Original Article

Diagnostic Yield of Percutaneous Image-Guided Tissue Biopsy of Focal Hepatic Lesions in Cancer Patients

Ten Percent Are Not Metastases From the Primary Malignancy

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BACKGROUND: The diagnostic yield was evaluated of percutaneous image-guided tissue biopsy of hepatic lesions identified on computed tomography performed for staging of a primary malignancy, and it was determined how often the biopsy result was unexpectedly negative, benign, or secondary to a second unknown malignancy. **METHODS:** In a retrospective investigation from 1998 through 2008, 580 patients with primary malignancies had indeterminate focal hepatic lesions and underwent percutaneous image-guided biopsy; 369 patients had lesions in their liver at first cross-sectional imaging, performed for staging; 211 patients had a negative liver imaging study, followed by the subsequent appearance of at least 1 indeterminate suspicious lesion. The results of percutaneous image-guided tissue biopsies were compared with the histology of the primary malignancy. **RESULTS:** Liver biopsies were performed in 580 patients (288 men and 292 women; age, 25-92 years; mean age, 61 years). The most common primary malignancies were pancreatic (n = 96), breast (n = 85), melanoma (n = 57), esophageal (n = 51), lung (n = 47), colorectal (n = 37), and urothelial tumors (n = 26). Biopsy results were positive for malignancy in 528 (91%) cases. Among the positive biopsies, 29 (5%) cases had pathology results different from the primary tumor. Of the 52 biopsies negative for malignancy, 20 yielded a specific benign diagnosis, and 32 were nondiagnostic. **CONCLUSIONS:** If all liver lesions had been assumed to be metastases, as expected secondary to the known primary tumor, then the true or presumed alternate diagnosis would have been missed in 60 (10.3%) of the 580 cases. The authors did not attempt to determine whether actual clinical management changed based on these 60 liver biopsy results, so this number is an upper bound on management change. On the basis of these results, and given the minimal complication rate of liver biopsy, the authors suggest that liver biopsy should still be performed in the types of cases studied here, despite the finding that the vast majority of biopsies produced the expected result and presumably did not change patient management. ***Cancer* 2011;117:4041–8.** © *2011 American Cancer Society.*

KEYWORDS: biopsy, diagnostic yield, hepatic lesions, liver.

In patients with cancer, tissue diagnosis, often by percutaneous image-guided needle biopsy, is typically required to establish a definitive diagnosis and to guide management. In some cases, at the time of initial presentation with suspected metastatic cancer, the primary lesion and its tissue type may be known and even have been treated; the suspected metastases may have been known at the time of initial primary neoplasm diagnosis or may present at a later time, indicating the development of new metastatic disease. In other cases of suspected metastasis, imaging may have identified a suspected primary lesion, although a biopsy may not yet have been performed, and the specific tissue type may be unknown. In yet another set of cases, the primary lesion is a mystery and not only may a biopsy of suspected metastases prove metastatic disease, but the tissue type discovered may be sufficient for therapy, or indicate the likely primary tumor and assist in planning diagnostic tests to uncover it.

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Percutaneous image-guided liver biopsy for suspected metastasis is a common procedure in our institution. We wondered how much information is provided by such biopsies in the various situations described above; how often do they simply confirm what is already known? Specifically, we wondered how often new hepatic lesions (or suspicious lesions seen on first imaging) are negative, benign, or arise from a malignancy not suspected from either imaging detection of a suspected primary malignancy or from a known primary lesion. Perhaps in some clinical situations, it might be possible to accept imaging findings as proof of metastasis and avoid the biopsy procedure. We retrospectively reviewed 11 years of percutaneous image-guided liver biopsies to evaluate the diagnostic yield of percutaneous image-guided tissue biopsy of hepatic lesions identified on computed tomography (CT) performed for staging of a primary malignancy and to determine how often the biopsy result was unexpectedly negative, benign, or secondary to a second unknown malignancy.

MATERIALS AND METHODS

This study was performed in compliance with the US Health Insurance Portability and Accountability Act. Institutional review board approval was obtained for the review of subjects' medical records. Because of the retrospective nature of the investigation, patient informed consent was not required.

