Cancer of the kidney invading the vena cava and heart

Results after 11 years of treatment

Between October, 1973, and October, 1983, 18 patients with cancer of the kidney or adrenal gland that had invaded the vena cava, and in 11 cases had reached the heart, were operated on by seven surgical teams. The surgical excision in all patients was performed with extracorporeal circulation, circulatory arrest and deep hypothermia. No deaths occurred. If there are no detectable metastases before operation, the 5 year survival rate is 75% as compared to 6 months with medical treatment. This clinical situation is not uncommon, as 3% to 10% of cancers of the kidney invade the inferior vena cava and 40% of them reach the heart. The possibility of curing the cancers with minimal operative risk should prompt a systematic search for venous invasion with any cancer of the kidney.

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The immediate prognosis for cancer of the kidney invading the inferior vena cava is grave. However, the life expectancy of patients with these neoplasms has been improved during the past 10 years by operative techniques that allow excision of the carcinoma. The carcinoma can be excised because in most cases the tumor has spread within the lumen and has not actually invaded the walls of the veins or the heart. Moreover, ultrasonography and scanning have become reliable means of noninvasive investigation. When used systematically they enable a precise evaluation of tumor extension to be made preoperatively. Since 1973 we have been using extracorporeal circulation, deep hypothermia, and circulatory arrest to treat these tumors. This technique was once considered to be a heroic measure but now is safe and is being used more frequently. To confirm this claim, we now present a multicenter study in which nine of the first author's cases have been considered along with nine more operated upon by six different surgical teams. These 18 cases represent the entire sequential experience of these authors.

Patients

Between October, 1973, and October, 1983, 18 patients were operated on for a neoplastic thrombosis of the inferior vena cava by seven surgical teams that included urologists and cardiac surgeons (Table I). The neoplastic thrombosis was of renal origin in all except one patient, who had an adrenal tumor. Eleven of these neoplasms extended into the cavities of the heart. The sample comprised 15 adults (four women and 11 men), aged between 18 and 61 years (mean 50 years), and three children, aged 5, 3, and 2 years. The clinical signs of renal tumors most often observed were hematuria in seven patients and a mass in the right side in six. Deterioration in general health (three patients) and arterial hypertension (two patients) were more rarely encountered. Ten patients had signs of inferior vena caval involvement. Dyspnea, ascites, hepatomegaly, and involvement of the collateral venous circulation were present in four patients. Two of these patients had
Table I. Patients

<table>
<thead>
<tr>
<th>Clinical signs of renal tumor</th>
<th>No. of patients</th>
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<tbody>
<tr>
<td>Hematuria</td>
<td>7</td>
</tr>
<tr>
<td>Mass on right side</td>
<td>6</td>
</tr>
<tr>
<td>Deterioration of general condition</td>
<td>3</td>
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<tr>
<td>Arterial hypertension</td>
<td>2</td>
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<tr>
<td>Clinical signs of extension to vena cava</td>
<td></td>
</tr>
<tr>
<td>Dyspnea, ascites, hepatomegaly, and involvement of collateral circulation</td>
<td>4</td>
</tr>
<tr>
<td>Hepatomegaly</td>
<td>2</td>
</tr>
<tr>
<td>Phlegmasia cerulea dolens</td>
<td>1</td>
</tr>
<tr>
<td>Right ventricular failure</td>
<td>2</td>
</tr>
<tr>
<td>Means of diagnosing venous extension</td>
<td></td>
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<tr>
<td>Before 1980</td>
<td></td>
</tr>
<tr>
<td>Cavography</td>
<td>6</td>
</tr>
<tr>
<td>Arteriography</td>
<td>3</td>
</tr>
<tr>
<td>After 1980</td>
<td></td>
</tr>
<tr>
<td>Cavography</td>
<td>3</td>
</tr>
<tr>
<td>Scan</td>
<td>2</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>3</td>
</tr>
<tr>
<td>Ultrasound and scan</td>
<td>1</td>
</tr>
</tbody>
</table>

hepatomegaly, one had phlegmasia cerulea dolens (blue phlebitis), and one had right ventricular failure. Intravenous urography was diagnostic in every instance. Selective arteriography of the renal artery merely confirmed this diagnosis (Fig. 1).

In one case an apparently primary cardiac tumor was retrospectively assigned to its renal origin after anatomic and pathologic analysis of the removed cardiac tumor. Venous or cardiac extension was defined in different ways before and after 1980. Before 1980 cavography was used in six patients (Figs. 2 and 3) and the venous phase of renal arteriography in three. After 1980 cavography was used in three patients (Figs. 4 and 5). In the last patient we used both the scanner (Fig. 6) and ultrasound. Metastasis had been suspected in four patients before the operation (pulmonary in three and hepatic in one). In every instance, it was possible before the operation to state the diagnosis and the extent of tumor invasion or of adherence to the vena caval walls. In 11 patients the thrombus had invaded the supradiaphragmatic part of the inferior vena cava and extended as far as the right atrium. In one of these patients the thrombus (Fig. 7) extended into the right ventricle, and in the others it was subdiaphragmatic. All operations to excise the neoplastic thrombus of the inferior vena cava were performed with extracorporeal circulation, circulatory arrest, and deep hypothermia (Figs. 8 and 9). In 16 patients extended total nephrectomy was also performed during the same procedure. These operations were performed by median sternotomy and laparotomy according to a technique described in our previous work. In one patient adrenalectomy was done in a second stage after the retrospective diagnosis of corticoadrenal tumor had been made. In another patient the regional extension of the tumor made nephrectomy impossible. All the tumors occurring in adults were adenocarcinomas; those in the children were all nephroblastomas. The children were also treated by irradiation, surgical therapy, and supplementary chemotherapy.

