

Definitive treatment of traumatic biliary injuries

Travmatik safra yolu yaralanmalarında kalıcı tedavi

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BACKGROUND

We presented our experience with definitive treatment of traumatic biliary injuries.

METHODS

Six male patients (mean age 13 years; range 2 to 32 years) who were referred to our unit for definitive treatment of traumatic biliary injuries were retrospectively evaluated. Data were analyzed in terms of demographic characteristics, mechanisms of injuries, associated injuries, previous treatments, symptoms on admission, treatment at our unit, and the results of treatment. Outcome was assessed using modified Schweiser and Blumgart criteria.

RESULTS

The injuries were due to blunt abdominal trauma in all the patients but one who had a gunshot wound. In three patients, biliary injuries were missed at the initial operation. On admission, three patients had external biliary fistulas, two had biliary strictures. One patient was sent following inadvertent ligation of the hepatoduodenal ligament during attempts to control hemorrhage. Roux-en-Y hepaticojejunostomy was performed in three patients. Percutaneous biloma drainage was performed in two patients, resulting in fistula closure in 13 and 40 days, respectively. One patient was treated by endoscopic retrograde cholangiopancreatography and papillotomy, which enabled fistula closure in three days. One patient was lost to follow-up. One patient died from hepatic failure 11 years after the trauma. At the end of a mean follow-up of 49 months (range 15 to 75 months), three patients were in excellent condition, while one patient experienced occasional attacks of cholangitis.

CONCLUSION

In patients with undetected biliary injuries and in those with unsuccessful repair attempts, biliary reconstruction should be performed in experienced hepatopancreatobiliary surgery units.

Key Words: Bile ducts; biliary fistula; biliary tract; cholangiopancreatography, endoscopic retrograde; gallbladder.

AMAÇ

Travmatik safra yolu yaralanmasının kalıcı onarımı konusundaki deneyimimizin sunulması amaçlandı.

GEREÇ VE YÖNTEM

Travmatik safra yolu yaralanması nedeniyle kalıcı tedavinin yapılması amacıyla servisimize sevk edilen altı erkek hasta (ort. yaş 13; dağılım 2-32) retrospektif olarak değerlendirildi. Hastaların demografik özellikleri, yaralanma mekanizması, ek yaralanmalar, önceki müdahaleler, başvuru semptomları, uygulanan tedaviler ve sonuçları incelendi. Sonuçlar modifiye Schweiser ve Blumgart ölçütleri kullanılarak değerlendirildi.

BULGULAR

Penetran yaralanması olan bir erişkin hasta dışında tüm yaralanmalar künt travmaya bağlıydı. Üç hastada safra yolu yaralanması ilk tedavi merkezlerinde saptanamamıştı. Üç hasta da fistül, iki hastada striktür vardı; bir hasta ise, kanama kontrolü için yapılan hepatoduodenal ligaman bağlanmasını takiben gönderilmişti. Cerrahi tedavi uygulanan üç hastada Roux-en-Y hepaticojejunostomi yapıldı. Fistül bulunan üç hastanın ikisi perkütan biloma drenajı ile tedavi edildi ve fistüller sırasıyla 13 ve 40 günde kapandı. Bir hasta endoskopik retrograd kolanjiyopankreatografi ve papillotomiyle tedavi edildi ve fistülü üç günde kapandı. Bir hasta takip edilemedi. Bir hasta portal hipertansiyon nedeniyle travmadan 11 yıl sonra yaşamını yitirdi. Ortalama 49 aylık (dağılım 12-75 ay) izlem sonunda, dört hastanın üçü mükemmel durumda iken, biri seyrek kolanjit atakları geçirilmekteydi.

SONUÇ

Safra yolu yaralanmasının saptanamadığı veya ilk tedavi girişimlerinin başarısız olduğu olgularda, safra yolu onarımı hepatopancreatobiliyer cerrahi merkezlerinde yapılmalıdır.