By using our departmental biopsy database, all percutaneous image-guided liver biopsies performed in adults from January 1998 through December 2008 were identified. By using our institution's electronic data repository, the medical records of the patients undergoing these biopsies were reviewed to assess inclusion and exclusion criteria. Patients underwent liver biopsy as a part of their clinical care, and these lesions were sufficiently suspicious by clinical and imaging characteristics to warrant biopsy. All of these biopsies were performed to answer clinical questions. None of these biopsies was required as part of a research protocol or treatment study. No attempt was made to retrospectively re-evaluate the appropriateness of the clinical decision making, because the goal of the study was to evaluate liver biopsy as used in clinical practice.

Cases were excluded if the biopsy was performed for reasons other than the determination of malignancy (eg, to confirm microabscesses in the liver). Cases were also excluded if the goal of the biopsy was the first determination of malignancy, including cases where the lesion was a presumed primary neoplasm of the liver or cases where the primary tumor was completely unknown (both location and tissue type) at the time of the biopsy. These latter exclusions were made because in these situations, imaging findings of hepatic lesions could not be a potential substitute for hepatic biopsy. Cirrhosis of the liver was not a specific exclusion criterion, but these patients were excluded when the biopsy was performed to diagnose primary hepatic malignancy.

Cases were included if the primary tumor was known from biopsy or surgical resection of a primary lesion and/or other metastases in organs other than the liver. Cases were also included if a specific primary tumor was suspected from imaging tests (such as an adenocarcinoma of the pancreas). Cases were subdivided based on whether the patient had previously undergone imaging that showed a metastasis-free liver before an imaging study that was suggestive of newly discovered metastases (Group 1), or whether the first available imaging showed lesions suspicious for metastases (Group 2).

For the study population, patient medical records were reviewed for demographic information, complications from the liver biopsy, histology of the primary tumor (if determined), and the results of any biopsies performed. In cases where the index biopsy did not confirm the suspected metastatic disease, the medical record was reviewed to identify the next steps taken clinically, such as a second biopsy, but specifically to determine whether negative biopsies were treated clinically as positive results although the histology did not confirm the presence of metastases. The data were analyzed with descriptive statistics.

RESULTS

From January 1998 through December 2008, 1958 percutaneous image-guided hepatic biopsies were performed. Of these, 956 liver biopsies were of suspected metastases, and 580 met the inclusion criteria. Of these 580 biopsies, 499 (86.0%) matched the pathology of the primary malignancy (Fig. 1), whereas 81 (14.0%) did not.

The 580 patients were composed of 288 men and 292 women, with a mean age of 61 years (range, 25-92 years). Biopsies were performed under ultrasound guidance in most cases (n = 571); CT was used for guiding biopsy in only 9 cases. The most common primary malignancies were pancreatic, breast, melanoma, esophageal, lung, colorectal, and urothelial tumors. A complete list of primary tumors and biopsy results are provided in

