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Tumour marker mini project

Final report, Tumark Vision migration research

1. Test set-up

Turkey breasts were acquired commercially and handled in the following sterile conditions to the greatest possible extent. The turkey breasts were cut up into pieces of roughly the same size, between 75 and 100 g. Two metal hairpins were inserted into each piece orthogonally to one another right up to the bend. One hairpin was therefore frontally inserted into the cut surface of the tissue approx. 2 cm from the right-hand edge, while the second one, seen from there, is pushed into the right-hand side approx. 1 cm from the cut surface of the tissue. This means that both pins run parallel to the floor and are vertically positioned somewhere near the centre of the piece of turkey breast. The tumour marker was implanted between the two pins at around the same height in each case and the catheter was inserted up to the second marking (Fig. 1). In addition, the test set-up (Tumark Vision) included the insertion of a cannula, approx. one centimetre long into the left-hand half of the pieces of turkey breast (the blue arrow in Figure 1). This designates a positive control, meaning that it should have been able to move easily within the tissue.

Two pieces of turkey breast were identically prepared for each tumour marker and cycle. One piece was shaken using a lab shaker (specimen; shaken in the same way as positive control), with another piece being handled in the same way to serve as a negative control, but without being shaken (control; or rather positive control not shaken). The terms ‘control’ and ‘specimen’ refer to a tumour marker, while the term ‘positive control’ refers to the additional accompanying cannula.

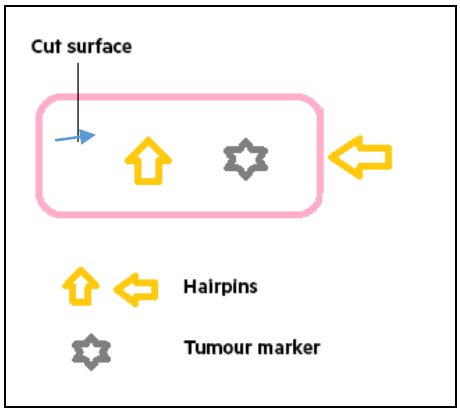

Figure 1: Diagram of the test set-up showing the position of each of the metal components that are yet to be sonographed. The blue arrow represents the accompanying positive control in the test series (cannula).

Once prepared, the pieces of turkey breast were transferred to disposable plastic bowls and covered with an incise foil so as to maintain sterility during the sonography.

The specimens were sonographed using a Fujifilm VisualSonics fitted with the Vevo 3100 Imaging System and a sonic head designed for use with rats. The specimens were sonographed on day 0 (Baseline) and on day 7 (Final), with every possible effort being made to take the day 0 and day 7 images from the same angle. Between days 0 and 7 the turkey breast pieces were stored at 4°C in the refrigerator and in addition to being sealed the bowls were covered with a lid. Above all, the controls served to determine which movement was caused by the natural alteration of the tissue (drying out, decomposition) over time. The specimens were shaken using a lab shaker set at a low frequency range.

The sharpest possible ultrasound image was evaluated per measurement and turkey breast piece, as shown in Figure 2. This was done using software appropriate for an ultrasound scanner with three frames being measured per shot. The information provided by the results is the difference of the average values between day 0 and day 7 in mm.

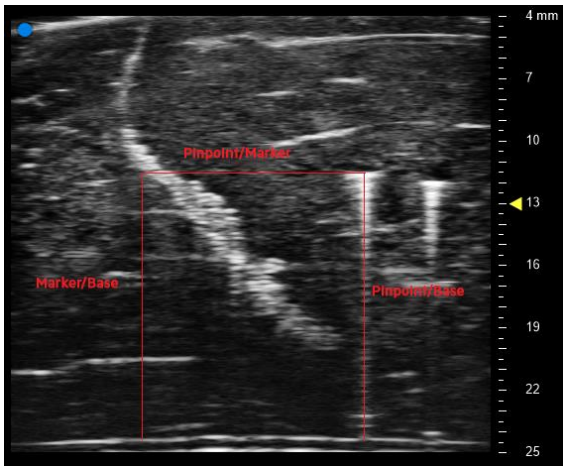

Figure 2: Sample illustration of the image measurement. Three distances were always measured: Hairpin point - base of container, hairpin point – marker edge and marker edge – base of container. Distance measurements were taken every 3 frames per image and repeated in each case on day 0 and day 7.

