Aneurysms in abdominal organ transplant recipients

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Objective: **The purpose of this study was to characterize the prevalence and natural history of aneurysms among abdominal transplant recipients.**

Methods: **This article is a retrospective review of adult patients who underwent a kidney or liver transplant at a single center between February 23, 2000, and October 6, 2011. Data were obtained by searching electronic medical records for documentation of arterial aneurysm. Abdominal aortic aneurysms (AAAs) were included if they were ≥3.0 cm in diameter, and thoracic aortic aneurysms were included if they had a diameter ≥3.75 cm. Additional data collected included recipient demographics, transplant-specific data, and characteristics of the aneurysms.**

Results: **There were 927 liver transplant recipients, 2133 kidney transplant recipients, 23 liver-kidney transplant recipients, and 133 kidney-pancreas transplant recipients included in our study; 127 of these patients were identified to have aneurysms (40 liver, 83 kidney, 3 liver-kidney, 1 kidney-pancreas). The overall prevalence of any aneurysm was similar for liver and kidney recipients, but the distribution of aneurysm types was different for the two groups. AAAs made up 29.6% of aneurysms in kidney transplant recipients and 11.4% of aneurysms in liver transplant recipients ($P = .02$). Visceral aneurysms were 10-fold as common in liver transplant recipients compared with kidney transplant recipients (47.7% of aneurysms vs 5.1% of aneurysms; $P < .01$). The majority of visceral artery aneurysms involved the hepatic and splenic artery. For both liver and kidney transplant recipients, most aneurysms occurred post-transplantation. All known aortic aneurysm ruptures occurred post-transplantation (25% of AAAs in liver transplant patients and 22.2% of thoracic aortic aneurysms in kidney transplant patients). There was a trend toward higher AAA expansion rates after transplantation (0.58 ± 0.48 cm/y compared with 0.41 ± 0.16 cm/y).**

Conclusions: **Compared with the general population, aneurysms may be more common and may have an aggressive natural history in abdominal transplant recipients. Furthermore, the types of aneurysms that affect liver and kidney transplant recipients differ. Care teams should be aware of these risks and surveillance programs should be tailored appropriately. (J Vasc Surg 2014;59:594-8.)**

Arterial aneurysms in the transplant population remain a significant source of morbidity and mortality. Recent studies have demonstrated increased rates of aneurysm growth and rupture in transplant patients, underscoring the importance of vigilant surveillance in this population.[1-4] As survival following transplantation continues to improve, appropriate diagnosis and management of this vascular condition is increasingly important.

The prevalence and natural history of arterial aneurysms in abdominal organ transplant recipients remains unclear. Previous studies have documented increased rates of growth and rupture of abdominal aortic aneurysms (AAAs) in heart transplant recipients.[2,3] Steroid dependent immunosuppressive regimens and modified hemodynamics following transplantation have both been postulated as causal factors.[1,4] Although abdominal transplant recipients outnumber thoracic recipients nearly six to one each year in the United States, much less is known about arterial aneurysms in this large population of patients.

With this study, we describe a single-center experience with aortic, peripheral, visceral, and cerebral arterial aneurysms in abdominal transplant recipients. The natural history of these aneurysms, including expansion and rupture rates, is characterized, and this information is reconciled to guide screening and treatment recommendations.

METHODS

This study employed a retrospective review of all adult patients undergoing liver or kidney transplantation at the University of Michigan Transplant Center between February 23, 2000, and October 6, 2011. This cohort represented our index population. Among these patients, we queried any mention of arterial aneurysm in clinical documentation or radiology reports with the Electronic Medical Record Search Engine (EMERSE).[5] Permission to carry out this study was granted by the University of Michigan Institutional Review Board.

Inclusion criteria included a standing diagnosis of arterial aneurysm, a history of previous arterial aneurysm repair, or radiographic documentation of arterial aneurysm. AAAs were defined radiographically by an aortic diameter ≥3.0 cm; thoracic aortic aneurysms (TAAs) were defined by an aortic diameter ≥3.75 cm. For alternative aneurysms (ie, peripheral, visceral, and cerebral) radiographic documentation of aneurysm alone was sufficient for inclusion, as size was not reliably available. Venous aneurysms,

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Table I. Patient characteristics stratified by transplant organ

Transplant organ	*Liver*	*Kidney*	*Liver/kidney*	*Kidney/pancreas*
Total transplant patients	927	2133	23	133
Aneurysm patients	40 (4.31)	83 (3.89)	3 (13.04)	1 (0.75)
Average age at first transplant	53.6 ± 10.1	55.0 ± 12.6	64.0 ± 1.9	54.0
Average age at first aneurysm	55.14 ± 10.1	54.9 ± 10.9	64.0 ± 2.5	43.0
Male sex	23 (58)	57 (69)	2 (67)	1 (100)
Race				
African American	2 (5)	5 (6)	0	0
Asian	1 (3)	3 (4)	0	0
Caucasian	36 (90)	74 (89)	3 (100)	1 (100)
Other	1 (3)	1 (1)	0	0

Demographic information is for all patients with arterial aneurysm. Subjects are grouped based on transplant organ. Categoric data are shown as number (%) and continuous data as mean ± standard deviation.

pseudoaneurysms, and peri-anastomotic vascular abnormalities were excluded.