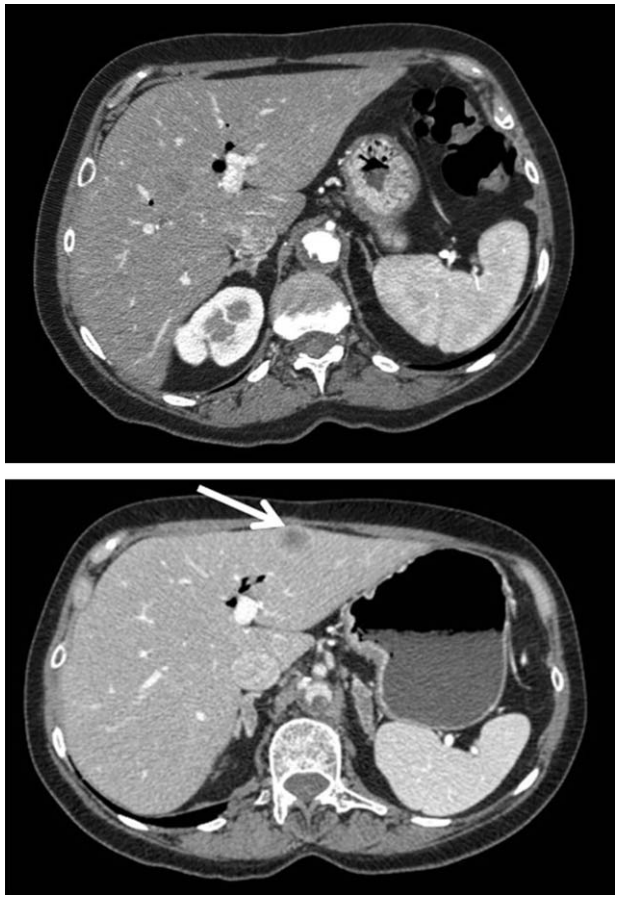

Figure 1. (*Top*) Axial computed tomography section from a 60-year-old patient with biopsy-proven pancreatic adenocarcinoma shows pneumobilia related to a biliary stent, but no lesions within the liver. (*Bottom*) A follow-up study 20 months later shows a new low-attenuation lesion (arrow) within the left lobe of the liver. Biopsy of this lesion was positive for metastatic adenocarcinoma.

Table 1. Primary Tumors (Known or Clinically Suspected by Imaging) in 580 Liver Biopsies

Primary Tumor	No.	%
Pancreatic	96	16.6
Breast	85	14.7
Melanoma	57	9.8
Esophageal	51	8.8
Lung	47	8.1
Colorectal	37	6.3
Urothelial	26	4.4
Multiple primaries	25	4.3
Leukemia/lymphoma	23	4.0
Cholangiocarcinoma	21	3.6
Renal cell	20	3.4
Head and neck	17	2.9
Carcinoid	9	1.6
Sarcoma	9	1.6
Prostate	8	1.4
Neuroendocrine	7	1.2
GIST	5	0.9
Ovarian	5	0.9
Adrenal cortical	4	0.7
Ampullary	4	0.7
Gastric	3	0.5
Anal	2	0.3
Hepatocellular	2	0.3
Merkel cell	2	0.3
Thymic	2	0.3
Thyroid	2	0.3
Carcinoma ex pleomorphic adenoma	1	0.2
Cecal	1	0.2
Cervical	1	0.2
Chordoma	1	0.2
Choriocarcinoma	1	0.2
Endometrial	1	0.2
Hemangioendothelioma	1	0.2
Hemangiopericytoma	1	0.2
Mesothelioma	1	0.2
Parotid adenoid cystic	1	0.2
Peripheral nerve sheath tumor	1	0.2

GIST indicates gastrointestinal stromal tumor.

Tables 1 and 2. The distribution of primary tumors reflects our referral pattern as a quaternary academic medical center.

The primary neoplasm was proven by pathology in 468 (80.7%) of 580 cases and determined by imaging in 112 (19.3%) of 580 cases. In the latter category, imaging in addition to multidisciplinary tumor board decisions—which deemed the diagnosis to be primary malignancy—were considered sufficient.

Prior CT scans that showed a liver free of lesions suspicious for metastases (Group 1 patients) were available in 211 patients. The remaining 369 patients (Group 2) presented for biopsy with an initial study showing suspicious liver lesions, and no prior negative CT, magnetic resonance imaging (MRI), or positron emission tomography scan.

Of the 499 biopsies in which the biopsy matched the pathology of the primary malignancy, 392 (78.6%) had histologic proof of the primary malignancy, whereas 107 (21.4%) had imaging diagnosis of the primary tumor, and 188 (37.7%) were in Group 1 patients, whereas 311 (62.3%) were in Group 2 patients.

In 29 (5.0%) of 580 cases, liver biopsy returned a malignant result that was different from the presumed primary malignancy (Fig. 2). All but 1 of these cases occurred in patients for whom histologic proof of the primary malignancy was known. Ten (34%) of 29 occurred in Group 1 patients, and 19 (66%) of 29 occurred in Group 2 patients.