Anahtar Sözcükler: Safra yolu; biliyer fistül; biliyer kanal; kolanjiyopankreatografi, endoskopik retrograd; safrakesesi.

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Traumatic biliary injury (TBI) is a rare event accounting for 1% to 3.5% of all abdominal injuries.^[1-2] Its management is comparatively more challenging than that of iatrogenic biliary injuries due to frequently associated major organ injuries, high percentage of child victims, small caliber of the previously normal biliary system, and frequent delays in diagnosis.^[3]

Definitive treatment of TBI is mostly determined by the clinical status at initial presentation. In unstable patients with multiple intra-abdominal injuries, treatment of bile duct injuries are of lower priority. Under such circumstances, drainage of the biliary system and the perihepatic area is sufficient.^[3,4] Only in hemodynamically stable patients, may the surgeon attempt biliary repair.^[3-5] The choice of the repair depends on associated injuries, the location and extent of biliary injury and the surgeons' experience in biliary reconstruction, ranging from a primary repair over a T-tube to Roux-en-Y hepaticojejunostomy with or without hepatic or pancreaticoduodenal resection.^[3,5,6]

In otherwise healthy patients in whom biliary injury was missed at the initial operation or in those in whom initial repair attempts fail, biliary reconstruction should be performed at a later stage by surgeons who are experienced in hepatopancreatobiliary (HPB) surgery. A multidisciplinary approach, with utilization of interventional radiology and endoscopy yields a better prognosis. In this article, definitive treatment of such injuries was evaluated in six patients submitted to our HPB unit.

MATERIALS AND METHODS

Data were retrospectively reviewed from the charts of 186 patients treated for biliary injury between January 1987 and 2002 at the Hepato-Pancreato-Biliary Surgery Unit of the Department of General Surgery, İstanbul Medical Faculty, İstanbul University. Patients with TBI were included in the study while isolated gallbladder trauma and iatrogenic injuries were excluded. Of 186 bile duct injuries, six patients (3.2%) had TBI, while the remaining patients (96.8%) had iatrogenic biliary injuries. All the patients with TBI were males, with a mean age of 13 years (range 2 to 32 years).

Data were analyzed in terms of demographic characteristics, mechanisms of injuries, associated

injuries, previous treatments, symptoms on admission, treatment at our unit, and mortality and restenosis rates. Outcome was assessed using modified Schweiser and Blumgart criteria.^[7]

RESULTS

The etiology of injuries was blunt abdominal trauma due to road traffic accidents in all but one patient who had a gunshot wound. None of the patients had injuries to the head, chest, or extremities. The mean duration between the traumatic injury and admission to our unit was 34 days (range 2 to 94 days). All patients were initially treated in a trauma center and were referred after one or two reparative operations. Along with the biliary system, injuries involved the liver (n=2), liver and intra-abdominal organs (n=2), liver and gallbladder (n=1), portal vein and gallbladder (n=1). All patients underwent emergency laparotomy.

In three patients, biliary injuries were missed at the initial operation, all of whom had concomitant hepatic injuries (Case 1, 4, and 5).

One patient was initially operated on for intraabdominal bleeding due to a hepatic laceration (Case 1). The bleeding was controlled by hepatorrhaphy, but a hilar injury was missed. The patient was reoperated on on the next day due to a major bleeding from a missed portal vein injury and the hepatoduodenal ligament was inadvertently ligated. In two cases, the common and the right hepatic ducts were found to be partially transected and were primarily repaired (Case 2 and 3). One patient had liver laceration and gallbladder perforation and was treated by hepatorrhaphy and cholecystectomy, but bile duct injury was missed (Case 4). In another patient, hepatorrhaphy was performed to control bleeding from the lacerated liver, but biliary injury was again missed (Case 5). Reoperation and drainage were performed in the latter two cases in the early postoperative period due to biliary peritonitis. In one patient, a gunshot with a trajectory passing through the hepatic hilum to the left of the vena cava fragmented the left hepatic lobe and injured the middle and left hepatic veins (Case 6). The middle hepatic vein was ligated, and a left hepatectomy and contralateral Roux-en-Y hepaticojejunostomy were performed.

