Hepatic arterial redistribution prior to Yttrium 90 radioembolisation: Efficacy of treatment and outcome

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Authors: N. Karunanithy, P. Tait; London/UK
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Purpose

Tumours of the liver > 3 mm in diameter derive 80-100% of their blood supply from the hepatic arterial rather than the portal venous circulation [1]. Transcatheter hepatic arterial radioembolisation with yttrium 90 (Y90) microspheres has emerged as an effective and relatively safe treatment modality for patients with unresectable liver dominant malignancy and a life expectancy > 3 months [2,3].

The arterial blood supply to the liver is variable with accessory or replaced hepatic arterial branches being a relatively frequent finding [4]. When the arterial supply to the left and right lobes of the liver are widely separated and from multiple sources, Y90 radioembolisation can be logistically difficult. When one of the hepatic arteries is interrupted, the interlobar arterial collateral system or communicating arcade help to re-establish arterial perfusion of the segment of liver previously supplied by the interrupted artery [5,6,7]. When performing Y90 radioembolisation, this would potentially allow the entire liver to be treated from a single injection into a selectively catheterised hepatic artery [8].

The purpose of this study was to compare the response to Y90 radioembolisation between a group of patients in whom radioembolisation was performed after multiple hepatic arteries were embolised to 'simplify' arterial blood flow to a group who had no alterations in their hepatic arterial flow and the radiotherapeutic agent was administered into the proper hepatic artery as a single dose or in divided doses into the immediate hepatic arterial branches of the proper hepatic artery.
Methods and Materials

Between June 2004 and February 2008, all patients treated with Y90 at our institution and who had had a pre and post procedure PET scan, were included. Patients with a history of external beam radiotherapy, ascites or severely altered liver function tests suggesting liver failure were excluded.

The study protocol was approved by the Institutional Review Board.

Reduction of SUV values on FDG PET imaging was taken as a measure of early response [9]. The readers of the PET scans (AA-N, MH) were blinded to the interventional procedures the patients had undergone. SUV measurements were taken from representative lesions in the right and left lobes of the liver where present. When there was more than one lesion in a lobe, the most prominent lesion on the pre procedure PET was chosen as the target lesion. Where a single central lesion was present, the lesion was divided into right and left components on the coronal images using the right lateral border of the spine as the divider.

All patients underwent a pre-procedure visceral angiogram to map the hepatic arterial anatomy. At the time of the initial angiography, the operator (NPT) assessed the hepatic artery supply to determine if this was sufficiently complex to require embolisation to enable a simplified therapeutic injection. If deemed necessary, embolisation of the hepatic artery branches was carried out with coils.

Patients would then return for a second visceral angiogram one to two weeks, later at which point the radioembolic material was injected. The purpose of the treatment was to try and achieve total liver delivery with a single injection of the radioembolic material.

A total of 57 procedures were carried out between June 2004 and February 2008. In 25 instances a pre and post procedure PET studies were not done and hence these patients were excluded. 32 procedures in 30 patients over this time period were hence included in the study. The mean age was 56.9 years (range 39-77) and the male: female ratio was 17:13. In 29 cases the liver lesions were due to colorectal metastases, in 2 cases breast metastases and in 1 case cholangiocarcinoma. All patients had extensive disease and had exhausted other therapeutic options.

There were 20 cases in which administration of Y90 was carried out and no manipulation of the hepatic arterial supply occurred (Group 1, Table 1).
In 12 cases Y90 was administered following manipulation of the hepatic arterial flow by embolisation of one or more hepatic arterial branches (Group 2, Table 2). In most cases of vascular manipulation, embolisation of the left +/- middle hepatic arteries was carried out allowing selective catheterisation and administration of Y90 into the right hepatic artery.

Response to treatment and comparison of the responses between Groups 1 and 2 were carried out. The mean time to follow up PET in Group 1 was 54 days (range 30-76 days) and in Group 2 was 74 days (range 13-196 days). The methodology applied was Mixed Models. The modelling and estimation of the effects of interest was carried out by SPSS 15. The significance level set was 5%. 
Results

For the non manipulation group, there was a significant response to treatment (p-value <0.001) for right lobe lesions with the estimated marginal effect for pre (12.9) higher than the estimated marginal effect for post (8.9). For left lobe lesions in the non-manipulation group, there was no significant difference between the pre and post treatment SUV values (p-value = 0.549).

For the manipulation group, though less strong a significant response to treatment was seen for right lobe lesions (p-value = 0.028) with the estimated marginal effect for pre (10.6) being higher than that for post (8.3). Also for left lobe lesions in the manipulation group, a significant response to treatment was seen (p-value = 0.014) with the estimated marginal effect for pre (7.6) higher than the estimated marginal effect for post (3.7).

Comparison was made between manipulation and non-manipulation groups. There was no significant difference in response of the right lobe lesions (p=0.726). However a significantly greater response of left lobe lesions in the manipulation group was observed (p=0.004). The estimated response for the non manipulation group was 8.867 and the estimated response for the manipulation group was 3.650.
Conclusion

The therapeutic response to radioembolisation as demonstrated by PET scanning has been shown to be equal in both halves of the liver where the variant arterial supply has been manipulated to allow a single arterial injection, indicating that this is a valid method of achieving total liver coverage with a simpler means of radioembolic material delivery. Indeed the response in the left lobe in those individuals considered to have normal anatomy is less adequate. This could have implications as to the methodology of the therapeutic injection in those particular individuals. Further study is required of the consequences of position and the nature of particulate release in the hepatic arterial circulation.
References


Personal Information

If you have any comments I would be very pleased to hear them.

Narayan Karunanithy

Email: nara121@doctors.org.uk