A Trend Toward Improved Learning of Cardiovascular Pathophysiology in Medical Students From Using a Human Patient Simulator: Results of a Pilot Study

This study evaluated the effectiveness of human patient simulator (HPS) as a teaching tool for basic pathophysiology. We conducted a randomized controlled trial (RCT) comparing the use of a HPS with a standard lecture. The teaching objectives included understanding the determinants of oxygen delivery and the pathophysiology of different types of shock. The primary outcome measured was a difference in pre-teaching test (pre-TT) and post-teaching test (post-TT) scores between the two groups.

Novice second-year preclinical medical students were recruited on a volunteer basis after ethics approval had been obtained. Students were aware of the experimental nature of the session and that testing of their performance was required. The topic of the session was concealed to avoid preparation. Participants were randomized to receive a 1-h teaching session either via a traditional lecture in the form of a slide presentation or a session using a HPS (Medical Education Technologies, Sarasota, FL). All students performed a pre-TT to establish their baseline score, which served as each student’s control. The test was of written format, consisting of questions requiring written responses as well as multiple-choice questions. The syllabus of both forums was standardized and delivered by different instructors concurrently at different venues. After a brief break, all students were asked to complete a post-TT of a similar nature to the pre-TT.

For the HPS session, physiological variables were displayed in real time on a computer with all its audible features enabled. Students were asked in turn to predict responses to different physiological maneuvers such as alterations in preload, myocardial contractility, and systemic vascular resistance. The results of the students’ suggestions were then presented on the monitor and discussed, with the expected “correct” response presented when necessary.

Tests were marked by a blinded examiner, and scores are expressed as a percentage of the maximum obtainable score. Means and SDs were calculated for pre-TT and post-TT scores of each group. The pre-TT score was compared by t-test. Analysis of covariance was performed to compare the improvement of score (post-TT – pre-TT score) between the two groups, adjusting for the pre-TT score.

Only 19 of the 140 eligible students participated in this study, with 10 students randomized to the HPS group and 9 students to the lecture group. There were no differences in pre-TT scores between groups (P = 0.58; Table 1). Both groups made significant improvements in their test scores after the intervention, with the mean score increasing from 23.8% to 35.7% for the HPS group and from 28.4% to 53.8% (27.3%) for the lecture group. However, the 5.5% difference in pre-TT to post-TT scores between HPS and control groups was not statistically significant (P = 0.22) and was not correlated with the pre-TT score (P = 0.62).

It is recognized that RCTs in education may lack true blinding and randomization, uniformity in the intervention, and

### Table 1. Summary of TT scores pre- and postintervention

<table>
<thead>
<tr>
<th></th>
<th>HSP Group</th>
<th>Traditional Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-TT Mean (SD)</td>
<td>23.8 (8.4)</td>
<td>26.5 (12.2)</td>
</tr>
<tr>
<td>(Q1, Q3)</td>
<td>(18.3, 33.5)</td>
<td>(17.5, 37.6)</td>
</tr>
<tr>
<td>Post-TT Mean (SD)</td>
<td>56.6 (12.3)</td>
<td>53.8 (13.8)</td>
</tr>
<tr>
<td>(Q1, Q3)</td>
<td>(49.4, 69.3)</td>
<td>(44.6, 69.3)</td>
</tr>
<tr>
<td>Improvement Mean (SD)</td>
<td>32.8 (10.2)</td>
<td>27.3 (8.2)</td>
</tr>
<tr>
<td>(Q1, Q3)</td>
<td>(28.5, 36.5)</td>
<td>(23.0, 32.4)</td>
</tr>
</tbody>
</table>

n = 10 respondents from the human patient simulator (HSP) group and 9 respondents from the traditional group. TT, teaching test.

An improvement in future studies of this type may include a crossover design using two subject matters. Each instructor is required to teach both subject matters sequentially using a different method for each topic. Assessment of the perception of the instructor’s competency would also have to be measured and compared. This may minimize teacher styles as a confounder, as may have the case in this study. Furthermore, other variables may also be measured, such as evaluating the student’s decision abilities. In conclusion, context-based learning using a HPS may enhance the understanding of certain basic pathophysiological principles compared with standard lecture.

### ACKNOWLEDGMENTS

The authors thank all the students who took part in this study during their term break.

### GRANTS

This study was in part funded by the Run Run Shaw Research and Teaching Endowment Fund (teaching grants administered by the University of Hong Kong).

### REFERENCE


Gordon Wong,
Caroline Jenkins,
Tzy-Jyun Yao,
Michael Irwin
University of Hong Kong
Pok Fu Lam Road
Hong Kong
E-mail: gordon@hkucc.hku.hk
doi:10.1152/advan.00073.2007