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ORIGINAL ARTICLE

Evaluation of 2 inanimate models to improve percutaneous fluoroscopy-guided renalaccess time☆

Efraín Maldonado-Alcaraz[a], Fernando González-Meza García[b,*], Eduardo Alonso Serrano-Brambila[a]

[a] *Servicio de Urología, Hospital de Especialidades, Centro Médico Nacional Siglo XXI, México, D.F., Mexico*
[b] *Servicio de Urología, Hospital General Regional No. 25, Instituto Mexicano del Seguro Social, México, D.F., Mexico*

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KEYWORDS
Kidney;
Percutaneous nephrolithotomy;
Inanimate model;
Minimally invasive surgical procedures

Abstract
Background: Training devices for percutaneous renal access are expensive, have hazardous biological materials, or radiation. Two devices were designed that eliminate some or all of these characteristics (ManiPERC and iPERC).
Objective: To compare the improvement in access time to the posterior lower calix with 2 inanimate models in a group of urology residents.
Material and methods: Quasi-experimental clinical trial with 16 urology residents to compare the improvement over time of percutaneous renal access by training in 2 inanimate models (iPERC: simulated fluoroscopy and ManiPERC: real fluoroscopy).
Results: Subjects were assigned to one of 2 groups (iPERC and ManiPERC) and a video analysis of all of them was performed before and after 20 training sessions. Both groups improved their access time; with iPERC from 133.88 ± 41.40 to 76 ± 12.62 s ($p = 0.006$) and from 176.5 ± 85.81 to 68.75–18.40 s ($p = 0.007$) with ManiPERC. Comparing iPERC *versus* ManiPERC there was no difference between them in improving access time (ANCOVA: Model F (1.13) = 1.598, $p = 0.228$).
Conclusions: Both models are equivalent in improving skills; however, even though none of them generated bio-waste, the absence of radioactive emissions makes iPERC the more advantageous model.
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* Corresponding author at: Servicio de Urología, Hospital de Especialidades, Centro Médico Nacional Siglo XXI, Cuauhtémoc 330, Piso 3, Col. Doctores Cuauhtémoc, 06700 México, D.F., Mexico.
E-mail address: urology_md@hotmail.es (F. González-Meza García).

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PALABRAS CLAVE
Riñón;
Nefrolitotricia percutánea;
Modelo inanimado;
Procedimientos quirúrgicos mínimamente invasivos

Evaluación de 2 modelos inanimados para mejorar el tiempo de acceso renal percutáneo guiado por fluoroscopia

Resumen
Antecedentes: Los dispositivos de entrenamiento en punción percutánea renal son costosos, usan residuos biológicos infecciosos o emiten radiación. Diseñamos 2 dispositivos que eliminan algunas o todas estas características (ManiPERC e iPERC).
Objetivo: Comparar la mejoría en el tiempo de acceso al colector posterior e inferior al practicar en los dispositivos.
Material y métodos: Ensayo clínico cuasiexperimental con 16 residentes de urología. Se asignaron los sujetos a uno de dos modelos de dispositivo de entrenamiento para realizar 20 sesiones de punción y se analizaron los videos del entrenamiento antes y después de 20 sesiones.
Resultados: Ambos grupos mejoraron su tiempo de acceso; con iPERC pasó de 133.88 ± 41.40 a 76 ± 12.62 s (p = 0.006), y con ManiPERC, de 176.5 ± 85.81 a 68.75 ± 18.40 s (p = 0.007). Al comparar iPERC *versus* ManiPERC, no hay diferencia entre ellos en la mejoría del tiempo de acceso (ANCOVA: F Modelo (1.13 = 1.598, p = 0.228).
Conclusiones: Ambos modelos son equivalentes en la mejoría de las destrezas; sin embargo, aun cuando ninguno de ellos genera residuos biológicos, la ausencia de emisiones radiactivas hace del iPERC el modelo con mayor ventaja.
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Background

The probability of developing urinary lithiasis during a lifetime has increased in parallel to obesity and type 2 diabetes, at 12% for men and 4.8% for women, with a recurrence of 30–40%. This represents healthcare expenditure on lithiasis calculated at 2 billion dollars for the year 2000 in the United States.[1]

Percutaneous nephrolithotomy is the technique of choice for most renal calculi larger than 2 cm, and its use has increased by 50.4% over the past 15 years as it is a minimally invasive procedure.[2]

The complication rate of this surgical procedure is not negligible, and it is estimated that 7.8% of patients present significant bleeding, 5.7% requiring transfusion, 3.4% present major perforation of the pyelocalyceal system, and up to 1.8% present hydrothorax. Deaths associated with the procedure have also been described,[3] and perforation of the abdominal viscera: the duodenum,[4,5] the intra and extrahepatic bile duct,[6] spleen[7–9] and, most commonly, the colon.[10–12] Certain lesions can endanger the patient's life by damaging structures such as the vena cava.[13]

The puncture technique for percutaneous access is the procedure which is most associated with complications, and the time and number of punctures made for access are determining factors.[14,15]86.3% of percutaneous renal access procedures worldwide are fluoroscopy guided to enable better three-dimensional orientation of the pyelocalyceal system, and thus improve the precision of access between the complex vascular and calyceal anatomy of the kidney.[16–19]

There are other factors which make percutaneous access a procedure which requires a high degree of skill: the external rotation of the kidney on the coronal plane, the posterior rotation on the transversal plane and the great variability of the distance of the kidney from the skin due to each patient's body fat levels, and the presence of a duplex collecting system in the lower pole in more than half of cases.[20–22]

Furthermore, through procedures *in vivo*, on average doctors receive radiation dosages of 0.28 mSv (6.04 min), and the dosage would be even greater for tutors if they were present at all training sessions.[23] Doctors undergoing training can receive dosages of up to 5.2 mSv to the hands, 7.5 mSV to the fingers and 1.6 mSv to the eyes over up to 21.9 min per event.[24] According to the International Commission on Radiological Protection, the maximum recommended occupational exposure limit is 20 mSv per year,[25] therefore models where fluoroscopy is used to perform indefinite repetition sequences would appear not to be the best option.

The time to access the pyelocalyceal system during a fluoroscopy-guided nephrolithotomy is directly proportional to the time of exposure to radiation, and it has been estimated that one in 1000 people exposed to at least 10 mSv throughout their lives will develop cancer.[26]

From 36 to 60 cases are required for the learning curve to perform percutaneous renal surgery,[27] but a doctor in training will feel comfortable making access after 21 procedures; This curve is directly completed on patients as there is no appropriate model for *ex vivo* practice.[28–31]

When formal training is given on percutaneous access it is more likely that after training, the doctor will suggest the option of percutaneous nephrolithotomy (27% *vs.* 11%) to their patients, and those who do not suggest this option argue that it is an access procedure which requires a great deal of skill.[31]

There are few models for guided percutaneous renal access, and they are generally biological, which require training through repetitions on pigs' kidneys[27,32,33] and

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