LIVER TRANSPLANTATION 15:1488-1492, 2009

ORIGINAL ARTICLE

Incidence of Abdominal Wall Numbness Post–Liver Transplantation and Its Complications

Ashokkumar Jain,[1,2] **Pauline Nemitz,**[2] **Rajeev Sharma,**[2] **Baber Sheikh,**[1] **Saman Safadjou,**[2] **Marry Vetter,**[2] **Leah Brayan,**[2] **Pam Batzold,**[2] **Randeep Kashyap,**[2] **and Mark Orloff**[2]

[1]*Division of Abdominal Organ Transplant, Department of Surgery, Temple University Hospital, Philadelphia, PA; and* [2]*Division of Solid Organ Transplant and Hepatobiliary Surgery, Department of Surgery, University of Rochester, Rochester, NY*

Liver transplantation (LTx) is a life-saving procedure for end-stage liver disease. However, LTx remains a major surgical procedure with a significant amount of morbidity and mortality. Several different types of post-LTx complications have been studied and reported; however, the numbness of the abdominal skin between the subcostal incision and the umbilicus and its associated complications have not been studied in a large patient population. The aim of this study was to report the incidence of numbness in the abdominal skin post-LTx and its implications in routine life. One hundred and one post-LTx patients were questioned in the clinic about numbness. There were 52 male patients and 49 female patients with a mean age of 51.9 ± 11.3 years at the time of LTx, and the mean time from transplant was 35.0 ± 29.5 months (range, 3-113 months). The implications were recorded. All 101 patients (100%) had an area of numbness between the subcostal incision and the umbilicus. Four of these patients had an area of superficial-to-deep burns from hot food (accidentally dropped on the abdomen), heating pads, or a hot cup of tea. One patient had ecchymosis from blunt trauma during gardening. Out of 36 diabetic patients, more than 24 patients were insulin-dependent and used the area for subcutaneous insulin injections. In addition, some of the 43 hepatitis C virus–positive patients used the area for subcutaneous interferon therapy. In conclusion, 100% of the patients had persistent numbness up to 9 years following LTx. Five percent of the patients developed thermal injuries or blunt trauma complications that could have been prevented with better education and awareness. More then 24% of the patients used the area for subcutaneous injections of insulin and/or interferon. ***Liver Transpl 15:1488-1492, 2009.*** © **2009 AASLD.**

Received March 2, 2009; accepted May 25, 2009.

Liver transplantation (LTx) remains the only option for end-stage liver failure. It is a major surgical procedure. Several surgical and nonsurgical complications after LTx have been described. Although some are preventable, others are inevitable. LTx involves a bilateral subcostal incision with a vertical extension. Some surgeons have performed LTx without a left subcostal or vertical extension.[1,2] However, the right subcostal component of the incision is essential and is an inevitable part of LTx. It extends from the midline toward the right anterior axillary line. During the incision of abdominal wall muscles, the intercostal nerves (both sensory and motor components) are invariably divided along the line of incision. A patient can lose cutaneous sensations from the division of the sensory components of the intercostal nerves, particularly in dermatomes T8 and T9 on the right side and in dermatome T8 on the left side.[3] This type of loss of cutaneous sensations below the subcostal incision and its duration with associated complications post-LTx have not been studied in large patient populations; however, recently there was a case report describing burns and ulcerations over the abdominal skin after LTx.[4]

The aim of the present study was to determine the incidence of abdominal wall numbness at different time intervals after LTx and also to determine its implications.

Abbreviations: ETOH, alcohol-related; HBV, hepatitis B virus; HCC, hepatocellular carcinoma; HCV, hepatitis C virus; LTx, liver transplantation; NASH, nonalcoholic steatohepatitis; PBS, primary biliary cirrhosis; PSC, primary sclerosing cholangitis.

