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Hepatic Artery Pseudoaneurysm Following Orthotopic Liver Transplantation: Increasing Clinical Suspicion for a Rare but Lethal Pathology

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
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Background: Despite an incidence of between 1% and 2%, the mortality rate in ruptured hepatic artery pseudoaneurysm after orthotopic liver transplantation approaches 69%. Our aim is to report operative and outcomes data for 7 patients with pseudoaneurysm following transplant at 1 institution, with emphasis on suspected risk factors for aneurysm formation. From these risk factors, we performed a systematic review to assess their clinical saliency.

Material/Methods: Using PRISMA guidelines, we completed a PubMed and online database review to gather studies addressing risk factors for pseudoaneurysm following transplant. We cross-compared infection, Roux-en-Y hepaticojejunostomy, bile leak, and primary sclerosing cholangitis as independent risk factors in order to identify concomitance between each and pseudoaneurysm.

Results: The incidence of pseudoaneurysm was 0.94%. Of pseudoaneurysm patients, 77.8% had documented infection. Of these, 36.5% had Roux-en-Y hepaticojejunostomy and 33.3% had a documented bile leak. Infection was present in 70% of patients with Roux-en-Y hepaticojejunostomy, 84% of patients with bile leak, and 93% of patients with primary sclerosing cholangitis.

Conclusions: Roux-en-Y hepaticojejunostomy, bile leak, and primary sclerosing cholangitis are important risk factors for pseudoaneurysm in the setting of infection. Occurring together, these risk factors should heighten clinical suspicion for their formation in the postoperative period.

MeSH Keywords: **Hepatic Artery • Liver Transplantation • Postoperative Complications**

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Background

Orthotopic liver transplantation (OLT), the standard of care for patients with end-stage liver disease, is a procedure that has continued to evolve since it was first attempted in 1967 [1]. Despite vast improvements in technique, several complications still challenge surgeons and medical practitioners alike, including biliary and vascular complications, acute and chronic rejection, and disease recurrence [2–17]. Vascular complications, including hepatic artery thrombosis or stenosis, hepatic artery pseudoaneurysm, and portal vein thrombosis or stenosis, reportedly occur in 6% to 10% of cases and often require urgent surgical management or other interventions [18]. Of these, hepatic artery pseudoaneurysm (HAP), which is reported to occur in 1% to 2% of OLT patients, is associated with significant morbidity and mortality [11]. Mortality rates for ruptured HAP have been reported to be as high as 69% [11].

Prompt identification and intervention is warranted in patients who experience symptoms after OLT, with a high index of suspicion for HAP, particularly in the setting of germane risk factors. Recent data from Volpin et al. found an increased risk for HAP in patients with bilio-enteric anastomosis and biliary leak [16]. Other risk factors, including infection and technical failure, have been suggested throughout the literature, but no formal statistical analysis has been completed to fully evaluate their role in predisposing patients to HAP [3–5,7–12,15,18–25]. We present a series of 7 patients at our institution, who developed HAP following OLT. After scrutiny of our small data series, we chose to further examine whether the type of biliary anastomosis influences the rate of bile leakage and infection in patients with known HAP following OLT. To this end, we completed a literature review with inclusion of our data to assess what clinical features are, in fact, significant risk factors for HAP development.

Material and Methods

After obtaining approval from the Institutional Review Board, we performed a retrospective chart review of patients with HAP formation following OLT between 2003 and 2015 at Thomas Jefferson University Hospital (TJUH). Operative notes, discharge summaries, and appropriate laboratory data and radiology were collected to evaluate the cohort. All data were gathered from electronic and paper sources. Information was compiled on demographics, including age, sex, clinical indication for transplant, time to HAP diagnosis, and overall mortality rate. Technical aspects of the liver transplant procedure, such as the caval, vascular, and biliary anastomoses, were documented. We also documented postoperative findings, including infection (defined as positive blood cultures), bile leaks, and choledocho-arterial fistula. We also documented technical and clinical data related to OLT data collected immediately preceding the HAP development. Available radiology for each patient with HAP was reviewed, and representative images are included for illustration of varying presentations (Figure 1).