On admission to our unit, three patients had persistent biliary fistulas (Case 2, 4, and 5). Two patients had biliary strictures (Case 3 and 6), for which Roux-en-Y hepaticojejunostomy was performed following percutaneous transhepatic cholangiography and drainage to delineate the proximal biliary system and to relieve biliary obstruction. One patient who had been sent with sepsis and liver ischemia following ligation of the hepatoduodenal ligament underwent Roux-en-Y hepaticojejunostomy along with repair of the portal vein (Case 1). Three patients with persistent biliary fistulas underwent non-operative treatment. The biloma was treated with percutaneous drainage in two patients (Case 4 and 5) and the fistulas closed in 13 and 40 days, respectively. Endoscopic retrograde cholangiopancreatography (ERCP) enabled rapid closure of the fistula in the other patient in as soon as three days (Case 2).

No mortality occurred. One patient was lost to follow-up (Case 1). The rest were followed-up for a mean of 49 months (range 12 to 75 months). The adult patient with the gunshot injury (Case 6) developed cirrhosis due to combined effects of hepatic outflow obstruction and biliary stricture. He underwent reoperation due to a variceal bleeding in the sixth postoperative year. At laparotomy, varices that had developed at the hepaticojejunostomy site were ligated. He died from hepatic failure eleven years after the initial injury. One patient experienced occasional attacks of cholangitis (Case 3). The remaining patients became symptomless with normal biochemistry (Case 2, 4, and 5).

DISCUSSION

Although substantial experience has accumulated in the management of iatrogenic biliary injuries, the treatment of TBI is still a point of debate. This is because it is not possible to treat TBI patients under the same algorithm developed for iatrogenic biliary injuries and because experience derived from sporadic TBI cases may not be sufficient to deal with individual cases. According to Chapman et al.^[8] any iatrogenic bile duct injury identified at laparotomy should be repaired during the initial procedure. Although this is true for iatrogenic injuries, it is not justified by the principals of damage control in trauma surgery.^[3,9,10] Even the basic principals of work-up and repair have to be tailored to the individual case due to a wide variety of clinical presentations.

In general, there are three issues that should be considered in TBI patients. Firstly, patients might be referred from a primary or secondary care center in the early post-traumatic period either with an injury seen on computed tomography (CT) scans, that the referring hospital is unable to treat, or with packs inserted for control of hemorrhage at the the initial operation.^[4,11] It is more appropriate to treat such patients in tertiary trauma centers rather than tertiary HPB referral centers.

With the introduction of “damage control” concept in the last decade, mortality rates associated with major hepatic injuries have sharply decreased from 50% to 10%.^[9,10,12,13] In multiorgan trauma settings, biliary injuries are of lower priority and attempts are directed to achieve and maintain hemodynamic and metabolic stabilization of the patient by means of staged surgery and interventional radiology.^[3,4,14] Hence, it is not appropriate to perform delicate and complex biliary operations in unstable patients. Instead, drainage of the perihepatic area and, if possible, the biliary system is adequate. After recovery from trauma, the patient can be sent to an HPB unit for biliary reconstruction. Case 1 was referred to our unit in 1987, which was before the adoption of damage control concept in our institution. An urgent operation was inevitable to reperfuse the liver; therefore, the portal vein was repaired without delay by laparotomy. On the other hand, repair of the common bile duct laceration was simultaneously performed by Roux-en-Y hepaticojejunostomy. It is now clear that such an exceptional success should not encourage the surgeon to perform synchronous reconstruction of the biliary system in an unstable patient.^[3-5,14]

Biliary injuries are underdiagnosed in a considerable number of abdominal trauma patients treated either conservatively or surgically.^[15-19] With the resolution of initial symptoms, delay in diagnosis is common, since sterile bile causes only mild irritation and is continuously reabsorbed through the peritoneum.^[16,20,21] Zollinger et al.^[16] reported a mean of three-week delay before the discovery of injuries missed at initial operations.