Address reprint requests to Ashokkumar Jain, M.D., F.A.C.S., Division of Abdominal Organ Transplantation, Department of Surgery, Temple University Hospital, 3322 North Broad Street, Medical Office Building, Suite 147, Philadelphia, PA 19140. Telephone: 212-707-4545; FAX: 212-707-8894; E-mail: ashokkumar.jain@tuhs.temple.edu

DOI 10.1002/lt.21850
Published online in Wiley InterScience (www.interscience.wiley.com).

TABLE 1. Interval from Liver Transplantation

Interval	Number of Cases	%
<3 months	7	6.93
≥3 months to 12 months	22	21.78
>1 year to ≤3 years	36	35.64
>3 years to ≤5 years	13	12.87
>5 years but ≤8 years	20	19.80
>8 years	3	2.97

PATIENTS AND METHODS

From July 2008 onward, all post-LTx patients attending an outpatient clinic were asked about abdominal cutaneous numbness (below the bilateral subcostal scar), and they were also asked if it affected their daily routine life. One hundred one patients were evaluated for numbness. There were 52 male patients and 49 female patients. The mean age was 51.9 ± 11.3 years, and the mean time from transplant was 35.0 ± 29.5 months (range, 3-113 months). These patients were divided into 6 groups depending on the time interval from LTx: <3 months (7 patients), ≥3 months to 12 months (22), >1 year to ≤3 years (36), >3 years to ≤5 years (13), >5 years to ≤8 years (20), and >8 years (3; Table 1). Seven patients were less than 3 months post-LTx, and 23 patients were more than 5 years post-LTx (Table 1). Eighteen patients had upper abdominal surgery prior to LTx [open cholecystectomy (13), total colectomy (1), Kasai (1), hepatic resection (1), partial gastrectomy (1), and abdominal wall reconstruction (1)]. Also, 12 patients underwent LTx a second time, and 3 of these patients underwent LTx a third time. One patient who was born with a congenital defect had more than 50 surgeries, mainly in the lower abdominal region. Indications for LTx are mentioned in Table 2. As in other series, the commonest cause was hepatitis C infection (42.5%) followed by alcohol-related liver disease (21.2%).

TABLE 2. Indications for Liver Transplantation

Indication	Number of Cases
HCV	43
ETOH	21
PBC	9
PSC	8
Cryptogenic	8
Acute fulminant	5
NASH	4
HCC	3
Wilson	3
Hemochromatosis	2
Autoimmune	2
HBV	1
Sarcoid	1
Total	101

Abbreviations: ETOH, alcohol-related; HBV, hepatitis B virus; HCC, hepatocellular carcinoma; HCV, hepatitis C virus; NASH, nonalcoholic steatohepatitis; PBS, primary biliary cirrhosis; PSC, primary sclerosing cholangitis.

Figure 1. Case 11: Healed area of burns from hot food that was not removed readily.

RESULTS

All 101 (100%) patients had an area of numbness between the subcostal incision and the umbilicus. Four patients had epidermal to deep dermal burns (cases 11, 55, 58, and 101), and another patient (case 87) had ecchymosis from blunt trauma during gardening.

Case 11, a 49-year-old woman, received LTx 80 months ago for hepatitis C virus–related end-stage liver disease. While she was working close to a stove, hot food accidentally fell on her abdomen that was not removed readily. She sustained burns to the area of numbness on her abdominal wall. Subsequently, she healed completely (Fig. 1).

Case 55, a 60-year-old woman who underwent LTx for alcohol-related end-stage liver disease, came to the clinic for a routine visit 20 months post-LTx with an area of burns on her abdomen. She had placed a hot cup of tea over her abdomen while reading a newspaper and, without her knowledge, sustained superficial burns.

Case 58, a 50-year-old man, underwent LTx 18 months ago for alcohol-related end-stage liver disease. He was using heating pads regularly for his abdominal discomfort. He sustained deep burns that were aggravated by scratching and peeling of the healing tissue. He had loss of pain sensations over the area (Fig. 2A,B).