For those transplant patients identified with arterial aneurysm, the electronic medical records were reviewed and the following data were collected: patient demographic information (age, sex, race); information relevant to the patient's transplant (transplant organ, date of transplant); and information relevant to the patient's aneurysm (location, date of incidence, expansion rate, and incidence of rupture). Aneurysms were classified as AAA, TAA, cerebral, visceral (renal, hepatic, splenic, celiac, superior mesenteric, gastric, and gastroduodenal), and peripheral (iliac, femoral, and popliteal). The primary variables analyzed included aneurysm prevalence, incidence of rupture, and rate of expansion. Expansion rate was calculated in cm/y if a patient had two sequential computed tomography scans taken at least 3 months apart. To account for variability in measurement, AAA and iliac aneurysm expansion was defined as growth of ≥3 mm between scans.

RESULTS

Our study population included 3216 abdominal organ transplant recipients, including liver (n = 927), kidney (n = 2133), combined liver-kidney (n = 23), and combined kidney-pancreas (n = 133). Of this cohort, 127 patients were identified as having at least one arterial aneurysm. Forty aneurysms were identified in liver recipients, 83 in kidney recipients, 3 in combined liver-kidney recipients, and 1 in a combined kidney-pancreas recipient. Patient demographics are summarized in Table I.

Aneurysm prevalence and distribution is summarized in Table II and illustrated in the Fig. Individuals that had multiple transplants were grouped based on their index organ transplant. The overall prevalence of any aneurysm was similar for liver and kidney recipients, but the distribution of aneurysm types varied across the two groups. AAA prevalence was significantly higher in kidney transplant recipients compared with liver transplant recipients (29.6% of aneurysms vs 11.4% of aneurysms; $P = .02$). Most notably, visceral aneurysms (primarily hepatic and splenic) were 10-fold as common in liver transplant recipients compared with kidney transplant recipients (47.7% of aneurysms vs 5.1% of aneurysms; $P < .01$). Additionally, alternative visceral aneurysms identified exclusively in the liver transplant recipients included aneurysms of the celiac artery (n = 3), superior mesenteric artery (n = 2), gastroduodenal artery (n = 2), and left gastric artery (n = 1).

In addition to aneurysm type, liver and kidney transplant recipients also differed in the timing of aneurysm incidence. In the liver recipients, 72.5% of aneurysms occurred post-transplantation, regardless of the aneurysm type. Of visceral aneurysms, 80% occurred post-transplantation in the liver recipients (78% of splenic artery aneurysms and 90% of hepatic artery aneurysms). TAAs and peripheral aneurysms were also more common post-transplantation in the liver recipients, as 80% of each of these aneurysms occurred post-transplantation. AAAs were slightly more common following liver transplantation (60% of AAAs). In the kidney recipients, the timing of aneurysm development was divided equally between pre- and post-transplantation when considering all aneurysms. AAAs were slightly less common post-transplantation (38.5% of AAAs), whereas TAAs and peripheral aneurysms were more common post-transplantation (82.4% of TAAs and 71.4% of peripheral aneurysms).

Aneurysm rupture and repair rates are summarized in Table III. Aortic rupture was only identified post-transplantation. AAA rupture occurred in one liver recipient following transplantation (25%). Size of this aneurysm prior to rupture was unavailable, and this patient died following repair. TAA dissection occurred in four kidney recipients following transplantation (22.2%), and one of these patients died. The average size of these aneurysms prior to dissection was 4.6 ± .65 cm. Cerebral aneurysm ruptures were slightly more common pretransplantation for both liver and kidney transplant recipients. Few visceral aneurysms ruptured, and no peripheral aneurysms ruptured. For the eight AAA patients with sufficient imaging to calculate expansion rates, there was suggestion of a trend toward greater AAA expansion following transplantation (0.58 ± 0.48 cm/y compared with 0.41 ± 0.16 cm/y), although not enough serial imaging data were available to achieve statistical significance.