A total of 52 liver biopsies yielded results that were negative for malignancy. Of these negative results, 20 (38%) of 52 yielded a histologic diagnosis of a benign

Table 2. Biopsy Results of the Cases Included in the Study

Code	New Positive Liver Lesion (With Prior Negative Imaging) (Group 1)	No Previous Negative Imaging (Group 2)	Subtotal
Biopsy matches primary			
1	176 (30.3)	216 (37.2)	392 (67.5)
5	12 (2.1)	95 (16.4)	107 (18.5)
Subtotal	188 (32.4)	311 (53.6)	499 (86.0)
Biopsy malignant but different from expected primary			
2	10 (1.7)	18 (3.1)	28 (4.8)
6	0 (0)	1 (0.2)	1 (0.2)
Subtotal	10 (1.7)	19 (3.3)	29 (5.0)
Nondiagnostic			
3	10 (1.7)	20 (3.4)	30 (5.2)
7	0 (0)	2 (0.3)	2 (0.3)
Subtotal	10 (1.7)	22 (3.8)	32 (5.5)
Benign			
4	3 (0.5)	15 (2.6)	18 (3.1)
8	0 (0)	2 (0.3)	2 (0.3)
Subtotal	3 (0.5)	17 (2.9)	20 (3.4)
Total	211 (36.4)	369 (63.6)	580 (100)

The following code was used. Primary malignancy known from histologic diagnosis: 1 = liver biopsy matches pathology primary; 2 = liver biopsy malignant but different from pathology primary; 3 = negative (nondiagnostic); 4 = benign. Primary malignancy known from clinical diagnosis (no tissue diagnosis): 5 = liver biopsy matches clinical diagnosis; 6 = liver biopsy malignant but different from clinical diagnosis; 7 = negative (nondiagnostic); 8 = benign.

Numbers in parentheses represent percentages of the total 580 cases. Line and column totals vary due to rounding.

Group 1 consists of patients who had previously undergone imaging that showed a metastasis-free liver before an imaging study that was suspicious for newly discovered metastases leading to biopsy. Group 2 consists of patients for whom the first available imaging showed lesions suspicious for liver metastases.

Histologic means that the primary tumor was known prior to liver biopsy by either biopsy or resection of the primary tumor and/or a nonhepatic metastasis. *Imaging* means that the primary tumor was diagnosed based on classic imaging findings.

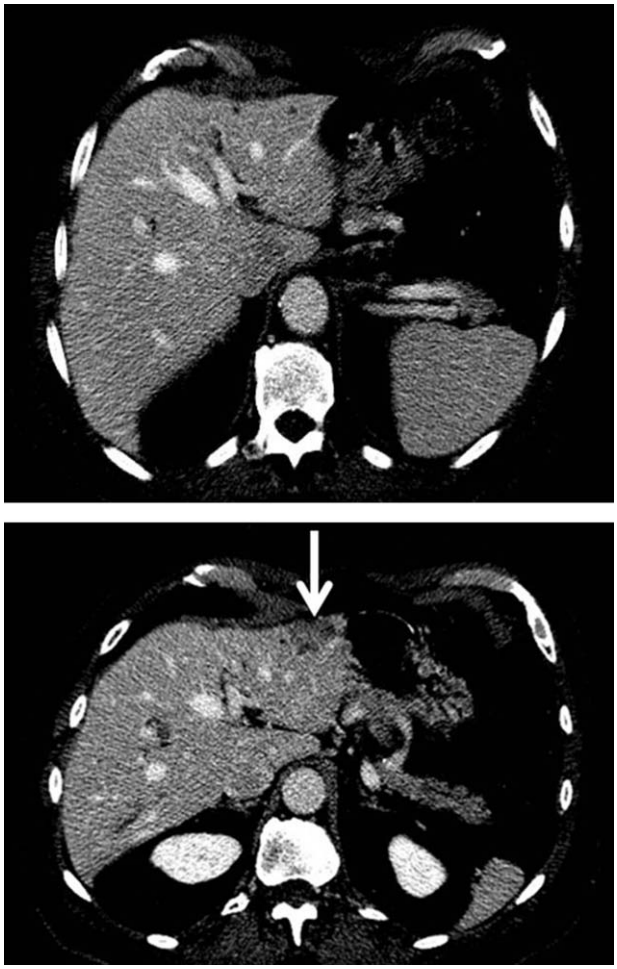

Figure 2. (*Top*) Axial computed tomography (CT) image of an 83-year-old man with history of transitional cell carcinoma is shown. (*Bottom*) Axial CT image from a CT urogram performed 12 months later shows an ill-defined lesion (arrow) in the left hepatic lobe. Biopsy of this lesion showed adenocarcinoma secondary to a colorectal primary tumor.