Case 101, a 52-year-old man who underwent LTx for cryptogenic cirrhosis with hepatocellular carcinoma, came to visit the clinic 29 months post-LTx. He had accidentally dropped hot food on his abdomen and, without his knowledge, sustained superficial burns, as shown in Fig. 3.

Another patient (case 87), a 56-year-old man, presented to the clinic with ecchymosis in the subcostal area 5 years post-LTx for hepatitis C virus–related end-stage liver disease. He complained of deep muscular

Figure 2. Case 58: Multiple areas of burns from a heating pad for abdominal pain that were worsened by scratching. Dotted line added to show the incision.

Figure 3. Case 101: Area of superficial burns (arrow) from hot food that was dropped.

pain following gardening and grass cutting over the weekend.

Thirty-six patients were diabetic; 24 of them were insulin-dependent. All 24 patients used the numb area for subcutaneous insulin injections. In addition, 9 of the hepatitis C virus–positive patients used the area of numbness for subcutaneous interferon injections.

DISCUSSION

LTx remains a life-saving procedure for patients with end-stage liver disease. The procedure does carry considerable morbidity and mortality. Several complications post-LTx have been described,[5] including several different types of neurological,[6,7] cardiovascular,[8] respiratory,[9-11] and gastrointestinal complications,[12] acute and chronic renal failure/impairment[13-17]; arterial/venous complications,[5,18-20] biliary complications,[21,22] and posttransplant lymphoproliferative disorder/de novo cancers.[23-25] Additional complications associated with infections, including bacterial, viral, and fungal infections,[26-31] incisional hernias,[32] bleeding,[33] metabolic disorders,[31,34-38] impaired quality of life,[31] and erectile dysfunction[39] have also been described. However, the area of numbness below the subcostal incision has not been studied. Abdominal wall muscles and skin are supplied by the ventral rami of intercostal nerves T8 to T12. The motor components of the nerves supply the muscles as they travel anteriorly between the muscle layers and give rise to collateral and lateral cutaneous branches. Each lateral cutaneous nerve descends, supplying the skin after piercing muscles and subcutaneous fat.[40] The right subcostal incision is longer, and T8 and T9 are invariably divided, whereas the incision on the left side is shorter and reaches the lateral border of the rectus sheath. Thus, on the left side, T8 is always divided, but T9 may be spared at times (Fig. 4).[3] In the study population, 23 patients were more than 5 years post-LTx. Of these, 3 patients were more than 8 years post-LTx. However, they still reported a loss of cutaneous sensations.

As previously mentioned, 18 patients underwent additional surgeries in addition to LTx, but we believe that cutaneous nerve injury occurred during the first LTx procedure. Singhal et al.[4] recently described a case report of thermal injury to the abdominal wall as a late complication post-LTx. In their report, they described a 50-year-old man who was 7 months post-LTx and sustained thermal injury at a barbeque party at which he was actively involved in cooking food on a barbeque grill. Similar areas of numbness following musculocutaneous flap for abdominoplasty or mammoplasty have been described. Areas of burns from heating pads and hot water bottles have also been reported.[41-46]

We believe that following a major life-saving procedure, a loss of cutaneous sensations has been observed by virtually all transplant surgeons. However, it has not been given any serious consideration, and the issue has somehow remained underreported. With the increasing incidence of litigation, even in a life-saving setting, it may be important for the transplant community, as a standard of practice, to educate patients about this seemingly inevitable complication during their evalua-

