# Dynamic and Static Scintigraphy in Evaluation of Hepatic Metastases in Patients with Gastrointestinal Malignancy¶

*GASTROİNTESTİNAL KANSERLİ HASTALARDA KARACİĞER METASTAZLARININ DEĞERLENDİRİLMESİNDE DİNAMİK VE STATİK SİNTİGRAFİ*

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**SUMMARY**

*When primary or metastatic neoplasms are present in the liver, the normal patern of blood flow is distrupted and the hepatic artery supplies a larger fraction of the total flow. Static-dynamic flow scintigraphy computed tomography, ultrasound and laparotomy were performed on the 48 gastrointestinal malignancy at the begining and 2 year later. Hepatic Perfusion Index (HPI) was expressed as the ratio of arterial to total inflow and levels above 0.42 were considered to be abnormally elevated. Of 6 patients with hepatic metastases had the begining. 5 had HPI values above 0.42 and 3 had a heteregenous static scan. The sensitivities of the HPI and static scan were 83% and 50%, respectively. Of the 35 patients with no apparent hepatic metastasis at laparotomy, 16 had HPI values below 0.42 and 26 had homogenous static scan. Specifities of the HPI and static scan were 45% and 76%, respectively. Of the 35 patients without metastasis at laparotomy, 7 developed late hepatic metastasis within the following period. All patients had HPI values above 0.42 and 26 had homogenous static scan. Sensitivies and specifities for HPI and static scan were 100%, 45%, 70%, and 73%, respectively. Our results suggest that a low preoperative HPI value could reliably be used to identify patients who are at low risk of developing late liver metastasis and thus avoid unnecessary adjuvant chemotherapy.*

**Key Words:** Static-dynamic Scintigraphy, Hepatic metastasis

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**ÖZET**

*Karaciğerde primer veya metastatik tümör varlığında normal kan akım düzeni bozulmakta ve hepatik arteryel fraksiyon artmaktadır. Bu amaçla 48 gastrointestinal tümörlü hastaya başlangıçta ve 2 yıl sonra statik-dinamik sintigrafi, bilgisayarlı tomografi, ultrasound ve laparotomi yapıldı. Hepatik perfüzyon indeksi (HPİ) total karaciğer kan akımının bir yüzdesi olarak hesaplandı ve 0.42 (%42) üzerindeki değerler anormal olarak düşünüldü. Başlangıçta hepatik metastazlı 6 hastanın 5'i yüksek HPİ değerine, 3'ü normal statik sintigrafiye sahipti. HPİ ve statik görüntü için sensitivite sırasıyla %33 ve %56 bulundu. Başlangıçta hepatik metastaz görülmeyen 35 hastanın 16'sı 0.42'nin altında HPİ'ye ve 26'sı normal statik sintigrafiye sahipti. HPİ ve statik sintigrafi için spesifite sırasıyla %45 ve %76 idi. Başlangıçta metastaz olmayan 35 hastanın 7'sinde 2 yıl sonra hepatik metastaz gelişti. Bu 7 hastanın hepsinde HPİ 0.42'nin üzerindeydi ve toplam 26 hasta ise normal statik sintigrafiye sahipti. Sensitivite ve spesifite HPİ ve statik sintigrafi için sırasıyla %100, %45, %70 ve %73'dü. Bu sonuçlar düşük bir preoperatif HPİ değerinin geç karaciğer metastazı gelişme riski düşük hastaları saptama ve bu sayede gereksiz adjuvant kemoterapi uygulamalarından kaçınmada güvenle kullanılabileceğini desteklemektedir.*

**Anahtar Kelimeler:** Dinamik-statik sintigrafi, Hepatik metastaz

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Dynamic hepatic scintigraphy has been described as a method for enhancing diagnostic specificity of hepatic images. This method is based on the fact that the normal liver receives approximately 25-30% of its blood supply through the hepatic artery and the remainder through the portal vein.