abnormality that could explain the imaging anomaly (Fig. 3), such as focal nodular hyperplasia or hemangioma. The remaining 32 (62%) of 52 biopsies were nondiagnostic: either a histologic diagnosis of normal liver tissue or a tissue sample that was deemed inadequate for diagnosis of malignancy. The subsequent clinical course of these patients was reviewed. Five (16%) of 32 patients with nondiagnostic biopsies were lost to follow-up after their biopsy. Of the remaining 27 patients, 15 (56%) of 27 were treated by the clinical service for presumed metastatic disease, 4 (15%) of 27 underwent 1 or more additional liver biopsies, and 8 (30%) of 27 were not treated as metastatic disease and did not undergo subsequent biopsies (Table 3). Of the 4 patients who underwent a second liver biopsy, none returned a histologic diagnosis of malignancy. One patient was subsequently treated as being free of metastases. A second patient underwent a third liver biopsy, which was also negative for malignancy, and then had the liver mass resected with a final diagnosis of benign focal nodular hyperplasia. A third patient underwent endoscopic ultrasound, with a biopsy positive for malignancy consistent with the known primary neoplasm (Fig. 4). The fourth patient underwent endoscopic retrograde cholangiopancreatography with histologic diagnosis of a second malignancy (cholangiocarcinoma; original primary colorectal cancer).

Excluding 5 patients lost to follow-up after a single nondiagnostic liver biopsy, patient management was known or presumed in 575 patients (Table 4). We

assumed that if any liver biopsy matched the known primary malignancy, the patient would be treated as such. A similar assumption was made for patients whose liver biopsy uncovered a new malignancy. For patients whose liver biopsy showed a benign diagnosis, we assumed they would be treated as having no metastases. For patients with nondiagnostic biopsies, we determined how they were treated from chart review. Of the 575 patients where management was known or presumed, 515 (89.6%) were treated the same as they would have been if the imaging findings had been considered diagnostic of hepatic metastases from the known primary malignancy. Thirty (5.2%) had a second malignancy uncovered and were managed accordingly, and 30 (5.2%) were managed as if they did not have hepatic metastases. However, because the medical records did not include a treatment plan proposed before the liver biopsy results became available, we do not know how many of these last 60 patients actually had specific treatment alterations from the treatment they would have received if they had been assumed to have hepatic metastases from their known primary malignancy.

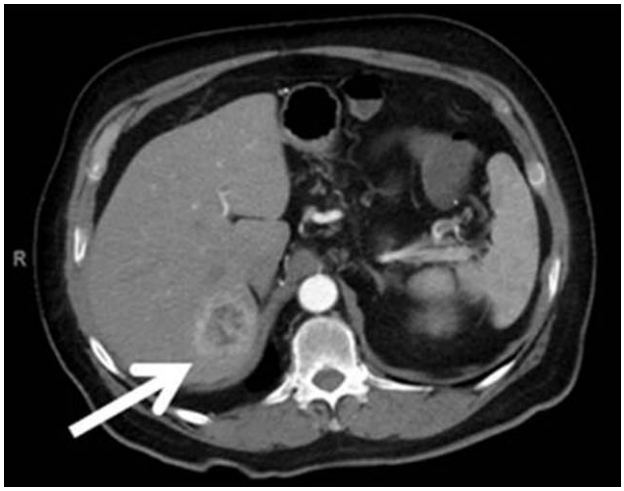

Figure 3. Marginally enhancing lesion (arrow) is shown in the posterior right lobe in a 67-year-old man with a history of renal cell carcinoma. Biopsy of the lesion showed dense scarring and old hemorrhage with chronic inflammation related to an old abscess. The patient had no prior imaging at our facility.

Complications were documented for only 4 (0.7%) of 580 liver biopsies in our series (3 patients developed pneumothorax that needed treatment by chest tube, and 1 had vasovagal hypotension). No fatalities occurred.