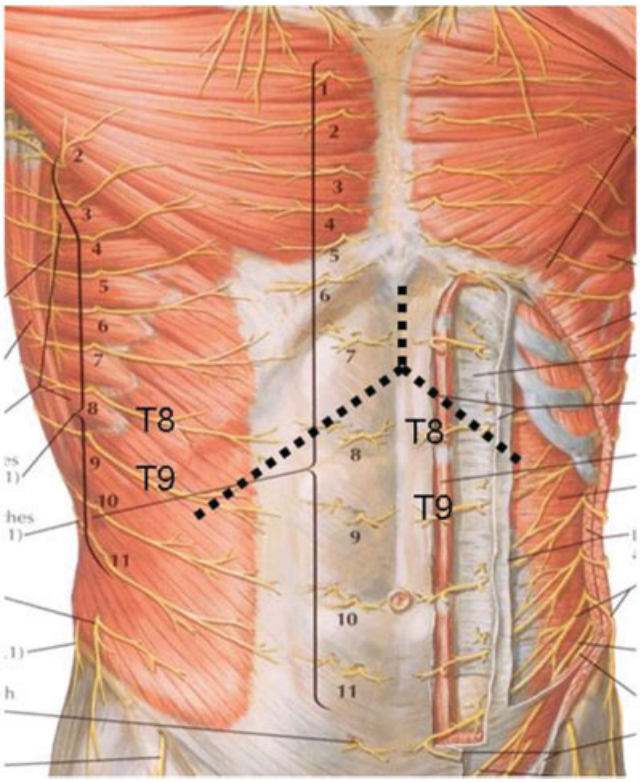

Figure 4. Cutaneous nerve supply of the abdominal wall. Reprinted with permission from *Atlas of Human Anatomy*.[3] Dotted line added to show the incision.

tion for LTx. We feel that at the time of discharge, all patients should be cautioned about thermal burns and blunt trauma for the remainder of their lives. It is interesting that several patients have taken advantage of this numbness for subcutaneous injections of insulin and/or interferon. However, this advantage does not reduce the future liability on the part of the transplant community for neglecting to warn patients about this potentially harmful complication.

In conclusion, abdominal wall numbness was observed in 100% of the patients post-LTx with up to 8 years of follow-up. Five percent of patients experienced cutaneous complications from thermal burns or blunt trauma. It is suggested that post-LTx recipients should be educated against this trivial but preventable complication from numbness.