Secondly, patients with undetected biliary injuries usually present with bilomas. Ultrasonography, CT, and radionuclide scanning are the tools for diagnosis.^[3,17,18,22,23] Endoscopic retrograde cholangiopancreatography is another valuable tool in both diag-

nosis and treatment of TBIs.^[1,18,24,25] Non-operative treatment by image-guided percutaneous drainage and ERCP often results in closure of the fistulas.^[15,18,19] In half of our patients, biliary injury was not recognised at the initial operation, and before referral, all underwent subsequent operations for the control of bile leak. The presence of an hepatic injury was common in these patients. Two of the patients with persistent biliary fistulas were treated by percutaneous drainage of the bilomas, and endoscopic papillotomy was added to percutaneous drainage in the third one. Fistulas closed in 13 and 40 days in the first two patients, respectively. Papillotomy results in rapid closure of fistulas as seen in the third patient (3 days), though it represents a technical challenge to the endoscopist in that children make up a significant percentage of TBI patients.^[3,22,26]

Thirdly, patients with TBI may present with biliary strictures months to years after trauma. Although the long-term effect of spontaneous healing of significant hepatic parenchymal lesions is unknown as regards the eventual development of biliary strictures, they are mostly attributed to unsuccessful initial repair attempts.^[6,27-30] The most important factors that influence the outcome are the preservation of the axial blood supply to the extrahepatic bile ducts and the creation of a tension-free anastomosis.^[5,27,31] Disruption of the blood supply may either result from the existing trauma or from excessive dissection around the bile ducts in order to create an end-to-end anastomosis. Several authors believe that simple partial transections without significant loss of ductal tissues can be managed by primary repair over a T-tube, with a minimal risk for late stricture formation.^[4,17,32,33] However, end-to-end anastomoses were associated with a high incidence of stricture formation reaching 55% to 60%.^[34,35] In recent years, Roux-en-Y hepaticojejunostomy has been shown to be the treatment of choice in biliary injuries in both acute and delayed settings.^[5] In our series, primary biliary repair was conducted in two patients; one required reoperation for a biliary stricture in the sixth postoperative year, and the other still experienced occasional attacks of cholangitis. Percutaneous transhepatic cholangiography and drainage have become a standard tool for elective biliary repairs, resulting in improved outcome.^[36] This technique is necessary for the delineation of

the proximal biliary system and to relieve cholangitis, both of which are known to improve survival.^[37] It may also contribute to the closure of fistulas by decreasing the biliary pressure.

The patient with the gunshot wound had major injuries to both the bile duct and the hepatic veins. Treatment with hepaticojejunostomy was followed by the development of a biliary stricture and portal hypertension due to hepatic outflow obstruction. Biliary obstruction was relieved by a repeat hepaticojejunostomy, but complications of portal hypertension led to his death eleven years after the initial trauma.

In conclusion, TBI poses a great challenge to both the traumatologist and the HPB surgeon. In hemodynamically stable patients, Roux-en-Y hepaticojejunostomy performed with expertise at the initial operation may provide a long-term success in the majority of patients. In unstable patients, however, or with an insufficiently experienced surgeon in biliary reconstruction, simple external drainage seems to be the best alternative. Definitive reconstruction should be made at a later stage under a multidisciplinary approach. Endoscopy and interventional radiology are valuable tools in the treatment of TBI patients. Surveillance and repeat interventions, whenever necessary, may improve the long-term survival.