DISCUSSION

When a patient presents with imaging findings that raise suspicion of hepatic metastases, a percutaneous image-guided biopsy of the liver is often obtained to confirm that diagnosis. For patients without a known malignancy, this procedure, when successful, returns a histologic diagnosis that not only confirms the presence of metastases, but also suggests what the primary neoplasm may be. However, the efficacy of a liver biopsy is less clear in patients who have a primary malignancy known from histologic biopsy of that tumor or 1 of its nonhepatic metastases, or who have imaging findings that strongly suggest a specific primary neoplasm. For these patients, it is reasonable to ask if the biopsy procedure simply confirms the expected result. The aim of our investigation was to assess the diagnostic yield of percutaneous image-guided liver biopsy in the diagnosis of suspicious focal hepatic lesions in patients with a known primary malignancy and to determine how often the biopsy result was unexpectedly negative, benign, or secondary to a second unknown malignancy.

Complications such as hemorrhage and vasovagal reaction have been reported to occur in 0.6% of liver biopsies.[1] Although rare, it has been reported that hemorrhage can be fatal in 1/3 of liver biopsies that are complicated by hemorrhage.[2] In another series of 68,276 liver

Table 3. Subsequent Clinical Course of Patients With Nondiagnostic Biopsy Outcomes

Primary Lesion Diagnosis	Treated as Presumed Metastatic Disease	Not Treated as Metastatic Disease	≥1 Additional Biopsies Performed	Total
Histologic	14	8	4[a]	26
Imaging	1	0	0	1
Total	15 (56)	8 (30)	4 (15)	27

Five of the 32 patients who underwent nondiagnostic biopsies were lost to follow-up.
Parentheses indicate total percentages, which are calculated based on the remaining 27 known outcomes.
Histologic means that the primary tumor was known prior to liver biopsy by either biopsy or resection of the primary tumor and/or a nonhepatic metastasis. *Imaging* means that the primary tumor was diagnosed based on classic imaging findings.
[a] See text for outcomes of these 4 cases.

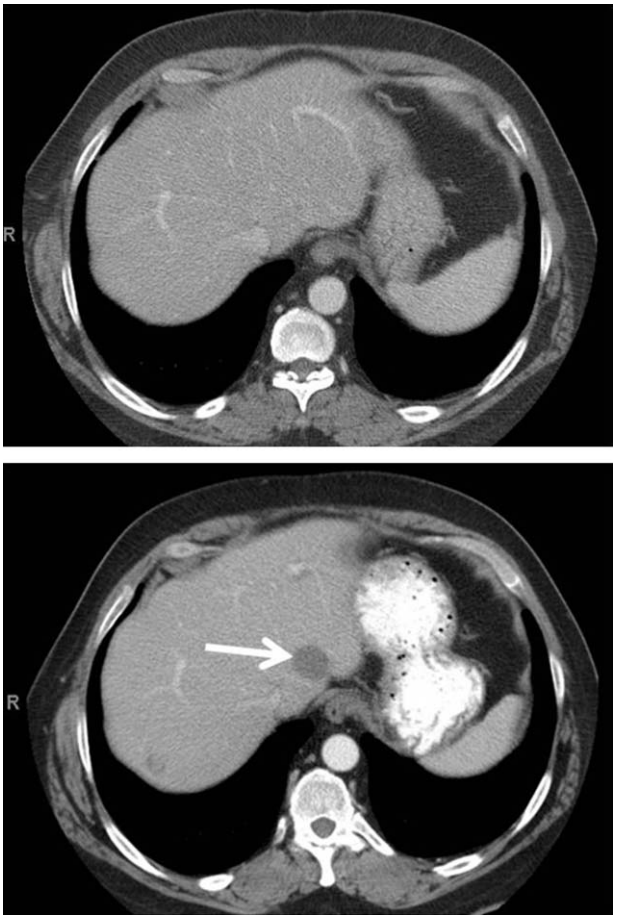

Figure 4. (*Top*) Axial computed tomography (CT) section of a 50-year-old man with a history of biopsy-proven retroperitoneal sarcoma is shown. (*Bottom*) Axial CT image 10 months later shows new low-attenuation lesions in the caudate lobe (arrow) and posterior segment of the right hepatic lobe. The right lobe lesion was biopsied twice, with nondiagnostic results both times. The patient was eventually found to have metastatic disease from the sarcoma primary malignancy after a third biopsy performed using endoscopic ultrasound.

biopsies, death, serious hemorrhagic complications, pneumothorax, and biliary peritonitis were reported to complicate 0.1% to 0.3% of liver biopsies.[3] In our study, complications were documented for 4 (0.7%) of 580 cases (3 developed pneumothorax that was treated by chest tube insertion, and 1 had vasovagal hypotension); none of these complications was fatal.

