table I). This shows the benefits of practice with simulators.

When students were classified into groups, differences in time taken to make the spiral before and after practice were detected (Table II), particularly in students classified as fast compared to the slow group, indicating that practice drastically changes the skills of students. This was also manifested in the number of errors in students classified as inaccurate: before the practice the FI group made the most errors, but following practice the two inaccurate groups (FI and SI) made a similar number of errors. In general, the time taken to complete the spiral showed the same trend after practice, and was shorter.

The mean age by gender was similar (female= 22.75 years; male= 22.64 years), and therefore the comparison between men and women was valid. Women took longer to draw the spiral than men, both before and after practice (Table III). Following the use of simulators, the time taken for the spiral was reduced in both men and women, indicating evidence of learning. There was no difference in the number of errors (Table I). This shows the benefits of practice with simulators.

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The use of simulation models as an educational method for medical procedures is growing rapidly, with significant improvements in reliability, both visual and tactile. This allows for competency assessment and accreditation of skills (Michelson and Manning, 2008). Surgical training has recently undergone various changes, owing to student interest in acquiring surgical skills outside the operating room through simulation of surgical procedures, using artificial or cadaver tissues, animal models and virtual reality simulation, thus allowing the full transfer of the skills learned and practiced by students in the laboratory to the operating room (Torkington et al., 2000).

The use of simulators is a fast, efficient way to teach, allowing students to acquire surgical skills at low cost (Michelson and Manning, 2008; Ko-
The students showed improvement in the acquisition of psychomotor skills with biological simulators, increasing speed and reducing the number of errors. There were differences in the number of errors between men and women, men completing the test more quickly and with fewer errors.

REFERENCES


