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Evaluation of cryoprobe deployment precision with body surface and *in situ* templates

Keegan L. Maxwell, Courtney Phillips*, Jay S. Belani, Yan Yan and Jaime Landman*

*Division of Urology, Washington University school of Medicine, St. Louis, MO, and *Department of Urology, Columbia University, New York, NY, USA*

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OBJECTIVE

To evaluate the precision of cryoprobe targeting with a surface template, an *in situ* template (on the target organ), or a combined approach.

MATERIALS AND METHODS

Fourteen participants placed five 17 G cryoprobes into porcine kidneys in a laparoscopic trainer using a surface template (group 1), an *in situ* template (group 2) or a combination of the two templates (group 3). The distance from the ideal probe placement was measured both on the anterior and posterior aspect of the kidney. The sequence of attempts was randomized. The distances were compared across the three groups using ANOVA with the adjustment for multiple comparisons.

RESULTS

The mean distance from the ideal probe placement was 1.58 cm (anterior) and 1.81 cm (posterior) in group 1, 0.05 cm and 0.39 cm in group 2, and 0.07 cm and 0.22 cm in group 3, respectively. The placement of the probes was significantly more accurate in groups 2 ($P < 0.001$ anteriorly and $P < 0.002$ posteriorly) and 3 ($P = 0.001$ anteriorly and $P < 0.001$ posteriorly) compared with group 1. There was no significant difference between groups 2 and 3.

CONCLUSION

In this *in vitro* model, the use of internal or combined internal and external templates allows for significantly more precise deployment of 17-G cryoprobes than a standard external template alone.

KEYWORDS

cryoablation, renal mass, template

INTRODUCTION

Cryoablation has become an increasingly important surgical option in the treatment of renal masses [1]. Standard cryoablation techniques have incorporated the application of a single larger (3–5 mm) probe for ablation. The use of this large probe has been associated with a greater risk of haemorrhage after probe removal and difficulties targeting the one large probe correctly. These limitations have prevented the more widespread acceptance of the technique. To help minimize these problems application of multiple smaller calibre (17 G) cryoprobes has been described, either from a laparoscopic approach [2] or using CT or MRI for localization and targeting [3]. For ablation to completely ablate a mass using smaller probes, deployment must be very precise to assure complete freezing of the lesion. Currently, a rigid surface template is used to help assure that the probes are deployed precisely. The use of a surface template ensures that the probes are correctly configured at the skin, but this practice is less precise in the tumour after the probes have passed through the body wall. We hypothesized that using the combination of an *in situ* template located directly on the lesion as well as a surface template may optimize ablation-probe deployment. This two-template design should allow for parallel placement of the needles, and precise placement of probes through lesions deep within the kidney. In the present study we evaluated the precision of probe targeting with a surface template, an *in situ* template (on the target organ), or a combined *in situ* and surface approach in a laparoscopic trainer model, using porcine kidneys. We further evaluate the difficulty and time required for placement of probes using these novel templates.

MATERIALS AND METHODS

A flexible template was created using a mesh membrane with a centre hole and five holes evenly spaced one centimetre from the centre. The template was flexible enough to be placed through a 10-mm trocar.

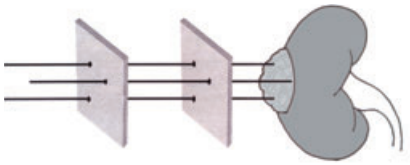
Fourteen subjects placed five 17 G cryoablation probes (Galil Medical, Plymouth Meeting, PA, USA) into 14 porcine kidneys in a laparoscopic trainer. The probes were placed three times, for which order was randomized in an external template on the surface of the trainer (group 1), an *in situ* template only (group 2), and an external and an *in situ* template (group 3) (Fig. 1). The time for probe placement, and the anterior and posterior distance from ideal placement was measured. An analogue difficulty scale (1 being very easy and 10 being very difficult) survey was given to the subjects asking how difficult probe placement was and how accurate they felt their probe placement was with each group. The level of training and number of laparoscopic case experience for each participant was also recorded. The distances were compared across the three groups using ANOVA with the adjustment for multiple comparisons.

RESULTS

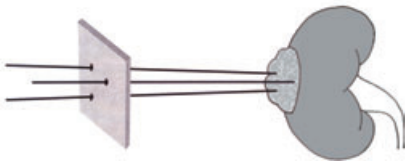
Of the 14 participants, five had no surgical training, seven were residents, one was an attending and one was a fellow. Six participants had no laparoscopic experience,

*FIG. 1. **A,** Combined external and in situ templates for precise parallel deployment of multiple-ablation probes. **B,** Standard external template probe deployment with less precise targeting of a renal cortical neoplasm.*

A



B



one had 1–20 laparoscopic cases, three had 21–40, three had 40–60 and one had >100. The mean reported difficulty was 5.5 on a scale of 1–10 for group 1, 3.4 for group 2 and 3.3 for group 3 ($P = 0.002$). The mean time for placement of the probes was 94.7 s for group 1, 100.5 s for group 2, and 111.1 s for group 3 ($P < 0.26$). The participants rated how precisely they felt they placed their probes on a scale from 1 to 10 with 1 being very precise and 10 being very random. The mean precision rating was 5.6 for group 1, 3.6 for group 2 and 3.3 for group 3 ($P = 0.001$).

The mean distance from the ideal placement was 1.58 (0.95) cm anteriorly and 1.81 (1.13) cm posteriorly in group 1, 0.05 (0.57) cm and 0.39 (0.78) cm in group 2, and 0.07 (0.61) cm and 0.22 (1.1) cm in group 3, respectively.

The placement of the probes was significantly more accurate in groups 2 ($P < 0.001$ anteriorly and $P = 0.002$ posteriorly) and 3 ($P = 0.001$ anteriorly and $P < 0.001$ posteriorly) compared with group 1. There was no significant difference in the placement accuracy between groups 2 and 3 ($P = 0.9$ anteriorly and $P = 0.89$ posteriorly). The participants of the study felt that the placement of probes was significantly less difficult for group 2 and 3 than it was for group 1 ($P = 0.001$). The participants also felt that their placement was more precise in the trials where the *in situ* (group 2) or combined (group 3) approaches were used and their perceptions of how precisely probes were placed generally reflected the actual measurements. The time required for probe placement was not significantly different between the groups.

DISCUSSION

The use of either an *in situ* or combined *in situ* and external templates allows for more precise placement of 17 G cryoablation probes compared with an external template, which is in clinical use now. The application of a dual-template system should significantly improve the ability to laparoscopically deploy and target renal masses with precision, and prevent areas within a lesion from being under-treated. In theory, the use of the combined *in situ* and external templates offer the additional advantage of the probes being parallel, offering greater precision for lesions located deep within the kidney (endophytic lesions) compared with any single template approach (either *in situ* or external template alone). However, the data suggested that the use of just the internal template was equally precise.

The present study shows that using an *in situ* template either alone or combined with an external template may increase the ease and precision of multiple probe deployment when compared with conventional external probe placement. Future clinical evaluation will be required to confirm these results.

In this *in vitro* evaluation, the application of a flexible *in situ* template, or a combination of external and *in situ* templates, allowed increased precision of multiple small probe deployment when compared with a standard external template probe placement.

CONFLICT OF INTEREST

None declared.

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Correspondence: Jaime Landman, 161 Fort Washington Avenue, Room 1111, New York, NY 10023, USA.
e-mail: landmanj@yahoo.com