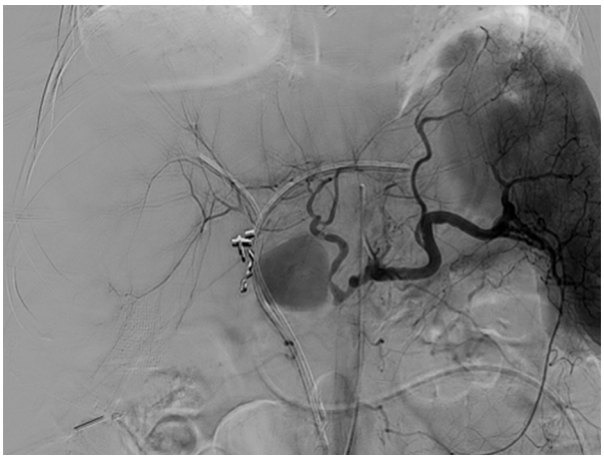

Figure 1. A 3-cm pseudoaneurysm arising from hepatic artery and gastroduodenal artery anastomosis site in patient 7. Clinical evidence of choledochoarterial fistula formation from hemobilia confirmed intraoperatively.

Literature search and study inclusion criteria

Following our evaluation of both operative and clinical features of the TJUH HAP cohort, we conducted a literature review based on PRISMA guidelines. This review was completed without date restrictions, using PubMed, Cochrane, and Google Scholar databases to further assess the clinical relationship between type of biliary anastomosis and infection in patients with HAP. We collected articles published in English that referenced or presented the number of HAPs encountered at the institution, operative and outcome information, and 4 potential risk factors identified from our cohort: (1) type of biliary anastomosis, (2) presence or absence of infection or bile leak were included, (3) choledocho-arterial fistula, and (4) PSC as the etiology for OLT, as these had all been identified in the TJUH cohort. The search used the following keywords either alone or in combination: “hepatic artery pseudoaneurysm,” “orthotopic liver transplant,” “bile leak,” “hepaticojejunostomy,” and “infection.”

Data extraction and analysis

Articles were scrutinized for the data on the identified potential risk factors, which was then organized through a tally system in a Microsoft Excel spreadsheet by 1 investigator. Due to the near absence of controlled studies, each report was described by the date of publication, type of study, number of HAP patients, and primary outcome, which included the variables of interest. From the individual studies, raw totals for each variable were compiled to compute incidence and frequencies of

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Table 1. Epidemiologic and operative data for TJUH Cohort.

	Age	Sex	Etiology for OLTx	Caval anastamosis	Arterial anastamosis (donor to recipient)	Portal vein anastamosis	Biliary anastamosis	Back-table arterial reconstruction
Patient 1	43	M	HCV/HCC	E-E	CHA – PHA	E-E	C-C	rLHA
Patient 2	55	M	HCV	E-E	HA – CHA at GDA take-off	E-E	C-C	rRHA and a LHA
Patient 3	59	M	HBV/HCC	E-E	CHA – CHA at GDA take-off	E-E	C-C	T1
Patient 4	58	M	HCV/HCC	E-E	CHA – CHA at GDA take-off	E-E	R-Y	T1
Patient 5	28	F	PSC	E-E	CHA – CHA at GDA take-off	E-E	R-Y	aLHA and aRHA
Patient 6	40	M	PSC	E-E	HA – aortic jump	E-E	R-Y	aLHA
Patient 7	62	F	HCV	S-S	CHA – CHA at GDA take-off	E-E	C-C	rRHA
	Average 49.3							

HCV – hepatitis C virus; HCC – hepatocellular carcinoma; HBV – hepatitis B virus; PSC – primary sclerosing cholangitis; E-E – end-to-end; CHA – common hepatic artery; PHA – hepatic artery proper; GDA – gastroduodenal artery; CC – cholecholedochostomy; R-Y – roux-en-Y hepaticojejunostomy; rHA – replaced left hepatic artery; rRHA – replaced right hepatic artery; LHA – left hepatic artery; aLHA – accessory left hepatic artery; aRHA – aberrant right hepatic artery; T1 – type 1 hepatic arterial anatomy.

overlap between variables. Cross-variable comparisons were then made between biliary anastomosis, infection, bile leak, and PSC and HAP development to assess frequency and to identify associations between risk factors. Additional epidemiological and clinical data, including HAP incidence, mortality rates, and number of days to presentation, were also compared across studies and reported as average values.

Results

Our retrospective chart review of TJUH patients with HAP formation following OLT between 2003 and 2015 identified 7 patients. All patients had a portal-to-portal anastomosis completed to restore venous flow to the donor liver. Six patients underwent an end-to-end caval anastomosis under veno-venous bypass, and 1 other patient had end-to-side ("piggy-back") caval anastomosis. Arterial anastomoses were completed in donor common hepatic artery to recipient common hepatic artery at the takeoff of the gastroduodenal artery in 5 patients; donor common hepatic artery to recipient proper hepatic artery in 1 patient; and donor common hepatic artery to recipient aorta by jump graft in 1 patient. Back-table arterial reconstruction varied across liver grafts from 2 patients with type 1 celiac axis arterial anatomy. The characteristics of these aberrations can be found in Table 1.

