Original Paper

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Diagnosis and Surgical Therapy of Dependent and Pedunculated Hepatic Tumours

Abstract

Hepatic resection for large solitary tumours but particularly for hepatocellular cancer (HCC) produces the best palliation, improves the prognosis, and offers the only chance of cure. Nevertheless, resectional surgery can be difficult due to the large size of many of these lesions, and underlying cirrhosis often makes it essential to preserve the maximum amount of parenchyma. Pedunculated or dependent hepatic tumours represent a rare subgroup of hepatic tumours: a favourable group for resection in most cases because of their anatomical configuration and their morphological characteristic to be often encapsulated. The aim of this study was to review our experience of 20 patients referred from October 1986 to April 1995 with pedunculated or dependent hepatic tumours considered suitable for resection. This group consisted of 14 patients with HCC, 3 with colorectal metastases, and 3 patients with focal nodular hyperplasias. Fifteen of these patients underwent laparotomy, and 13 tumours were resectable. There was no operative or 30-day mortality. From the HCC-operated group 2 patients remain alive for 73 and 60 months, respectively, without tumour recurrence. In our series we found a possible relationship between survival and the different histomorphological findings in the transition zone between the tumour and the liver tissue. Pedunculated lesions other than HCC have not previously been described but were found in 3 patients with colorectal metastases and in 3 patients with focal nodular hyperplasias. It is important that this favourable anatomical configuration is recognized when assessing patients with large hepatic tumoral lesions because it offers a great chance for tumoural resection.

Introduction

Hepatic resection for large solitary tumours of the liver but particularly for hepatocellular cancer (HCC) produces the best palliation, improves survival, and offers the only chance of a possible cure [1, 2]. There is a wide range of surgical options, including formal, segmental, subsegmental, and atypical hepatic resections. The choice of these various approaches is often limited not only by the gross distribution of the malignant hepatic process, but by the underlying hepatic parenchymal damage and the consequently impaired reserve capacity of the liver. Cirrhosis is the most important of these pathologies and especially in the Far East is a major consideration in over 75% of the

patients presenting with HCC. In these cases, the poor hepatic reserve mandates that, in order to avoid an unacceptably high mortality, only limited or even local resections be undertaken [3]. These limited resections can occasionally give excellent results. This is particularly true in patients with dependent or pedunculated heaptic tumours which due to their anatomical configuration allow limited resection combined with total tumour removal and minimal loss of functional reserve. In our study we classified our tumours as pedunculated if they showed a real pedicle with pedicle vessels and as dependent if over 50% of their surface growth extrahepatically. In patients with HCC these lesions are reported to be extremely rare with an occurrence rate of 0.3–2.4% in Japan [4], being even more rare in the United States and Europe. However, their ability to grow to a considerable size whilst attached to the liver by a relatively narrow pedicle makes them most favourable for resection [4, 5]. As a consequence, it has become increasingly important to recognize these tumours as a separate group to avoid a nihilistic approach to their treatment in the presence of underlying liver disease such as liver cirrhosis. While the gross anatomical feature may be assessed with little effort, the exact nature of these lesions can be surprisingly difficult to determine preoperatively. To identify hepatic lesions that are relatively easy to resect even in the presence of diffuse parenchymal liver disease, we prospectively evaluated all hepatic resections performed in our unit from October 1986 to April 1995.

Patients and Methods

From October 1986 to April 1995, 214 patients were referred with hepatic tumours considered suitable for resection. Twenty of these tumours proved to be dependent (15 cases) or pedunculated (5 cases). Our preoperative classification based on imaging investigations and our preoperative assessment of resectability has been published earlier [6]. All patients were fully assessed clinically and biochemically. The morphological classification was determined by ultrasound (fig. 1a), computed tomography (fig. 1b), or magnetic resonance imaging, with additional selective angiography (fig. 1c). Clinical features, histomorphological findings, choice of operative proce-