REFERENCES

1. Sawaya DE Jr, Johnson LW, Sittig K, McDonald JC, Zibari GB. Iatrogenic and noniatrogenic extrahepatic biliary tract injuries: a multi-institutional review. *Am Surg* 2001;67:473-7.
2. Zantut LF, Machado MA, Volpe P, Poggetti RS, Birolini D. Traumatic injuries of the gallbladder and of the extrahepatic biliary tract: analysis of 45 cases. *Rev Assoc Med Bras* 1995;41:53-9. [Abstract]
3. Feliciano DV. Biliary injuries as a result of blunt and penetrating trauma. *Surg Clin North Am* 1994;74:897-907.
4. Berne TV, Donovan AJ. Liver and bile duct injury. In: Blumgart LH, Fong Y, editors. *Surgery of the liver and biliary tract*. 3rd ed. London: W. B. Saunders; 2000. p. 1277-99.
5. Jurkovich GJ, Hoyt DB, Moore FA, Ney AL, Morris JA Jr, Scaela TM, et al. Portal triad injuries. *J Trauma* 1995; 39:426-34.
6. Pachter HL, Liang HG, Hofstetter SR. Liver and biliary tract trauma. In: Moore EE, Mattox KL, Feliciano DV, editors. *Trauma*. 2nd ed. Norwalk, Connecticut: Appleton & Lange; 1991. p. 441-63.