From this series, we conducted extensive literature and subsequent systematic review to elucidate possible risks for HAP formation in patients following OLT. We identified 17 papers that reported incidence, operative elements, and posited possible causes of HAP formation (Table 2). These studies varied in terms of institution, volume, and date of publication, which ranged from 1991 to 2014. Each paper was evaluated in the context of its reported outcomes and data were extracted for compilation. Studies ranged from case reports of 1 patient to larger retrospective reviews with up to 13 patients all from a single institution. In total, our review identified 74 patients who had adequate description of relevant information, and we pooled these patients with our own cohort (total N=81) (Table 3). Due to the paucity of randomization and controlled trials, no metric could be used to report variability across each study. Based on reported incidences, we found a HAP incidence of 0.94% (range, 0.3% to 2.3%). The average time to diagnosis across studies was 58.8 days (range, 10 to 252 days). HAP in 1 patient was detected 7 years after transplantation and was excluded as an outlier. Mortality in these studies varied from 0% in the 1-person case reports to 69% in larger series (Table 3) compared with our own cohort, which had a mortality rate of 28.6% (Table 4).

Careful evaluation of the operative reports from our 7-patient cohort spurred investigation of infection, hepaticojejunostomy, bile leak, and primary sclerosing cholangitis (PSC) as possible risk factors for HAP formation in the other 74 patients identified by our review. Incidence of these potential risk factors was tabulated, along with infection, from each study and pooled into our review cohort. We also anecdotally report bile

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Table 2. Overview of studies included for review.

Study Author	Year	Study Design	Outcomes	# Patients
Alamo et al. [18]	2005	Case report of a single patient who developed hepatic artery pseudoaneuryms	Patient underwent OLTx for HCV cirrhosis with unclear anastomotic reconstructions. Developed a bile duct to artery fistula and severe GI hemorrhage. Patient died awaiting OLTx redo	1
Almogy et al. [19	2002	Case report of a single patient with HAP	Patient underwent OLTx for PSC with choledochojejunostomy. Post-operative course associated with infection and bile leak. HAP identified following angiography	1
Finley et al. [3]	2005	Case series of seven patients who developed HAP; two patients following OLTx.	Two patients developed HAP discovered after hemobilia. One patient had HAP in setting of infection and bile leak. Unclear technical aspects of OLTx	2
Fistorious et al. [4]	2006	Case series of twelve patients with HAP following OLTx	Patients underwent transplantation for variety of reasons. Half of patients had biliary reconstruction in bilio-enteric fashion. Infection present in all but two patients, one of which had roux-en-Y. Three patients had developed bile leak prior to HAP detection	11
Houssin et al. [20]	1988	Case series of two patients with HAP following infection	Two patients transplanted for HBV cirrhosis and another for PBC who developed HAP in the setting of infection. Patient 1 with HBV underwent roux-en-Y biliary anastamosis while patient 2 had E-E reconstruction	2
Langnas et al. [8]	1991	Case series of patients with vascular complications at a single institution following liver transplant	Five patients identified with hepatic artery rupture following HAP. Three patients had roux-en-Y reconstruction. Infection was present in four patients. Suggest that origin of infection is enterotomy	5
Leelaudomlipi et al. [9]	2002	Retrospective chart review of eight patients who developed HAP in setting of OLTx	Evaluated technical considerations of OLTx and infection as risk factors for HAP development. Five patients had bilio-enteric anastamoses completed and infection was found in six patients	8
Leonardi et al. [17]	2001	Case report of a single patient with HAP	Patient underwent OLTx for HCV cirrhosis and was noted to have hemobilia. Biliary to arterial fistula found on ERCP with collections surrounding artery. Anastamosis completed in E-E fashion	1
Lowell et al. [22]	1999	Case series of two patients who developed HAP following OLTx without identified source of infection	Demonstrated two cases of HAP without positive cultures. Patient 1 was transplanted for HCV cirrhoses and had a roux-en-Y biliary anastamosis with associated fistula from artery to bile duct. Patient 2, who was transplanted for cryptogenic cirrhosis, had biliary obstruction from large HAP.	2
Madariaga et al. [23]	2011	Case series of seven patients who were treated with artery ligation following pseudoaneurysm development	Technical aspects of OLTx including biliary reconstruction in addition to the presence of infection or bile leak are reported	6
Maleux et al. [27]	2005	Case report of single patient who developed HAP following OLTX	Patient underwent OLTx for PBC. Biliary anastamosis done in E-E fashion. Infection present. Discovered after patient decompensated with hemodynamic shock	1
Marshall et al. [10]	2000	Retrospective chart review of thirteen patients who developed HAP in setting of OLTx. Of thirteen, nine had extrahepatic HAPs	Assessed radiologic findings of patients with HAP. Roux-en-Y biliary anastamosis conducted in five patients. Infection present in all patients. Bile leak detected in four patients. Bile leak associated with roux-en-Y in all but one patient	9