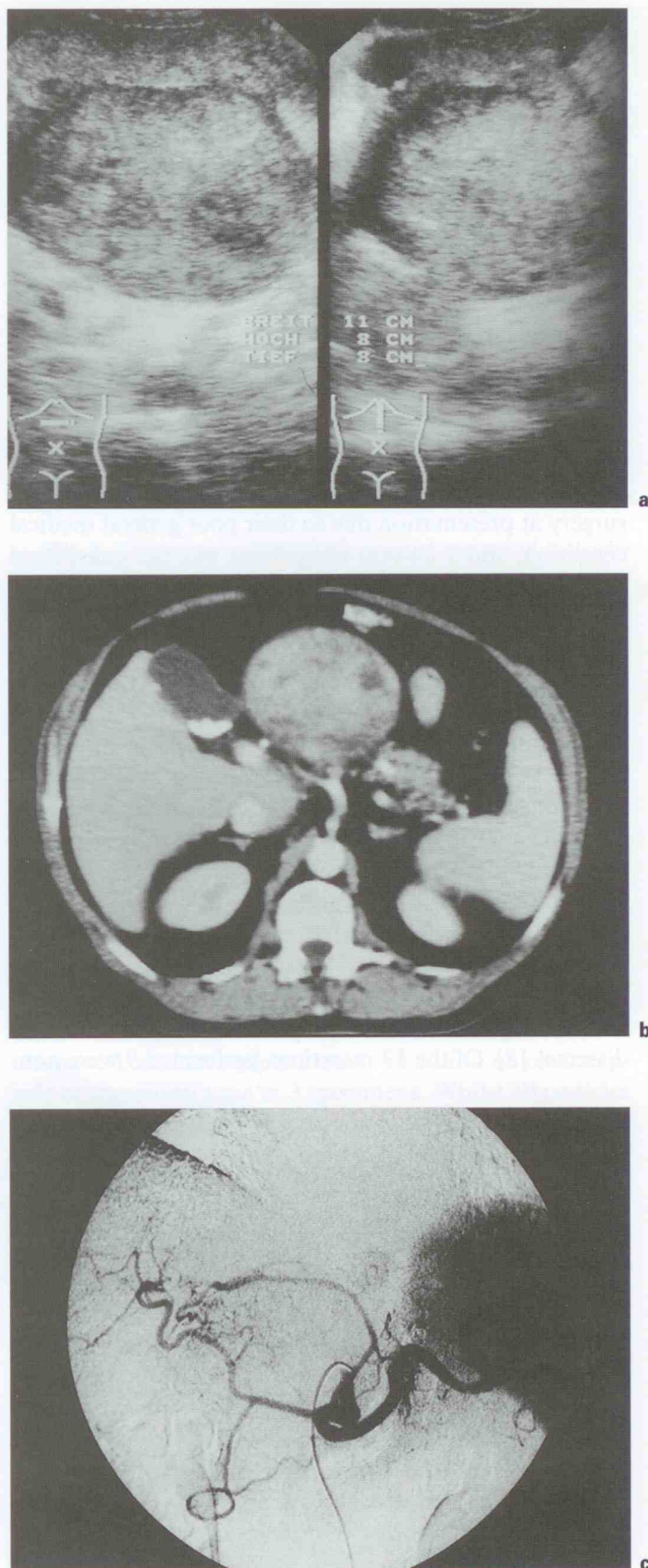**Fig. 1. a** Ultrasonogram of a 70-year-old patient with a hepatocellular cancer and liver cirrhosis, showing a dependent lesion on the free edge of segment 3. **b** CT scan of the same patient, showing a spherical lesion with no apparent connection to the liver in a caudal CT cut. **c** Typical angiographic findings in a pedunculated hepatocellular carcinoma (same patient).

dures, and outcome were evaluated. This subgroup of tumours represents hepatic tumours arising in the subcapsular area of the liver, in most cases growing extrahepatically with (pedunculated) or without (dependent) a pedicle with often minimal invasion into the adjacent liver parenchyma and occasionally separated by a fibrous pseudocapsule.

Results

Clinical Features

Demographic data are detailed in table 1. There were 20 patients with dependent or pedunculated hepatic tumours out of 214 (12 males, 8 females, ratio 1.5:1). The mean age was 59 (range 19–72) years. Fourteen patients (70%) complained of abdominal pain and 4 (20%) of abdominal distension. Three patients were unsuitable for surgery at presentation due to their poor general medical condition, and 1 84-year-old patient was not considered for resection due to age. One patient did not return after assessment for surgery. Laparotomy findings were available from 15 patients and resection specimens from 13 (table 2). The average tumour size was 9.9 cm in maximum diameter with a range of 2.5–23 cm. The tumour arose from the right hepatic lobe in 10 and from the left lobe in 3 cases. Of the 20 tumours classified as dependent or pedunculated, there were 14 HCC, 3 solitary colorectal metastases (CM), and 3 focal nodular hyperplasias (FNH). Underlying cirrhosis was present in 3 patients (23%) considered for resection.