Results

Up to 30 days after the operation no operative deaths had been reported. Two patients had postoperative bleeding and were successfully treated by medical means alone.

We assessed the postoperative results by dividing the patients into two groups, depending on whether metastases, detectable before the operation, were present (Group I) or absent (Group II). The prognosis of any carcinoma depends on its stage, that is, the extent to which the tumor has spread. Extension of a renal carcinoma into a vein is not considered to be a metastasis if it does not invade the vascular walls and if it has...

Fig. 1. Selective arteriogram of renal artery shows voluminous hypervascularized tumor of left kidney.
been excised. Of the 14 patients in Group II, 10 are still living 10 years, 5 years, 5 years, 4 years, 4 years, 3½ years, 2 years, 8 months, and 1 month after the operation, without any signs of progressive disease. Two died of pulmonary metastasis after 6 years and 1 year. One is alive but is receiving chemotherapy because of a pulmonary metastasis. The last patient, a 3-year-old child, died of an abdominal recurrence of the tumor after a symptom-free interval. Of the patients in the Group I, three had pulmonary metastasis. They survived for 5, 7, and 8 months. One of them had the inoperable carcinoma described in the previous section. The last patient, who had a metastasis of the liver, survived for 6 months. He had a tumor of the adrenal cortex.

Discussion

Carcinomas of the kidney frequently extend into the inferior vena cava. When this occurs, it is a diagnostic problem. The annual incidence of renal carcinoma in the United States is 15,000 cases, and 7,000 deaths are attributed to this disease each year. From 3% to 10% of these carcinomas extend into the lumen of the vena cava; 40% of these reach the right atrium. These figures have long been underestimated because neoplastic thrombosis of the vena cava could be discovered only symptomatically or at autopsy. Two thirds of these tumors are not apparent clinically, however, because of the presence of a collateral circulation or of incomplete obliteration, and autopsies certainly are not done systematically.

The renal tumor syndrome can always be diagnosed by intravenous urography, and often neoplastic thrombosis of the vena cava can likewise be thus diagnosed. The most reliable pictures are given by cavography. However, it is difficult to suggest that every patient with a renal tumor should be systematically subjected to an invasive and costly examination. Noninvasive exploratory tests should be done before opacification of the inferior vena cava. Ultrasonography and scanners are now in general use, and their reliability is comparable. They can help to prevent more aggressive measures whose aim is simply diagnostic. Opacification of the inferior vena cava should thus be reserved to
refine the preoperative assessment in the event that spread to the vena cava is discovered by the scanner or by ultrasound. Its purpose will be to determine whether or not the tumor can be excised, that is, the extent to which it is adherent to or has invaded the venous wall.9

This approach is all the more important because the heroic measures employed a few years ago have now given place to safer and more effective treatments. Without treatment, a patient with a renal carcinoma and neoplastic thrombosis of the vena cava has a very short life expectancy.1,8 The only effective treatment is resection of the neoplastic tissue and removal of the carcinoma. Berg13 (1913) was the first to perform thrombectomy of the vena cava via the abdominal route, and Rehn11 (1922) continued a nephrectomy to include an invaded inferior vena cava. Marshall and associates6 used extracorporeal circulation for the first time in 1970. Since then, numerous isolated cases have been published,14,15 up to the series of six patients described by Clayman, Gonzalez, and Fralez.9

Those of us from Hôpital Rangueil, in Toulouse, have favored extracorporeal circulation, circulatory arrest, and deep hypothermia since 1973.2,3 This surgical approach simplifies all the operative stages and avoids applying a clamp to the vena cava, which involves the
risk of fragmenting the tumor. We perform sternotomy together with median laparotomy, because this naturally prolongs the incision without altering the patient’s position. It gives complete exposure, facilitates assessment of the lesions, and allows resection of the vena cava en bloc in the event of tumoral adhesions; it also avoids the collateral circulation. The right thoracoabdominal incision with the patient lying on the left side increases the risk of tricuspid occlusion by the tumor in the vena cava, as was demonstrated by Paul, Rhodes, and Skow. After analyzing our results, we decided to see whether this technique could be reproduced by other centres, to which it could be suggested as the technique of choice of these tumors. Extracorporeal circulation with circulatory arrest and deep hypothermia was therefore selected as the technique of choice by six
different surgical teams. This new experiment has confirmed the previous results of the Toulouse group: No operative deaths occurred, so that this technique may be regarded as safe and reliable. In addition, survival is considerably prolonged, so long as no metastases are detectable preoperatively. These findings have been reported in the literature. In the 60 cases studied the 5 year survival rate is 75% in the absence of preoperative metastasis,7,9,16,18,19 The operative mortality is 10%. The progress in surgical techniques for protecting the myocardium and for medical resuscitation has enabled us to reduce these figures. We think that extracorporeal circulation, deep hypothermia, and circulatory arrest should be used routinely. The first attempts to remove neoplastic thromboses of the vena cava, reported by Marshall and associates,6 who did not use extracorporeal circulation, were failures. The techniques consisted of clamping the vena cava7 or using a Foley probe,14 with the risk of fragmentation and migration of the tumor. The long-term prognosis certainly depends not only on the operative technique used but also on strictly tumoral factors, such as the histologic grade and the invasion of the perinephretic fat and perirenal lymph nodes.8 Regardless of the technique used, the type and extent of the lesion must be determined before operation can be recommended. The presence of detectable metastases contraindicates surgical treatment.

We conclude that extirpation of carcinomas of the kidney extending into the vena cava is the only chance of survival for these patients. The technique proposed herein has been tested for the past 10 years by many surgical teams. The 75% 5 year survival rate in the absence of detectable metastases and the minimal operative risk should encourage others to systematically investigate any carcinoma of the kidney with a view to adopting this reliable surgical solution.

REFERENCES