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Table 2 continued. Overview of studies included for review.

Study Author	Year	Study Design	Outcomes	# Patients
Patel et al. [12]	2003	Case report of single patient who developed hepatic artery pseudoaneurysm	Underwent OLTx for PBC and had E-E caval, bile duct, and portal vein reconstruction. Developed HAP 50 days status-post OLTx. Noted infection and bile leak prior to HAP rupture	1
Settmacher et al. [14]	2000	Retrospective chart review of vascular complications following orthotopic liver transplantation	Evaluated the arterial and biliary anastamoses of patients status-post OLTx in addition to area of aneurysm and presentation. Identified infection in four patients	5
Soin et al. [29]	1995	Case report of a single patient who developed hepatic artery pseudoaneurysm at ligated end of recipient hepatic artery	Patient underwent OLTx for HCV cirrhosis and had E-E caval, arterial, biliary, and portal vein anastamoses. Developed elevated transaminases, which upon further investigation revealed a bile leak. Infection was not present at time of HAP identification	1
Stange et al. [28]	2000	Retrospective chart review of six patients with hepartic artery pseudoaneurysm	Identified infection in four of six patients who developed HAP. Presumably E-E biliary anastamoses.. No reports of bile leak. Two patients were transplanted for PSC, and both infection	6
Volpin et al. [16]	2014	Retrospective chart review of patients with hepatic artery pseudoaneurysm and risk factor identification	Chi-squared analysis of HAP cohort compared against OLTx patients without complication. Statistically significant risk factors include bilio-enteric anastamosis and biliary leak. Infection present in 81% of HAP patients	11

duct to hepatic artery fistula but did not perform analysis due to unreliability in diagnosis and reporting. In our cohort of patients with HAP, we found infection to be present in 6 patients, Roux-en-Y hepaticojejunostomy in 3 patients, and bile leak in 3 patients. Fistula formation between bile duct and artery was associated with bile leak in all 3 patients. Six of 7 patients in the TJUH cohort were infected with either an enteric or hospital-acquired organism. The average patient age was 49.3 years old with range of 28 to 62 years and mean time to presentation 51.4 days (range, 14 to 133 days) (Tables 1, 4). The etiology for liver transplantation included chronic HCV infection with cirrhosis in 5 patients and PSC in 2 patients. All patients with Roux-en-Y had infection post-operatively, 1 of which had bile leak and 2 of which had PSC (Table 4). Both patients with PSC died, 1 intraoperatively and 1 soon after surgery.

Within our pooled cohort of 81 HAP, 63 had an associated infection (77.8%), 25 had bile leaks (30.8%), 34 had Roux-en-Y (41.9%), and 14 had PSC as their underlying diagnosis (17.7%). A cross-comparison of the variables was then done to substratify associations between risk factors. We crossed infection, Roux-en-Y hepaticojejunostomy reconstruction, bile leak, and PSC as independent variables. Of patients with infection, 23 (36.5%) had a Roux-en-Y hepaticojejunostomy, 21 (33.3%) had a bile leak, and 13 (20.6%) were transplanted for PSC. Within the Roux-en-Y subgroup, 23 (67.6%) were associated with infection, 12 (35.3%) with bile leak, and 11 (32.5%) with PSC. Amongst the bile leak HAP patients, 21 (84.0%) had infection, 12 (48.0%) were reconstructed with Roux-en-Y, and 6 (24.0%) had underlying PSC. In the final subgroup of PSC patients, 13 (93%) had postoperative infection, 11 (78.6%) had a Roux-en-Y anastomoses, and 6 (42.9%) had bile leak. Bile duct to hepatic artery fistula was noted in 10 patients (12.6%) (Table 5).