The diagnostic yield of percutaneous image-guided liver biopsy was investigated by several authors. Schmidt et al[4] reported relatively low diagnostic yield of 61%, 67%, and 61% for hepatic biopsies guided by MRI, CT, and ultrasound, respectively. Other series documented a significantly higher rate of accuracy of up to 98.6%.[5] Small lesion size and image artifacts accounted for significantly important reasons leading to diagnostic inaccuracy of biopsy.[6-8] In our study, hepatic biopsy yielded nondiagnostic results in 32 cases (5.5% of the total number of cases). Of these 32 cases, 5 were lost to follow-up, and 10 were treated as if they did not have metastatic disease. Metastases from the known primary neoplasm were assumed in 15 (56% of the 27 cases for which follow-up is available). Two had malignancy proven by other means (1 with a match to the primary histology and 1 with the finding of a second malignancy).

Our study found a high positive yield for the initial image-guided liver biopsy, which produced a diagnosis in 548 (94.5%) of 580 cases. Hepatic biopsy yielded malignant results in 528 (91%) of the 580 patients who had a primary tumor known from prior histology or characteristic imaging. Of these, 499 (94.5% of malignancy-positive biopsies and 86.0% of all cases) biopsies matched the pathology of the primary malignancy. In 29 (5.5% of malignancy-positive biopsies and 5% of all cases), liver biopsies revealed a malignancy that was different from the primary pathology. In 20 (3.4%) of 580 cases, a benign diagnosis was obtained at initial image-guided biopsy.

The clinical management of the 32 initial liver biopsies that were nondiagnostic raises some interesting issues. Apart from the 5 patients who were lost to follow-up after the initial biopsy, we found that 23 patients were managed as either positive (n=15) or negative (n=8) for metastases without additional histologic sampling, and 4 patients were referred for additional biopsies. We were unable in this retrospective study to determine why these different pathways were chosen, but it could relate to specific clinical factors (for example, the clinical assessment of the pretest probability of hepatic metastases, or limited difference in the treatments available) or to clinician or patient ability to deal with diagnostic uncertainty. In the 4 patients who underwent a second image-guided liver biopsy (and even a third such biopsy in 1 of these 4 patients), none of these biopsies was positive for malignancy. Although the sample size is small, this suggests that it may be more productive to seek an alternate method of diagnosis, if 1 is available and indicated, than repeat liver biopsy. Conversely, of the 3 patients who had further interventions to obtain tissue, $^2/_3$ did have malignant disease, and $^1/_3$ had a benign hepatic lesion. Despite the small numbers, this spread might call into question the decision in 23 patients to manage them without further histologic investigation, although it is interesting that the distribution of management (65% managed as having metastases and 35% managed as having

Table 4. Known or Presumed Management of Patients Based on Hepatic Biopsy Result

Liver Biopsy Result	Management		
	Treated as Hepatic Metastases From Known Primary Malignancy	Treated as Hepatic Metastases From Newly Uncovered Malignancy	Treated as No Hepatic Metastases
Consistent with known primary malignancy	499		
Consistent with newly uncovered malignancy		29	
Nondiagnostic			
After first biopsy, treated as metastases	15		
After first biopsy, treated as no metastases			8
After second biopsy, treated as no metastases			1
After lesion resection, treated as no metastases			1
Third biopsy consistent with known primary malignancy	1		
Third biopsy consistent with newly uncovered malignancy		1	
Benign			20
Total	515	30	30

Five of 580 patients had a nondiagnostic liver biopsy and then were lost to follow-up.

no metastases) almost exactly mirrors the results in the 3 patients in whom diagnostic tissue was obtained.