7. Schweizer WP, Matthews JB, Baer HU, Nudelmann LI, Triller J, Halter F, et al. Combined surgical and interventional radiological approach for complex benign biliary tract obstruction. *Br J Surg* 1991;78:559-63.
8. Chapman WC, Halevy A, Blumgart LH, Benjamin IS. Postcholecystectomy bile duct strictures. Management and outcome in 130 patients. *Arch Surg* 1995;130:597-602.
9. Pachter HL, Spencer FC, Hofstetter SR, Liang HG, Coppa GF. Significant trends in the treatment of hepatic trauma. Experience with 411 injuries. *Ann Surg* 1992;215:492-500.
10. Krige JE, Bornman PC, Terblanche J. Liver trauma in 446 patients. *S Afr J Surg* 1997;35:10-5.
11. Clark DE, Cobean RA, Radke FR, Abourjaily GS, Curci MR. Management of major hepatic trauma involving interhospital transfer. *Am Surg* 1994;60:881-5.
12. Cogbill TH, Moore EE, Jurkovich GJ, Feliciano DV, Morris JA, Mucha P. Severe hepatic trauma: a multi-center experience with 1,335 liver injuries. *J Trauma* 1988;28:1433-8.
13. Feliciano DV, Mattox KL, Jordan GL Jr, Burch JM, Bitondo CG, Cruse PA. Management of 1000 consecutive cases of hepatic trauma (1979-1984). *Ann Surg* 1986;204:438-45.
14. Pachter HL, Feliciano DV. Complex hepatic injuries. *Surg Clin North Am* 1996;76:763-82.
15. De Backer A, Fierens H, De Schepper A, Pelckmans P, Jorens PG, Vaneerdegew W. Diagnosis and nonsurgical management of bile leak complicated by biloma after blunt liver injury: report of two cases. *Eur Radiol* 1998;8:1619-22.
16. Zollinger RM Jr, Keller RT, Hubay CA. Traumatic rupture of the right and left hepatic ducts. *J Trauma* 1972;12:563-9.
17. Michelassi F, Ranson JH. Bile duct disruption by blunt trauma. *J Trauma* 1985;25:454-7.
18. Sugimoto K, Asari Y, Sakaguchi T, Owada T, Maekawa K. Endoscopic retrograde cholangiography in the non-surgical management of blunt liver injury. *J Trauma* 1993;35:192-9.
19. Pachter HL, Knudson MM, Esrig B, Ross S, Hoyt D, Cogbill T, et al. Status of nonoperative management of blunt hepatic injuries in 1995: a multicenter experience with 404 patients. *J Trauma* 1996;40:31-8.
20. Busuttill RW, Kitahama A, Cerise E, McFadden M, Lo R, Longmire WP Jr. Management of blunt and penetrating injuries to the porta hepatis. *Ann Surg* 1980;191:641-8.
21. Cohn I Jr, Cotlar AM, Atik M, Lumpkin WM, Hudson TL, Wernette GJ. Bile peritonitis. *Ann Surg* 1960;152:827-35.
22. Moulton SL, Downey EC, Anderson DS, Lynch FP. Blunt bile duct injuries in children. *J Pediatr Surg* 1993;28:795-7.
23. Delgado Millan MA, Deballon PO. Computed tomography, angiography, and endoscopic retrograde cholangiopancreatography in the nonoperative management of hepatic and splenic trauma. *World J Surg* 2001;25:1397-402.
24. Sugiyama M, Atomi Y, Matsuoka T, Yamaguchi Y. Endoscopic biliary stenting for treatment of persistent biliary fistula after blunt hepatic injury. *Gastrointest Endosc* 2000;51:42-4.
25. Carrillo EH, Reed DN Jr, Gordon L, Spain DA, Richardson JD. Delayed laparoscopy facilitates the management of biliary peritonitis in patients with complex liver injuries. *Surg Endosc* 2001;15:319-22.
26. Keil R, Snajdauf J, Stuj J, Kalousova J, Kocmichova B, Hribal Z. Nonoperative therapy of the posttraumatic biliary fistula in adolescents. *Eur J Pediatr Surg* 2001;11:274-6.
27. Jarnaghin WR, Blumgart LH. Benign biliary strictures. In: Blumgart LH, Fong Y, editors. *Surgery of the liver and biliary tract*. 3rd ed. London: W. B. Saunders; 2000. p. 895-934.
28. Horiguchi J, Ohwada S, Tanahashi Y, Sawada T, Ikeya T, Ogawa T, et al. Traumatic biliary stricture successfully treated by percutaneous transhepatic bile duct dilatation: a case report. *Hepatogastroenterology* 1998;45:2038-41.
29. Yoon KH, Ha HK, Kim MH, Seo DW, Kim CG, Bang SW, et al. Biliary stricture caused by blunt abdominal trauma: clinical and radiologic features in five patients. *Radiology* 1998;207:737-41.
30. Wilson RF, Walt AJ. Injuries to the liver and biliary tract. In: Wilson RF, Walt AJ, editors. *Management of trauma pitfalls and practice*. 2nd ed. Baltimore: Williams & Wilkins; 1996. p. 449-72.
31. Terblanche J, Allison HF, Northover JM. An ischemic basis for biliary strictures. *Surgery* 1983;94:52-7.
32. Rodriguez-Montes JA, Rojo E, Martin LG. Complications following repair of extrahepatic bile duct injuries after blunt abdominal trauma. *World J Surg* 2001;25:1313-6.
33. Bade PG, Thomson SR, Hirshberg A, Robbs JV. Surgical options in traumatic injury to the extrahepatic biliary tract. *Br J Surg* 1989;76:256-8.
34. Csendes A, Diaz JC, Burdiles P, Maluenda F. Late results of immediate primary end to end repair in accidental section of the common bile duct. *Surg Gynecol Obstet* 1989;168:125-30.
35. Bourque MD, Spigland N, Bensoussan AL, Garel L, Blanchard H. Isolated complete transection of the common bile duct due to blunt trauma in a child, and review of the literature. *J Pediatr Surg* 1989;24:1068-70.
36. Lillemoe KD, Melton GB, Cameron JL, Pitt HA, Campbell KA, Talamini MA, et al. Postoperative bile duct strictures: management and outcome in the 1990s. *Ann Surg* 2000;232:430-41.
37. Stewart L, Way LW. Bile duct injuries during laparoscopic cholecystectomy. Factors that influence the results of treatment. *Arch Surg* 1995;130:1123-8.