Total Hepatic Vascular Occlusion For Difficult Right Adrenalectomy
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Abstract
A new approach to resect a functioning malignant pheochromocytoma originating from the right adrenal gland and large enough to encircle the retrohepatic inferior vena cava is reported. The adrenal vein in this situation is difficult to expose and ligate in the initial phase of the dissection and in order to occlude venous outflow from the tumor and prevent a catecholamine surge while handling the tumor. The inferior vena cava (IVC) was controlled above and below the liver. This report describes the value of Total Hepatic Vascular Exclusion (THVE) in this situation. The IVC is controlled by encircling it above the liver and also just above the junction of the renal vein where the approach is unrestricted by the adrenal tumor. Pringle's maneuver of occluding the hepatic vascular inflow is also used to prevent acute hepatic venous congestion. Following this maneuver in our patient, the adrenal tumor was separated from the retrohepatic IVC with minimal bleeding and no recurrence of precipitous rise in blood pressure that resulted from handling the tumor prior to control of the IVC.

INTRODUCTION
Intra-operative manipulation of a functioning malignant pheochromocytoma leads to a tremendous rise of blood pressure due to catecholamine release into the blood stream (12). Pre-operative use of phenoxybenzamine and β-blockers can prevent this catecholamine surge into the blood stream (2). Despite such preparation, the use of nitroprusside, nitroglycerin and/or labetalol is often required during intra-operative manipulation before the adrenal vein is divided (13). Our patient was normotensive and was consequently not put on α or β blockers pre-operatively. Precipitous rise in BP however occurred intra-operatively on handling the neoplasm while trying to separate it from the IVC and ligate the adrenal vein (4). We resorted to THVE to circumvent this problem and prevent further crises.

CASE REPORT
A 40-year-old female patient presented with generalized weakness and low-grade fever. She was a diabetic and on screening abdominal ultrasound was found to have a large asymptomatic suprarenal mass. Her blood pressure was 120/70 mm Hg and on observation in hospital showed no fluctuations. Abdominal examination revealed mild hepatomegaly.

Investigations revealed a hemoglobin of 9.6g% and a peripheral smear suggested iron deficiency anemia. Her fasting blood sugar varied from 230-310 mg%. Serum cortisol was elevated - 31.5 µg/dl in A.M. (normal 6-30 µg/dl) and 18.9 µ/dl in P.M. (normal 3-16 µg/dl). Urine microscopy revealed microscopic hematuria and urinary VMA was 27.8 mg over 24 hours (Normal 1.8-7.1 mg/24 hours) - elevated nearly 4 times above the upper limit of normal. CT scan of the abdomen confirmed the right adrenal neoplasm, further showing the tumor to be encircling and possibly adherent to the retrohepatic inferior vena cava.

Figure 1
Figure 1: CT scan of the patient showing a large tumor originating from the right suprarenal gland encroaching the retrohepatic inferior vena cava.
liver was mobilized and the 10 cm X 8cm size adrenal tumor was exposed. Attempted manipulation of the tumor resulted in a precipitous rise in blood pressure (to over 300 mm Hg, systolic) which was controlled with intra-venous infusion of sodium nitroprusside and nitroglycerin.

Due to the large size of the tumor, the severe hypertension on handling and the possibility of retrohepatic caval extension, occlusion of the IVC above and below the liver was necessary to remove the tumor. As the suprahepatic cava was being clamped, hepatic vascular inflow also had to be controlled to prevent acute hepatic venous congestion. This was done by encircling and clamping the infrahepatic IVC above the renal veins. The suprahepatic cava was approached from the left by dividing the left triangular ligament and going around the cava from left to right just above the caudate lobe. The IVC ligament had to be incised on the right side of the cava and Pringle’s maneuver was applied to complete Total Hepatic Vascular Exclusion.

The right adrenal tumor was then excised without any further rise in BP and with blood loss of only 200 ml. Total Hepatic Vascular Exclusion time was 20 minutes and the infrahepatic IVC was clamped for 27 minutes. The neoplasm was infiltrating the upper pole of the right kidney which was also removed en bloc.

There was no invasion of the IVC, liver and diaphragm. The patient was extubated at the end of the procedure and her blood pressure monitored by arterial line remained normal post-operatively without any anti-hypertensive medication. Post operative liver function tests showed increased serum bilirubin to 3.3 mg% (conjugated - 1.7 mg%) and elevated liver enzymes (SGOT-284 IU/l and SGPT-79 IU/l). These returned to normal by the 7th post-operative day and she was discharged on the 12th post-operative day. Histopathological study of the tumor showed features consistent with a pheochromocytoma.

She had no distant metastasis when surveyed with chest roentgenography and CT scan and is presently clinically well one year after surgery.

**DISCUSSION**

Malignant pheochromocytoma is an uncommon tumor, which accounts for about 3-14% of all pheochromocytomas (3). Malignant change is difficult to predict from histological appearances, biochemistry or electron microscopy and is based on demonstration of tumor cells in sites where chromaffin tissue is not normally found as well as certain per-operative criteria such as size greater than 5 cms, capsular invasion, and invasion of adjacent structures and surrounding blood vessels (5). Management is based primarily on surgical resection and relief of symptoms by catecholamine blockade (5).

During resection of a pheochromocytoma, there is often a tremendous rise of blood pressure due to catecholamine release into the blood stream. although this can be counteracted pharmacologically, it is best prevented preoperatively with phenoxybenzamine and a β-blocker like propranolol. Intra-operative rise of blood pressure can be controlled with sodium nitroprusside, nitroglycerin and/or labetalol.

Control of the adrenal vein early in the course of the operation is recognized as important in preventing precipitous rise in blood pressure during mobilization of the right adrenal gland (6). This could not be done in our patient as the tumor was growing around the retrohepatic cava and the right adrenal vein could not be identified.

Total Hepatic Vascular Exclusion is a well-documented procedure to facilitate resection of large hepatic tumors situated close to hepatic vein and retrohepatic cava (7). Total Hepatic Vascular Exclusion has also been described for renal cell carcinomas (4), adrenal cortical carcinomas (9) and Wilm’s tumors invading the IVC (10). The usefulness of this procedure has not been described previously in the resection of a large functioning malignant pheochromocytoma of the right adrenal in which caval invasion is possible and encirclement of the retrohepatic cava as in this case precludes an early and safe ligation of the adrenal vein.

In this report we describe a patient in whom THVE was used only for 20 minutes to resect a large right adrenal pheochromocytoma. The patient tolerated the procedure well, intra-operative rise in blood pressure was prevented and the hepatic enzymes showed only a transient rise in an otherwise uncomplicated post-operative course.

**CONCLUSION**

Mobilization of the right lobe of the liver allowing visualization of the retrohepatic cava and applying Total Hepatic Vascular Exclusion appears to be effective for resection of a functioning malignant pheochromocytoma. A surgical technique for this procedure is described.
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