Discussion

HAP following orthotopic liver transplantation continues to have a high mortality rate following rupture. Owing to its infrequency, which we report as an incidence rate of 0.94%, prompt identification remains paramount in decreasing patient deaths. Our literature review found a consensus between case studies that infection is associated with HAP development, likely due to bacterial erosion of the arterial adventitia either at or near the site of anastomosis. With this background, we further examined our own cohort of 7 patients, who represent a 13-year span of patients who developed HAP following OLT. All but 1 patient had evidence of abdominal infection at the time of HAP detection, and all patients with a Roux-en-Y hepaticojejunostomy harbored infection. Of the 3 patients with R-en-Y, 2 were PSC patients, who both rapidly decompensated and died. Contrary to this rapid disease progression, routine follow-up identified 2 other patients in our cohort who remained stable with small (both <2 cm) HAP. Infection was present in 1 of these patients in the immediate postoperative period. These findings indicate that there are 2 distinct natural histories for pseudoaneurysm:

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Table 3. Inter-study comparison of hepatic artery pseudoaneurysm totals, operative variables, risk factors, and post-operative complications.

	Hepatic artery pseudo-aneurysm (HAP) total	HAP incidence	Mortality rate	Time to detection (days)	Total associated with infection	Total associated with bile leak	Total with Roux Limb recon-struction	Total with Primary Sclerosing Cholangitis (PSC)	Total with choledo-choarterial fistula
Alamo et al. [18]	2	0.4%	33%	95	2	1	0	0	1
Almogy et al. [19]	1	NR	0%	15	1	1	1	1	1
Finley et al. [3]	2	1%	0%	26, 2555	1	1	0	0	1
Fistorious et al. [4]	11	1.3%	36.4%	61.5	9	3	6	0	0
Houssin et al. [20]	2	2.3%	0%	75.5	2	2	1	0	1
Langnas et al. [8]	5	1.2%	25%	13.4	4	0	1	0	1
Leelaudomlipi et al. [9]	8	0.5%	50%	27.5	6	0	5	0	0
Leonardi et al. [17]	1	0.7%	0%	10	1	1	0	0	0
Lowell et al. [22]	2	0.7%	0%	120	0	1	1	0	0
Madriaga et al. [23]	6	0.3%	50%	39	5	4	3	1	2
Maleux et al. [27]	1	NR	0%	73	1	0	0	0	0
Marshall et al. [10]	9	1%	69%	30	9	4	7	5	0
Patel et al. [12]	1	NR	0%	50	1	1	0	0	0
Settmacher et al. [14]	5	0.5%	0%	252	4	0	2	2	0
Soin et al. [29]	1	NR	0%	90	0	1	0	0	0
Stange et al. [28]	6	0.62%	50%	120	4	0	0	2	0
Volpin et al. [16]	11	1.7%	54.5%	21.5	7	2	4	1	0
Total	**74**				**57**	**22**	**31**	**12**	**7**
Jefferson Cohort	7	NR	28.6%	51.3	6	3	3	2	3
Grand total	**81**				**63**	**25**	**34**	**14**	**10**

NR – not reported.

one rapidly progressive and fatal, and another more indolent and benign course. In the remaining 3 patients, we noted the presence of infection, bile leak, and choledocho-arterial fistula, which occurred in conjunction with each other. The cohort, although small, demonstrates a spectrum of disease pathogenesis, where a constellation of risk factors seems to portend the development of HAP at any time in certain patients.

In addition to infection, Volpin et al. demonstrated that biliary-enteric and bile leak are risk factors for HAP development, and our research also reinforces a clinical association between these variables and HAP formation [16]. After examining larger retrospective studies completed by Fistorious et al., Leeladomlipi et al., and Marshall et al., there again appears to be a relationship between infection, bile leak, and Roux-en-Y hepaticojejunostomy reconstruction [4,9,10]. Although our study does not prove causality, it does demonstrate interplay between these variables in the setting of HAP formation and the potential for rupture and death. We found nearly 80% of HAP patients had infection, 41.9% had Roux-en-Y

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Table 4. Hepatic artery pseudoaneurysm presentation and risk factors in TJUH Cohort.