Our retrospective study has some limitations. Patients whose first available scans showed suspicious liver lesions (Group 2) may have had prior negative liver imaging at another institution and thus might have been placed in Group 1 if we had had access to all imaging performed on patients, including outside studies. Indeed, it is logical to assume that if scanned at the appropriate time, all patients would at some point have had a negative study for liver metastases before the study that led to the liver biopsy. Approximately 1 in 5 patients (112 of 580, or 19.3%) did not have histologic proof of their primary malignancy, instead having imaging findings characteristic of a specific primary diagnosis. However, the rate of unexpected findings (second malignancy, benign lesion, or nondiagnostic biopsy) was lower for patients with imaging diagnosis of primary neoplasm than for patients with histologically proven primary neoplasm (4.5% vs 16.2%, respectively). Although we carefully checked available medical records to determine what diagnoses of primary neoplasm were known or suspected by imaging at the time of the liver biopsy, it is conceivable that some of the 29 patients whose liver biopsy revealed a metastasis from a malignancy different from that expected had had another malignancy proven at another institution of which our clinicians were unaware. However, we believe that our study would still reflect normal clinical practice and decision making.

No attempt was made to retrospectively re-evaluate the appropriateness of the clinical decision making, because the goal of the study was to evaluate liver biopsy as used in clinical practice. For the same reason, we did not retrospectively review the imaging findings of the lesions to evaluate the accuracy of the original interpretations or whether additional studies might have obviated the need for biopsy. For example, it is possible that some of the benign lesions could have been diagnosed noninvasively by MRI. In a series of 124 CT-indeterminate focal hepatic lesions, MRI was able to well characterize approximately 60% of these lesions.[9]

From the above results, we conclude that if all liver lesions had been assumed to be metastases, as expected secondary to the known primary tumor, then the true alternate diagnosis would have been missed in 51 (8.9%) of 575 cases with follow-up in which a benign liver lesion or alternate malignancy was instead found by initial image-guided biopsy or other means. In an additional 9 (1.6%) cases, patients were assumed to be free of hepatic metastases without a proven histologic diagnosis of the liver lesions. Thus in 60 cases (10.4% of 575 cases with follow-up and 10.3% of all 580 cases), there is the possibility of different patient management than if all patients were assumed to have hepatic metastases from their known primary neoplasms. Because of the extreme difficulty in doing so in a retrospective study, we did not attempt to determine whether actual clinical management changed in these 60 cases, so this number is an upper bound on management change. (For example, some patients might have been referred to hospice care in any case.) Similarly, without knowing the changes in clinical management and their presumed benefit to the patient,

we could not estimate the cost-effectiveness of liver biopsy in this population in which about 90% of the biopsies give the expected result. Fortunately, complications were few and relatively mild.

In this era of tighter healthcare dollars, it might be tempting to save the cost of liver biopsy by assuming that the result is a foregone conclusion. One important implication of our work is to refute any unconsidered proposition that patients with known or suspected primary neoplasms with apparent hepatic metastases by CT imaging should be routinely treated as if they have the expected metastases without further evaluation to save healthcare expenditures. To properly deliberate this concept requires cost-effectiveness analyses that are beyond the scope of this work, but may be considered as opportunities for future research, perhaps using decision analytic techniques.[10]

At the outset of the study, we wondered if liver biopsy in this patient population was really necessary, or simply always confirmed the clinical concern for metastasis from a known primary tumor. Although it was the case that the vast majority of biopsies in our series did not change patient management, we were surprised to find such a high percentage of cases in which the biopsy result of a presumed hepatic metastasis was different from the patient's known primary tumor, including 5.2% (30 of 580) that had a second unknown malignancy.

Given the current ability of imaging (particularly MRI) to make specific benign diagnoses of liver lesions, we were surprised that 3.6% (21 of 580) of biopsied lesions were proven to be of benign histology at initial biopsy (n = 20) or subsequent resection (n = 1). Because this is a biopsy-only series, we do not know how many patients with primary neoplasms did not have hepatic biopsies because imaging techniques showed that their liver lesions were benign. Nevertheless, our results argue for careful assessment of hepatic lesions found on CT scans in patients with neoplasms, rather than simply reflexively jumping to biopsy. We recognize that in many cases, metastasis is nearly certain from the CT imaging appearance, and in those cases biopsy may be appropriate, because we have shown that metastases may be from a different primary tumor than expected. Conversely, we propose that, to avoid biopsy in some patients, it would be appropriate to perform MRI in an attempt to noninvasively determine a diagnosis whenever there is any suggestion based on CT imaging criteria that a suspicious hepatic lesion may be benign, or clinical suspicion that liver metastasis might be unlikely.

CONFLICT OF INTEREST DISCLOSURES

The authors made no disclosures.

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