Surgical Treatment and Outcome

Liver resections were performed with the use of the ultrasound parenchymal dissector CUSA [7] or a water jet dissector [8]. Of the 13 resections performed 9 were non-anatomical, 1 was a left lobectomy, 1 an extended right hepatectomy, and 2 right lobectomies, the latter both for CM (see also table 2). Whilst these resections removed a considerable amount of tissue due to the large nature of the tumour (average tumour size 9.9 cm in diameter), the resection of functional liver tissue was minimal. Resection margins assessed intraoperatively were <10 mm in 3 cases because of the anatomical configuration of these tumours and >10 mm in 10. In the resected specimens subsequent histological examination demonstrated 8 cases of HCC, 3 cases of FNH, and 2 cases of CM.

The median intraoperative blood loss was 1,025 (range 200–2,500) ml. There was no operative or 30-day mortali-

Table 1. Demographic data with operative findings

Patient No.	Sex	Age years	Histological type	Tumor size, cm	Liver cirrhosis
1	male	68	HCC	–	no
2	female	57	HCC	5×5	no
3	male	72	HCC	10×10	yes
4	female	67	HCC	11×6	no
5	female	71	HCC	16×10	no
6	female	45	HCC	23×18	no
7	female	19	HCC	10×10	yes
8	male	61	HCC	20×20	no
9	male	50	HCC	5×5	yes
10	female	54	HCC	6.5×5.5	no
11	male	32	FNH	10×7	no
12	female	46	FNH	2.5×1.5	no
13	female	44	FNH (two-site)	13.5×12	no
14	male	53	CM	8×5	no
15	male	64	CM	5×5	no

Table 2. Operative findings with procedure and outcome in the HCC group

Patient No.	Tumour base (S = liver segment)	Pseudo-capsule	Liver metastases	Resection	Blood loss, ml	Survival months
1	S 5/6	–	yes	–	–	4 (died)
2	S 5/6	yes	no	atypical	250	73
3	S 2/3	yes	no	left	1,000	60
4	S 4/5	no	no	segment	200	5 (died)
5	S 4/5/6	yes	no	segment	500	11 (died)
6	S 6	partial	no	right ext.	2,500	43 (died)
7	S 5	yes	no	atypical	2,000	7 (died)
8	S 6	–	yes	lig. art. hep. dex.	–	3 (died)
9	S 3	no	no	segment	1,500	2 (died)
10	S 4	no	no	atypical	250	1

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ty. The postoperative morbidity was low (15%), with 1 patient having a pulmonary embolus and 1 patient having pre-existent cirrhosis (Child A), developing encephalopathy, and ascites. Both patients recovered completely following medical management. Resection was not performed in 1 patient found to have previously undetected bilateral extension of HCC. In this patient simple unilateral ligation of the hepatic artery on the side of the main lesion (right lobe) was performed to influence tumour progression. In a 2nd patient widespread infiltration into the right colon and the patient's general poor condition precluded any further resectional procedure. Both patients died 4 and 3 months, respectively, after surgery. In 3 of the cases resected tumours originated from the base of the right liver with dense adhesions to the adjacent colon. In 2 of these patients an 'en bloc' resection of the right colon was required to achieve a satisfactory clearance. Ideal treatment of the 3rd patient, a 72-year-old woman, would have meant a similar procedure, but in view of her general poor state and concomitant liver cirrhosis this was not possible, and a simple hepatic resection was performed. In 3 patients preoperative assessment had suggested contralateral lesions diagnosed as tumour deposits. Laparotomy was performed in these patients due to clinical uncertainty about the nature of these lesions which at operation proved to be a small haemangioma, a small benign cyst, and one multifocal nodular hyperplasia.