	Time to detection (days)	Etiology	Biliary anastamosis	Infection	Microbiologic finding	Bile Leak	Choledocho-arterial fistula formation	Mortality
Patient 1	133	HCV/HCC	C-C	0	N/A	0	0	N
Patient 2	72	HCV	C-C	1	*K. pneumoniae*	1	1	N
Patient 3	28	HBV/HCC	C-C	1	*K. pneumoniae*	0	0	N
Patient 4	28	HCV/HCC	R-Y	1	*K. pneumoniae*	1	1	N
Patient 5	14	PSC	R-Y	1	*K. pneumoniae*	0	0	Y
Patient 6	43	PSC	R-Y	1	*P. aeruginosa*	0	0	Y
Patient 7	41	HCV	C-C	1	*C. caseliflavus*	1	1	N
Average 51.4				6		3	3	0

HCV – hepatitis C virus; HCC – hepatocellular carcinoma; HBV – hepatitis B virus; PSC – primary sclerosing cholangitis; E-E – end-to-end; CC – cholecholedochostomy; R-Y – roux-en-Y hepaticojejunostomy.

Table 5. Categorical breakdown and tally of independent variables for HAP formation.

	Roux Limb	Infection	Bile Leak	PSC
Roux Limb	34	23 (67.6%)	12 (35.3%)	11 (32.5%)
Infection	23 (36.5%)	63	21 (33.3%)	13 (20.6%)
Bile Leak	12 (48.0%)	21 (84.0%)	25	6 (24.0%)
PSC	11 (78.6%)	13 (93.0%)	6 (42.9%)	14

hepaticojejunostomy, and 30.8% had bile leak. When we evaluated these variables (infection, Roux-en-Y, bile leak, and PSC) against each other, we detected high rates of infection in all groups. Infection appears to be a salient clinical harbinger for HAP formation, which may occur as a result of an underlying etiologic or technical variable or complication. The co-occurrence between these variables has been demonstrated in the literature. A study by Sheng et al. described a bile leak rate of 4.3% after liver transplantation in a large retrospective review, and also demonstrated that 95% of leaks occur at the site of a hepaticojejunostomy [25]. In leak patients, the principal clinical manifestation was infection, which was detected by signs of fever, peritonitis, and/or cholangitic symptoms [25]. Comparatively, Antolovic et al. described a bile leak rate of 5.6% for patients undergoing hepaticojejunostomy during any surgical procedure [2]. Although these studies did not look for a relationship between bile leak, Roux-en-Y, infection, and HAP development, we found that 48% of patients with bile leak had hepaticojejunostomy in the setting of HAP. These data suggest that with Roux-en-Y hepaticojejunostomy, a substantial risk for both bacterial translocation and biliary spillage frequently co-occur in HAP patients status-post live transplant. PSC seems to compound this risk, as ductal disease can prevent effective healing of the anastomosis, resulting in greater risk of infection or leak. PSC patients with Roux-en-Y reconstruction are at high risk for bile leak and infection; they appear to be at high risk for HAP formation and should be monitored intensively. A separate process also seems to exist in which as the aneurysm grows, and an erosive process into the biliary system can result in choledocho-arterial fistula formation and profound GI hemorrhage. This erosive process can compromise the hemodynamic status of the patient despite not acutely rupturing. In summary, we contend that the postoperative liver transplant patient with fever should be carefully evaluated for infection, especially in the setting of Roux-en-Y, documented bile leak, and/or PSC ESLD etiology since these risk factors coincide with the natural course of HAP.

Although we highlight 4 risk factors either occurring independently or simultaneously in patients with HAP formation following OLT, we believe that other variables, including type of immunosuppression, nutritional status, and back-table graft reconstruction, could warrant investigation [15,26,27]. In our review, however, these clinical features did not appear to impact

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the disease progression. Despite our analysis demonstrating the degree of association between our chosen risk factors, a large, multi-center effort with shared databases is ultimately necessary to produce control cohorts that could be used for multi-variate and/or meta-analysis of these variables. We believe this would definitively identify a temporal and clinical relationship of infection, biliary reconstruction, bile leak, PSC etiology, and fistula disease in the natural history of HAP following OLT. In summary, postoperative orthotopic liver transplant patients with Roux-en-Y reconstruction and signs of perioperative fever, leukocytosis, and clinical or laboratory signs of hemodynamic instability, especially those with PSC ESLD, should be managed with a high index of suspicion for pseudoaneurysm formation, as prompt recognition prior to rupture can dramatically decrease mortality.

Conclusions

Postoperative orthotopic liver transplant patients with Roux-en-Y reconstruction and signs of perioperative fever, leukocytosis, and clinical or laboratory signs of hemodynamic instability, especially those with PSC ESLD, should be managed with a high index of suspicion for pseudoaneurysm formation, as prompt recognition prior to rupture can dramatically decrease mortality.

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