Value of Needle-Guidance Technology in Procedures Performed by Radiology Residents

The Value of Needle-Guidance Technology in Ultrasound-Guided Percutaneous Procedures Performed by Radiology Residents - A comparison of Freehand, In-Plane, Fixed-Angle, and Electromagnetic Needle Tracking Techniques

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Summary and Methods

In this publication, the authors from the Keck School of Medicine of USC report the process and outcome of a clinical study comparing the use of an in-plane fixed-angle needle guide, Ultra-Pro II™ (CIVCO, Kalona, IA), electromagnetic needle tracking, eTRAX™ (CIVCO, Kalona, IA) and freehand technique to preform simulated liver lesion punctures on a humanoid phantom. "Traditionally, radiology residents gain this experience by performing supervised freehand ultrasound-guided procedures on patients who are subjected to potentially longer procedural times and higher complication rates. Emerging guidance technologies, which include in-plane, fixed-angle guidance (IPFA) and electromagnetic needle tracking (ENT), offer the potential to reduce procedure times and complications and therefore improve patient comfort and safety." The purpose of this study was to quantitatively measure the time from puncture of the skin to successful placement in the lesion and the number of needle passes required to reach the four lesions using each technique.

Eighteen radiology residents were divided into three groups: freehand technique, Ultra-Pro needle-guide, and eTRAX tip tracking. Each resident was instructed to place a needle under real-time ultrasound guidance into four separate liver lesions within a humanoid phantom. Each lesion was progressively more difficult to reach. Lesions 1 and 2 were superficial and deep with straightforward approaches. Lesions 3 and 4 were at a mid-depth with an intercostal approach. All lesions were of similar size. Primary outcomes were based on total time and total number of pullbacks or redirections of the needle. Secondary outcomes were also taken into consideration per lesion, measuring time and redirection of each needle placed.

Discussion and Results

The total mean amount of time for the freehand technique was 636.05 seconds. The mean time using an in-plane, fixed-angle needle guide, Ultra-Pro II, was 81.33 seconds. Using the Electromagnetic Needle Tracking, eTRAX, the mean time was 30.6 seconds. These results were significantly improved using Ultra-Pro II and eTRAX. As far as the number of total passes taken, the mean total for the freehand techniques was 29.43 passes. With the Ultra-Pro II needle guidance device, the mean number of passes was 2. Using eTRAX to guide the needle, a mean of .4 total passes were taken. Again, this was a statistically significant improvement using the Ultra-Pro II and eTRAX devices to decrease the number of passes. The secondary outcomes in individual lesions 1 and 2 were not seen as statistically significant, where the more difficult lesions 3 and 4 did show significant improvement.

Conclusions

The authors conclude that using CIVCO's in-plane fixed-angle needle guidance and electromagnetic needle tracking technologies significantly improves radiology resident procedure time and accuracy. The Ultra-Pro II improved procedure time by 87%, while eTRAX improved procedure time by 95%. Procedure accuracy improved by 93% using the Ultra Pro II and eTRAX improved procedure accuracy by 99%.

Author Commentary

"Emerging guidance technologies, which include in-plane, fixed-angle guidance (IPFA) and electromagnetic needle tracking (ENT), offer the potential to reduce procedure times and complications and therefore improve patient comfort and safety."

"Needle guidance technology, both In-Plane, Fixed-Angle guidance and Electromagnetic Needle Tracking, significantly improved radiology resident procedure time and accuracy, especially for lesions that are deep or require difficult approach."