Patient Survival

Patient survival in comparison with the operative data and histomorphological findings is detailed in table 2. The patient who was unresectable due to contralateral tumour was lost to follow-up. Of the 4 patients with HCC from the original 20 considered unfit for surgery, 1 patient remained alive with untreated HCC for 27 months, and 3 died after 1, 2, and 8 months, respectively, representing an average survival rate of 9.5 months. In the operated HCC group, 2 patients are still alive without tumour recurrence 73 and 60 months, respectively, after surgical treatment. Interestingly these 2 patients revealed a broad and complete fibrous pseudocapsule in the transition zone (pedicle) without an interdigitating zone between the tumour and the hepatic tissue (table 2). One patient was operated 1 month ago with uneventful outcome until now. The other 7 treated HCC patients showed a survival between 2 and 43 months with an average of 10.7 months. The 2 patients with operated CM showed an average survival of 24.5 months (11 and 38 months, respectively). The 3 patients with FNH rest all alive.
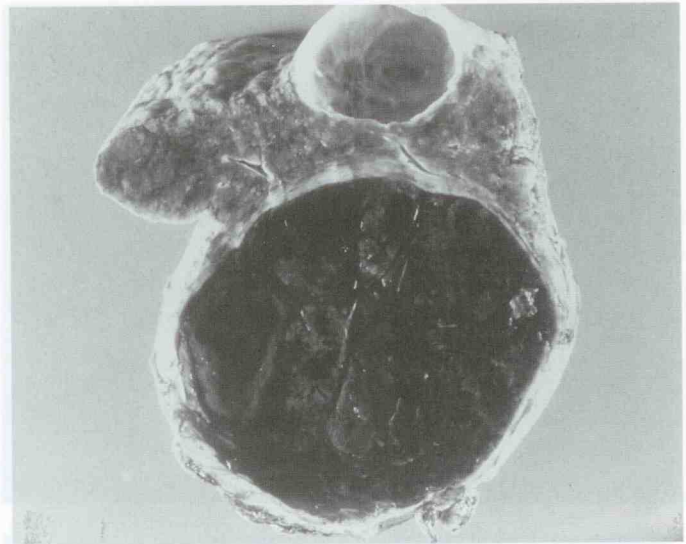

Fig. 2. Transverse section of the resected tumour of the same patient as shown in figure 1. Small pedicle of connecting tissue between the tumour and the resection margin and typical histological features of a moderately differentiated hepatocellular carcinoma.

Histomorphological Findings

All 8 HCC resected were type 1, as described by Miyoshi et al. [9], and varied in size from 5 × 5 to 23 × 18 cm. A distinction between pedunculated HCC type 1 and type 2 according to Nakashima and Kojiro [10] was not possible. A detailed examination of the transition zone [Zimmermann, press] revealed a broad and complete fibrous pseudocapsule (fig. 2) in 4 specimens (which contained numerous ductal proliferations and portal tract remnants), an incomplete capsule in 1, and no clear capsule or transition zone in 3 specimens. Whilst all pedicles contained prominent vessels where a pseudocapsule was present, these tended to run parallel to the periphery of the tumour, and where there was no pseudocapsule, they were orientated perpendicular to the tumour. In 1 patient with a marked pseudocapsule the vast majority of these vessels were small and resulted in a 'vascular sponge'. In the 3 patients with no pseudocapsule, atrophic and necrotic scattered nodules of liver tissue were evident interdigitating with foci of viable tumour. Three patients had FNH with otherwise unremarkable histological findings. One of these patients showed a two-site FNH with a dependent tumour in segment 3 and a intrahepatic tumour in segment 7 (fig. 3). Two patients had CM, the histology of which was consistent with that of the primary tumour.

Fig. 3. CT scan (**a**) and intraoperative situs (**b**) of a large dependent liver lesion of segment 3 with a separate lesion on segment 7. On the basis of the histological features of both lesions, it was found to be FNH.

Table 3. Comparison of the series of Horie et al. [4] and Moritz et al. [5] with our series: site of origin of the dependent/pedunculated liver lesions (operated patients only)

Site of origin of the tumour	Moritz et al. [5]	Horie et al. [4]	Present series
Right	21	11	10
Left	7	4	3
Caudate	1	0	0
Quadrate	1	0	0
Attachment	5 (colon 3, pancreas 1, spleen 1)	0	3 (colon)