2. Technical limitations

The FUJIFILM VisualSonic MX250 sonic head used provides a minimum image display resolution of 75 µm. It is also suitable for showing extremely small objects, like the tumour markers under examination. The evaluation of the captured images was done using the naked eye unless differences in distance of ≤ 1 mm were not valued as positive findings. Furthermore, the measurements were only taken on one plane (from above), meaning that only one movement could be captured on that plane. This was done bearing in mind that the shaking affected this plane, meaning that it could therefore be assumed that a movement of the marker caused by the shaking had been captured in the chosen approach. It is for this reason that every possible effort was made to ensure the images recorded on day 0 and on day 7 were taken from the same angle, but it goes without saying that this was only achievable up to a point. Firstly, the natural deterioration of the tissue during the 7-day incubation period prevented identical images from being taken, and secondly, the uniformity of the image was only visually controlled.

3. Results

Table 1: Results of test cycle with Tumark Vision markers, with the difference in the distances measured between day 0 and day 7 always indicated in mm. Critical differences in distance are shown in red.

Distance	Specimen: Difference in distance in mm	Positive control, shaken: Difference in distance in mm	Control: Difference in distance in mm	Positive control, not shaken: Difference in distance in mm
Tumark Vision 1				
Marker/Base	0.48	-2.42	0.22	0.27
Pin/Marker	0.27	2.90	-0.05	-0.84
Pin/Base	0.96	-1.21	0.30	0.22
Tumark Vision 2				
Marker/Base	0.99	0.58	-0.09	0.82
Pin/Marker	-0.12	-0.75	-0.04	-0.31
Pin/Base	0.90	0.55	-0.35	0.61

Tumark Vision: No movement was found to have occurred within the tissue. However, the selected positive control only shows the desired effect in one test set-up. The marker shows up more strongly in the sonography after seven days than it did on day 0 (Figure 2).

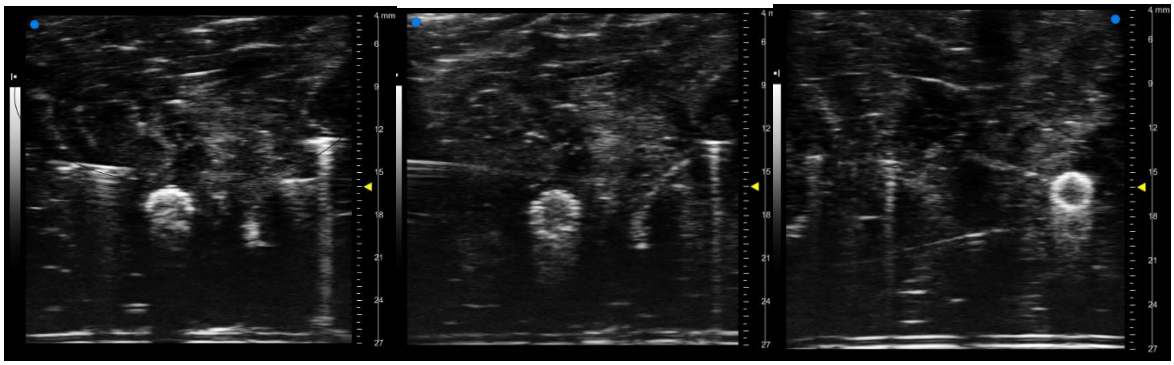

Figure 2: The Tumark Vision on day 0 (left) and on day 7 (centre and right). On day 0 a pronounced acoustic shadow helps the marker to be identified. On day 7 the round shape is clearly visible.

4. Summary of the results

No marker movement was detected with respect to the Tumark Vision markers. The selected positive control showed a clearly measurable movement in one case only and its suitability therefore seemed to be clearly limited.

The limitations of the selected test set-up in comparison with the in-vivo-situation are, on the one hand, described in the Technical Limitations Section and, on the other, are due to the shortness of the test period, the small random sample and the artificial, consistently regular movement of the specimens.