Many patients with gastrointestinal malignancy develop hepatic metastases because the venous drainage of the gastrointestinal tract flows through the liver. These metastases may be detected in about 45% to 80% of cases by biochemical or imaging tests, respectively. Nevertheless, ultrasound, computed tomography, and scintigraphy are unable to accurately detect hepatic metastases smaller than 1 or 2 cm diameter. Moreover, Finlay et al suggested that nearly 30% of patients undergoing apperently curative resection for colorectal carci-

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noma passes occult hepatic metastases that are undetected by any of these three curently used imaging tests (1). These occult metastases will develop and appear as late metastases during the follow-up at these patients. The dedection of hepatic metastases at the begening and occult metastases has become of greater importance with the development of techniques for the successful resection of hepatic metastases and with the advent of treatment protocols involving intraportal or intraperitoneal chemotherapy (6,7). A hepatic flow scintigraphy by means of assessing the ratio of arterial flow to total hepatic blood flow reportedly enhances this detection of hepatic metastases (2,3). The present study was designed to assess the sensitivity and specificity of hepatic flow scintigraphy at beginning hepatic metastases and chiefly for occult metastases appearing lately within two years after surgery.

## MATERIALS AND METHODS

We have studied 48 patients with known primary gastrointestinal neoplasms.

Table 1 shows the patient's distribution according to the type of malignancy at laparotomy and the presence or absence at the beginning liver metastases. Table 2 shows the patients distribution according to the type of malignancy and the presence or absence of late liver metastases within two years following surgery.

Static isotope scan and dynamic flow scintigraphy were performed before surgery. After fasting for 12 hours, patient were positioned supine under a large field gamma camera encompassing the liver, spleen, kidneys. Following rapid intravenous injection of 4 mCi of $^{99m}$Tc-labelled sulphur colloid, image data were recorded in 2-second frames for 60 seconds. After a further 15-minute static period, liver images (500.000 counts) were obtained in the anterior, posterior, lateral and oblique positions. From the stored dynamic data, region of interest were selected that corresponded to the right kidney, and right lobe of the liver, time-activity curves were generated. The peak time of the kidney curve was used to indicate the division between arterial and portal inflow phases of the liver curve. After three-point smoothing of the liver curve, the avarage slopes of the two consecutive 8-second sections on either side of the arterial-portal division were calculated. The first slope represented the arterial inflow and the second slope, the portal inflow. The hepatic perfusion index (HPI) was expressed as a fraction using the arterial inflow as the numerator and the total hepatic inflow as the denominator. We decided in advance to use 0.42 as the upper limit of normal. Static scintigraphy was assessed as being homogeneous or heterogeneous (4,5).

The results at static and dynamic flow scintigraphy were independently assessed and correlated with the findings at laparotomy. At surgical exploration, the liver was throughly inspected and bimanually palpated. If hepatic metastases were suspected, then a specimen was taken for biopsy and histologically studied. Of the 48 patients, 6 had overt hepatic metastases detected at laparotomy. All the patients were followed up for at leasts 2 years. The presence or absence of late metastases has been assessed by physical examination and by ultrasound or computed tomography. Of the 42 patients without metastases at laparotomy, 7 developed overt late hepatic metastases within the follow-up period.

**Table 1.** Patients characteristics at study envolment (N:48)

| Primary Carcinoma | No Metastases (N:42) | At the beginning liver metastases (N:6) |
|---|---|---|
| Colon | 21 | 3 |
| Rectum | 8 | 1 |
| Stomach | 7 | 2 |
| Esophagus | 4 | - |
| Pancreas | 2 | - |

**Table 2.** Details of patients with late liver metastases (N:42)

| Primary Carcinoma | No metastases (N:35) | Late liver metastases (N:7) |
|---|---|---|
| Colon | 17 | 4 |
| Rectum | 8 | - |
| Stomach | 5 | 2 |
| Esophagus | 4 | - |
| Pancreas | 1 | 1 |