Discussion

Eggel [11] was the first to propose a gross classification of HCC, describing the now familiar nodular, massive, and diffuse forms. This classification was modified by Edmondson and Steiner [12], and in 1984 Okuda et al. [13] demonstrated that the most common patterns of tumour growth produced expanding, spreading, and multifocal lesions. Subsequently in 1987, Kojiro and Nakashima [14] presented a similar but slightly expanded classification where infiltrative, expansive, mixed, and diffuse types were described, but pedunculated tumours and prominent tumour thrombi of the portal vein were also recognized. Nevertheless, the first description of a pedunculated HCC in the literature is attributed to Roux [15] who described the first case in 1897. Goldberg and Wallenstein [16] reported on a pedunculated HCC in 1934 that arose from the lower surface of the left hepatic lobe with a pedicle of about 1.5 cm in diameter. These single cases were regarded as an exception during the following decades, until in the 1980s a number of cases have been reported from Japan [4, 17]. In a review on hepatic tumours in Japan, Okuda [18] in 1980 found the incidence of pedunculated HCC to be 0.3% out of 4,031 cases treated between 1968 and 1977. Although in 1983 Horie et al. [4] described 3 new cases and reported just 15 more from the literature in 1988, Moritz et al. [5] described 2 further cases and were able to discover 34 well-documented reports dating to 1986. Nakashima and Kojiro [10] further divided pedunculated HCC into two subgroups, depending on their origin: type 1 of intrahepatic and type 2 of extrahepatic origin. Another attempt to classify pedunculated HCC was made by Nishizaki et al. [19] in 1993, subdividing 10 pedunculated HCC out of 350 treated patients into three groups with no intrahepatic, single intrahepatic, and multiple intrahepatic HCC, proving different surgical treatment and outcome between these three groups.

In an attempt to formulate a clinically useful classification that would aid surgical assessment, we have previously classified large focal liver lesions as (1) dependent (tumours grow with a base adjacent to the free liver edge and are hanging in their entirety); (2) expanding (tumours grow expansively and compress the surrounding normal liver tissue), or (3) infiltrating (tumours grow without anatomical limits and no clear margin or rim of compressed pseudocapsule) [6]. Based on our experience with 214 liver resections since 1986, this preoperative description proved to be remarkably reliable in predicting the likelihood of resectability in focal liver lesions. Whilst in
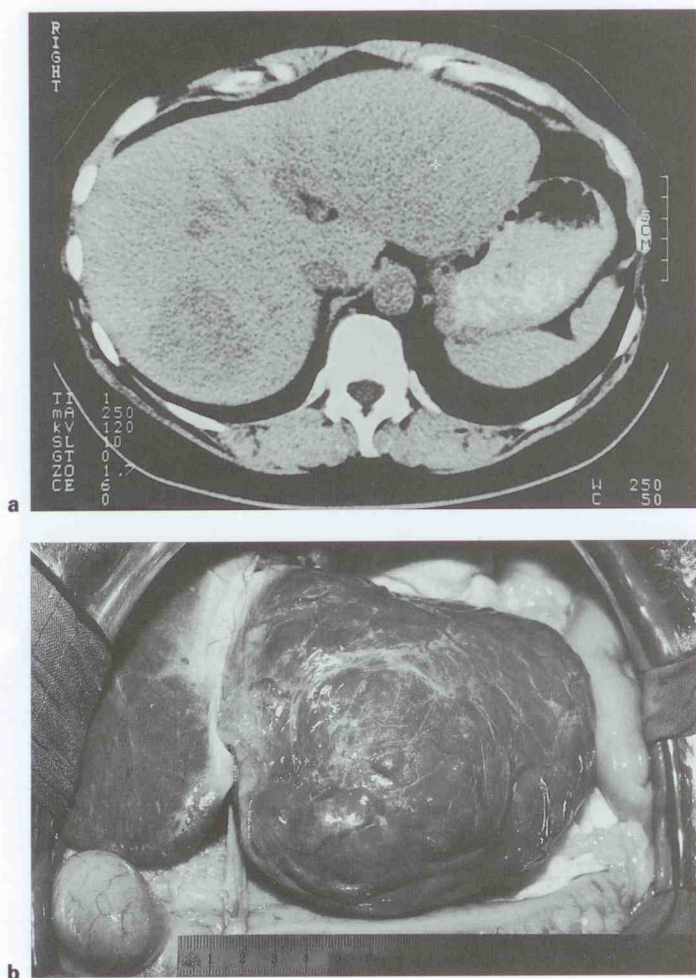
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pathological terms it is strictly only acceptable to call tumours with a narrow base and stalk (of variable length) attached to a large extrahepatic component pedunculated, we believe that surgically this term can be usefully expanded in order to classify them together with dependent tumours. In our opinion, this description should be applied clinically to all liver tumours that have more than 50% of their mass extrahepatically, as these tumours can all be managed in an identical fashion. This similarity in management is possible – even with lesions with broader bases – because they can be resected with a minimal reduction in functional capacity of the liver, an important consideration in the light of the high incidence of concomitant cirrhosis with marginal liver function.