REFERENCES

1. Donataccio M, Genco B, Donataccio D. Right subcostal incision in liver transplantation: prospective study of feasibility. Transplant Proc 2006;38:1109-1110.
2. Heisterkamp J, Marsman HA, Eker H, Metselaar HJ, Tilanus HW, Kazemier G. A J-shaped subcostal incision reduces the incidence of abdominal wall complications in liver transplantation. Liver Transpl 2008;14:1655-1658.
3. Netter F. Atlas of Human Anatomy. 2nd ed. Saunders Elsevier, Philadelphia, PA. 1997.
4. Singhal A, Bramhall S, Mutimer D. Abdominal wall burns: a late "complication" of liver transplant. Liver Transpl 2008;14:1065-1066.
5. Urbani L, Catalano G, Biancofiore G, Bindi L, Consani G, Bisà M, et al. Surgical complications after liver transplantation. Minerva Chir 2003;58:675-692.
6. Ghaus N, Bohlega S, Rezeig M. Neurological complications in liver transplantation. J Neurol 2001;248:1042-1048.
7. Jain A, Brody D, Hamad I, Rishi N, Kanal E, Fung J. Conversion to Neoral for neurotoxicity after primary adult liver transplantation under tacrolimus. Transplantation 2000;69:172-176.
8. Dec GW, Kondo N, Farrell ML, Dienstag J, Cosimi AB, Semigran MJ. Cardiovascular complications following liver transplantation. Clin Transplant 1995;9:463-471.
9. Durán FG, Piqueras B, Romero M, Carneros JA, de Diego A, Salcedo M, et al. Pulmonary complications following orthotopic liver transplant. Transpl Int 1998;11(suppl 1): S255-S259.
10. Howell RS, Bayley S, Calne RY. Respiratory failure after liver transplantation. Eur J Intensive Care Med 1975;1: 137-140.
11. Kumar D, Tellier R, Draker R, Levy G, Humar A. Severe acute respiratory syndrome (SARS) in a liver transplant recipient and guidelines for donor SARS screening. Am J Transplant 2003;3:977.
12. Tabasco-Minguillán J, Jain A, Naik M, Weber KM, Irish W, Fung JJ, et al. Gastrointestinal bleeding after liver transplantation. Transplantation 1997;63:60-67.
13. Gonwa TA, Mai ML, Melton LB, Hays SR, Goldstein RM, Levy MF, Klintmalm GB. End-stage renal disease (ESRD) after orthotopic liver transplantation (OLTX) using calcineurin-based immunotherapy: risk of development and treatment. Transplantation 2001;72:1934-1939.
14. Guitard J, Cointault O, Kamar N, Muscari F, Lavayssière L, Suc B, et al. Acute renal failure following liver transplantation with induction therapy. Clin Nephrol 2006;65: 103-112.
15. Paramesh AS, Roayaie S, Doan Y, Schwartz ME, Emre S, Fishbein T, et al. Post-liver transplant acute renal failure: factors predicting development of end-stage renal disease. Clin Transplant 2004;18:94-99.
16. Sanchez EQ, Gonwa TA, Levy MF, Goldstein RM, Mai ML, Hays SR, et al. Preoperative and perioperative predictors of the need for renal replacement therapy after orthotopic liver transplantation. Transplantation 2004;78:1048-1054.
17. Yalavarthy R, Edelstein CL, Teitelbaum I. Acute renal failure and chronic kidney disease following liver transplantation. Hemodial Int 2007;11(suppl 3):S7-S12.
18. Egawa H, Tanaka K, Kasahara M, Takada Y, Oike F, Ogawa K, et al. Single center experience of 39 patients with preoperative portal vein thrombosis among 404 adult living donor liver transplantations. Liver Transpl 2006;12: 1512-1518.
19. Jain A, Costa G, Marsh W, Fontes P, Devera M, Mazariegos G, et al. Thrombotic and nonthrombotic hepatic artery complications in adults and children following primary liver transplantation with long-term follow-up in 1000 consecutive patients. Transpl Int 2006;19:27-37.
20. Shaikh F, Solis J, Bajwa T. Hepatic artery stenosis after liver transplant, managed with percutaneous angioplasty and stent placement. Catheter Cardiovasc Interv 2007;69: 369-371.
21. Nio M, Sano N, Ishii T, Sasaki H, Hayashi Y, Ohi R. Cholangitis as a late complication in long-term survivors after surgery for biliary atresia. J Pediatr Surg 2004;39: 1797-1799.
22. Perkins JD. Biliary tract complications: the most common postoperative complication in living liver donors. Liver Transpl 2008;14:1372-1373.
23. Jain A, Nalesnik M, Reyes J, Pokharna R, Mazariegos G, Green M, et al. Posttransplant lymphoproliferative disor-

