

The measurement of liver resection margins

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Background

All tissue shrinks to some degree when placed in formalin fixative solution. The degree of shrinkage of liver tissue has particular relevance to the measurement of resection margins, as the current recommendation is that the surgeon should aim to achieve a resection margin of at least 1 cm. We were unable to find any published data concerning shrinkage of liver tissue in formalin. The aim of this study was therefore to quantify the shrinkage of liver specimens in the fixation process.

Methods

Distances of 10, 30 and 50 mm were measured and marked on 18 fresh liver specimens. The specimens were then fixed in

10% formalin solution for 24 h, and the distances were re-measured to assess shrinkage.

Results

The observed shrinkage at all three distances was <10% after 24 h in formalin. The degree of shrinkage was statistically significant.

Conclusion

Although the degree of shrinkage is small, it may be important when considering resection margins of the order of 1 cm and should therefore be taken into account.

Keywords

liver resection, resection margins, formalin

Introduction

Currently over 700 liver resections are performed in the UK each year [1]. The commonest indication for resection is metastatic colorectal cancer, for which hepatectomy can result in a 5-year survival rate of 38% [2]. Previous work has shown that the resection margin is a determinant of prognosis after hepatic resection, and it is currently recommended that the surgeon should aim to achieve a resection margin of at least 1 cm [3–6]. In much of the literature it is not specified whether this 1-cm margin is measured by the surgeon at operation or by the pathologist after fixation of the specimen in formalin.

It is well known that most tissues shrink to varying degrees when placed in a formalin fixative solution. A Medline search of the literature did not find any work quantifying liver shrinkage during the fixation process. The question therefore arose as to whether allowance for shrinkage should be made when assessing the fresh resection margin to achieve the optimal 1-cm clearance, as determined by pathological measurement of margins after chemical fixation in 10% formalin solution.

Methods

Fine sutures (4-0 polypropylene) were placed at 10-mm,

30-mm and 50-mm intervals in normal liver parenchyma of freshly resected liver specimens from 18 patients undergoing liver resection at this hospital between 2000 and 2001. The sutures were initially positioned by measurement against a ruler, accurate to the nearest millimetre. Once the sutures had been placed, the distances were re-checked using calipers against the ruler. If the suture placement was inaccurate, it was re-positioned. The same observer (EER) carried out all measurements. Intra-observer error was assessed by repeating all the measurements for the first five specimens three times.

The specimens were placed in 10% formalin fixative solution for 24 h, ensuring that the fixative covered the whole specimen. After 24 h, the specimens were removed from the formalin, and the distances between sutures were re-measured by the same observer using the same technique to the nearest millimetre.

Results

There was no significant intra-observer variation in the placing or re-measurement of distances between sutures.

In one specimen a suture 'cut out' and became detached from the specimen, precluding assessment of

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Table 1. Median shrinkage of liver parenchyma after fixation for 24 h in formalin

Distance between sutures (mm)	Median shrinkage (and range) (mm)	Significance*
10 (n = 17)	0 (0–3)	t = 2.89 p < 0.05
30 (n = 18)	2 (0–5)	t = 5.79 p < 0.05
50 (n = 18)	4 (0–7)	t = 6.28 p < 0.05

* Student's t test

shrinkage of the tissue between 0 and 10 mm sutures in that particular case.

For each distance measured (10, 30 and 50 mm), the percentage shrinkage was <10%. The degree of shrinkage was statistically significant when considering each of the three distances (Table 1).

Discussion

It is generally accepted that resection margins are an important prognostic indicator, yet paradoxically there is little to clarify their method of measurement in the literature. Various studies have quantified shrinkage of tissues in fixative solution, such as lingual mucosa [7], prostate [8], lung [9], cornea [10] and colon [11]. However, we were unable to find any such research concerning liver tissue.

Our study shows that liver parenchyma does shrink, although the magnitude of this effect is small. In every set of measurements, the degree of shrinkage reached statistical significance. This study raises awareness of the fact that 'shrinkage factors' should be considered when describing resection margins. Authors should be consistent when describing margins with respect to whether they were measured fresh or following fixation by any method.

We did not measure liver parenchyma in situ or microscopically following final fixation and preparation, and it is likely that a small degree of shrinkage may occur immediately on resection of the specimen. As with other tissues, it may therefore be pertinent to conduct a study to assess liver shrinkage precisely from the in vivo situation to its measurement on a microscope slide.

As the degree of shrinkage is small, and certainly <10%, it is unlikely to make a great difference to the measurement of small resection margins. Although most hepatic surgeons would aim for a resection margin of ≥ 1 cm, in practice this may not be possible when a tumour is either centrally placed or adjacent to important

anatomical structures. Here a surgeon may accept a smaller margin in the knowledge that provided the tumour has not been breached the prospects for survival will not have been greatly reduced [12]. For measured margins of ≤ 5 mm, small variations due to shrinkage could probably be ignored. In the histopathological examination of rectal specimens a lateral resection margin of <1 mm is counted as a positive margin [13]. It would appear reasonable to apply this principle to the liver when assessing clearance of colorectal liver metastases. Although shrinkage of <10% on a margin of 1 mm would have a miniscule effect, it would be worth defining that such a small measurement of clearance should only be made in the fixed state, particularly when it is to be used to signify a non-involved margin.

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