Although very large tumours can sometimes be felt on palpation, their dependent nature frequently becomes apparent only after a thorough preoperative assessment. Preoperative ultrasound (fig. 1a) and computed tomography (fig. 1b) will show a hemispherical lesion which extends beyond the main body of the liver and which in more caudal cuts may appear as an unattached lesion. Selective angiography will show a characteristic displacement downward both hepatic artery and splenic/portal vein, if the tumour is in the left lobe (fig. 1c). Magnetic resonance imaging is a relatively new technique that can be applied to focal liver lesions with the possibility to differentiate HCC from other benign hepatic tumours, particularly from FNH and liver cell adenoma [20]. If any doubt exists and the patient's general condition will permit a resection, a laparotomy is always indicated with solitary lesions. We do not perform laparoscopy, as we believe that, whilst this may reveal whether the tumour is dependent, a full assessment of resectability can only be obtained at laparotomy. Today, there is a wide range of surgical approaches to liver tumours, including formal hepatic resections, segmental or subsegmental resections, and atypical resections with or without the use of intraoperative ultrasound and parenchymal dissectors such as the CUSA [7] or water jet dissector [8].

The resectability rate in our series of dependent tumours is high. 13 of 15 (87%) operable cases were resected 'en bloc' with the right colon in 2 cases. These findings are in accord with those of Horie et al. [4] and Moritz et al. [5] (see table 3). Moritz et al. [5] successfully resected 16 of 18 patients operated upon (out of 34 originally assessed), with 'en bloc' resection of colon in 2 and of colon, spleen, and panceas in 1 case. Dependent lesions more commonly originate from the right lobe of the liver (10/3 in our series) which explains the propensity for malignant or inflammatory involvement of adjacent colon. This is par-ticularly the case for broader based tumours which originate from the inferior margin of segments 4–6 which runs parallel to the transverse colon. If the patient's condition permits, these lesions can all be successfully resected with involved structures without compromising the success of the resection. The three left-sided tumours in our series did not involve any adjacent structure unlike 1 patient in the series of Moritz et al. [5]. The ability to resect these often very large lesions even in the face of significant cirrhosis is due to several factors. They rarely infiltrate across the base into adjacent normal liver and may occasionally have a capsule or pseudocapsule permitting potentially curative resections as shown in our series with a tumour-free survival of 73 and 60 months, respectively, in 2 patients with a clear pseudocapsule in the transition zone of the tumour. The determining factors which may play an important role in the formation of such a tumour pseudocapsule are still unknown. Scientific work should be focused on this field to understand and perhaps influence this mechanisms which could offer a new therapeutic approach. As to clearance margins of resected tumour specimens [21], there is still controversy in the literature. Indeed in a report from Lai et al. [22] on 96 patients in whom tumours were greater than 5 cm in diameter, a clearance of >5 mm ensured histologically free margins. Although this point remains controversial, Yoshida et al. [23] previously suggested from their 40 patients that even in tumours >4 cm, margins of <10 mm did not have an effect on long-term survival; the series of Matsumata et al. [24] where 33 patients had intrahepatic tumour recurrence after resection, and in only 7 (21%) was this at the resection margin, suggests a possible explanation. Indeed, in the remaining 26 patients the recurrence was multifocal or well remote from the site of the original tumour, and this pattern would explain poor survival despite adequate clearance. However, Sakon et al. [25] demonstrated that in patients with cancer-free margin >10 mm of type 1 tumours (single nodular type) survival was significantly better than in those with less free margin. Thus whilst there is no clear consensus on this point, we feel that it is reasonable to resect single liver tumours provided that 10 mm of clearance can be achieved, which is almost always the case in dependent lesions, even in patients with significant cirrhosis.

We are not aware of tumours other than HCC previously described as dependent or pedunculated, although Ellis et al. [26] described a massive hemangioma which was principally retroperitoneal and relatively easy to resect. The recognition of this morphology with three solitary colorectal metastases and three cases of FNH (one

multifocal) is an important finding which must be remembered when assessing the resectability of large tumours in non-cirrhotic patients. The preoperative identification of this uncommon group of tumours is important and when assessing resectability implies a favourable anatomical configuration. Furthermore, in cirrhotic patients its recognition may have crucial functional significance. A diligent assessment of all large tumours, not just HCC, is necessary to ensure that these unusual patients are not deprived of a potentially curative resection.

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