ders in liver transplantation: a 20-year experience. Ann Surg 2002;236:429-436.
24. Jain A, Patil VP, Fung J. Incidence of de novo cancer and lymphoproliferative disorders after liver transplantation in relation to age and duration of follow-up. Liver Transpl 2008;14:1406-1411.
25. Oruc MT, Soran A, Jain AK, Wilson JW, Fung J. De novo breast cancer in patients with liver transplantation: University of Pittsburgh's experience and review of the literature. Liver Transpl 2004;10:1-6.
26. Falagas ME, Snydman DR, Griffith J, Ruthazer R, Werner BG. Effect of cytomegalovirus infection status on first-year mortality rates among orthotopic liver transplant recipients. Boston Center for Liver Transplantation CMVIG Study Group. Ann Intern Med 1997;126:275-279.
27. Gourishankar S, McDermid JC, Jhangri GS, Preiksaitis JK. Herpes zoster infection following solid organ transplantation: incidence, risk factors and outcomes in the current immunosuppressive era. Am J Transplant 2004; 4:108-115.
28. Grant RM, Weitzman SS, Sherman CG, Sirkin WL, Petric M, Tellier R. Fulminant disseminated varicella zoster virus infection without skin involvement. J Clin Virol 2002;24: 7-12.
29. Lautenschlager I, Lappalainen M, Linnavuori K, Suni J, Hockerstedt K. CMV infection is usually associated with concurrent HHV-6 and HHV-7 antigenemia in liver transplant patients. J Clin Virol 2002;25(suppl 2):S57-S61.
30. Schroter GP, Hoelscher M, Putnam CW, Porter KA, Starzl TE. Fungus infections after liver transplantation. Ann Surg 1977;186:115-122.
31. Shih FJ, Hu RH, Ho MC, Lin HY, Lin MH, Lee PH. Changes in health-related quality of life and working competence before and after liver transplantation. Transplant Proc 2000;32:2144-2148.
32. Kahn J, Müller H, Iberer F, Kniepeiss D, Duller D, Rehak P, Tscheliessnigg K. Incisional hernia following liver transplantation: incidence and predisposing factors. Clin Transplant 2007;21:423-426.
33. Imura S, Soejima Y, Ikegami T, Fujii M, Morine Y, Ikemoto T, et al. Spontaneous retroperitoneal massive hematoma after living-donor liver transplantation: an unpredictable but critical complication. Hepatogastroenterology 2008; 55:1778-1780.
34. Bjøro K, Brandsaeter B, Wiencke K, Bjøro T, Godang K, Bollerslev J, Schrumpf E. Secondary osteoporosis in liver transplant recipients: a longitudinal study in patients with and without cholestatic liver disease. Scand J Gastroenterol 2003;38:320-327.
35. Jain A, Marcos A, Reyes J, Mazariagos G, Kashyap R, Eghtesad B, et al. Tacrolimus for primary liver transplantation: 12 to 15 years actual follow-up with safety profile. Transplant Proc 2005;37:1207-1210.
36. Laryea M, Watt KD, Molinari M, Walsh MJ, McAlister VC, Marotta PJ, et al. Metabolic syndrome in liver transplant recipients: prevalence and association with major vascular events. Liver Transpl 2007;13:1109-1114.
37. Moreno R, Berenguer M. Post-liver transplantation medical complications. Ann Hepatol 2006;5:77-85.
38. Yoshida EM, Buczkowski AK, Sirrs SM, Elliott TG, Scudamore CH, Levin A, et al. Post-transplant diabetic ketoacidosis—a possible consequence of immunosuppression with calcineurin inhibiting agents: a case series. Transpl Int 2000;13:69-72.
39. Huyghe E, Kamar N, Wagner F, Yeung SJ, Capietto AH, El-Kahwaji L, et al. Erectile dysfunction in liver transplant patients. Am J Transplant 2008;8:2580-2589.
40. Williams P, Warwick R, Dyson M, Bannister L, eds. Gray's Anatomy. 37th ed. Edinburgh, Scotland: Churchill Livingstone; 1995.
41. Farah AB, Nahas FX, Ferreira LM, Mendes Jde A, Juliano Y. Sensibility of the abdomen after abdominoplasty. Plast Reconstr Surg 2004;114:577-582.
42. Fels KW, Cunha MS, Sturtz GP, Gemperli R, Ferreira MC. Evaluation of cutaneous abdominal wall sensibility after abdominoplasty. Aesthetic Plast Surg 2005;29:78-82.
43. Ferreira MC, Costa MP, Cunha MS, Sakae E, Fels KW. Sensibility of the breast after reduction mammaplasty. Ann Plast Surg 2003;51:1-5.
44. Gowaily K, Ellabban MG, Iqbal A, Kat CC. Hot water bottle burn to reconstructed breast. Burns 2004;30:873-874.
45. Ozgenel Ege GY, Ozcan M. Heating-pad burn as a complication of abdominoplasty. Br J Plast Surg 2003;56:52-53.
46. Stevenson TR, Hammond DC, Keip D, Argenta LC. Heating pad burns in anesthetic skin. Ann Plast Surg 1985;15:73-75.