## RESULTS

Table 3 shows the distribution of HPI values in the group of patients with and without hepatic metastases. Of 6 patients with early hepatic metastasis, 5 had HPI values above 0-42 and 3 had heteregenous static scan. The sensitivities of the HPI and static scan were 83% and 56%, respectively (Table 4). Of the 42 patients with no apperent hepatic metastases at laparotomy, 19 had HPI values below 0.42 and 32 had a homogenous static scan. The specificity of the HPI and static scan was 45% and 76%, respectively. Within the 2 years of follow-up, of the 42 patients who had a normal liver at laparotomy, 7 developed hepatic metastases. Of this group, 7 had HPI values above 0-42 and 5 had a heterogeneous static scan. The sensitivities of the HPI and static scan were 100% and 70%, respectively (Table 4). 35 patients have not developed hepatic metastases of this group, 16 had HPI values below 0-42 and 26 had a homogenous static scan. The specificity of the HPI and static scan were 45% and 73%, respectively.

**Table 3.** Results of hepatic flow scintigraphy. Of 6 patients with early hepatic metastasis, 5 (83%) had HPI values

| Hepatic metastases | | HPI index >0.42 | No of patients <0.42 |
|---|---|---|---|
| Athe | Yes | 5 | 1 |
| begining | No | 23 | 19 |
| Late | Yes | 7 | 0 |
| metastases | No | 19 | 6 |

**Table 4.** Sensitivity and specificity of static liver scan and hepatic flow index

| | | Hepatic metastases at the beginning | late |
|---|---|---|---|
| Liver | Sensitivity % | 56 | 70 |
| scan | Specificity % | 76 | 73 |
| Flow | Sensitivity % | 83 | 100 |
| scintigraphy | Specificity | 45 | 45 |

## DISCUSSION

For the detection of hepatic metastases in gastrointestinal malignancy, comperative studies between ultrasound evaluation, computed tomography and scintigraphy have not shown any advantage of one technique over the others. Liver lesions less then 2 cm in diameter are usually undetectable by radyonuclide static scintigraphy. In addition it is known that the proportion of patients with small (<2 cm) metastatic lesions within the liver may be as high as 30 per cent. It is not surprising therefore that all these methods tend to underestimate the incidence of hepatic metastatic disease.

Dynamic scintigraphy has been developed as a method assesing the relative components of arterial and portal flow to liver. The use of a colloidal tracer, whilst depending to an extent on Kupffer cell function, circumvents the problems of hepatic venous outflow, which represents an inherent error when using a nondiffusibl tracer. In addition since only a small dose is given the main determinant of the liver gradients obtained is hepatic in flow, both arterial and portal (5).

Other previous studies have suggested that computerized flow scintigrams could enhance the sensitivity of radionuclide liver imaging. Sarper et al have claimed a 100% sensitivity rate in detection of hepatic metastases. Leveson et al have reported a hemodynamic flow scintigraphy sensitivity of 94% (7). Finloy et al have reported an incidence of metachrenous metasteses of 30 percent in their patients, most of which became overt by repeated CT scanning, within 2 years of surgery. It is evident that not only are new diagnostic techniques necessary, but also that the true specificity of any such technique may only be assessed by careful follow-up at patients (1). In our experience, performing the same technique and using the same criteria as Leveson et al, HPI was more sensitive %83 and less specific (45%) than static scintigraphy (56% and 76%, respectively).

In conclusion, the most important feature of this study is that no patient with a low HPI has yet developed hepatic metastases. The practical advantages of flow scintigraphy are that it is inexpensive, non-invasive, sensitive and freely available in most hospitals. If adjuvant intraportal or intraperitoneal chemotherapy in gastrointestinal malignancy can reduce the incidence of late liver metastases (9), our results suggest that a low preoperative HPI value could reliably be used to identify patients who are at low risk of developing metachrenous liver metastases and this avoid unnecessary adjuvant chemotherapy.

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