Especialidad: Cirugía General

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CARLOS ARTURO HINOJOSA BECERRIL.

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UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO

FACULTAD DE MEDICINA
DIVISION DE ESTUDIOS DE POSGRADO E INVESTIGACION

SUBDIVISION DE ESPECIALIZACIONES MEDICAS

OFICIO FMED/SEM/1379/2003

ASUNTO: Autorización del trabajo de investigación del Dr. Carlos Arturo Hinojosa Becerril.

DR. ISIDRO AVILA MARTINEZ
SECRETARIO DE SERVICIOS ESCOLARES
DE LA FACULTAD DE MEDICINA
Presente.

Estimado Dr. Avila Martínez:

Me permito informar a usted que el **Dr. Carlos Arturo Hinojosa Becerril,** alumno del curso de especialización en **Cirugía General** en el **Instituto Nacional de Ciencias Médicas y de la Nutrición "Dr. Salvador Zubirán"**, presenta el trabajo de investigación intitulado ***"Acute bile duct injury"***.

De conformidad con el artículo 21 capítulo 5º de las Normas Operativas del Plan Unico de Especializaciones Médicas (PUEM) se considera que cumple con los requisitos para validarlo como el trabajo formal de Investigación que le otorga el derecho de la diplomación como especialista.

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Dr. Leobardo Ruiz Pérez
Jefe de la Subdivisión de Estudios de
Posgrado e Investigación
Facultad de Medicina, UNAM
Presente.

Por medio del presente, le comunico que esta Dirección de Enseñanza no tiene inconveniente alguno, en que el trabajo titulado **"Acute bile duct injury"**, que presenta el DR. CARLOS ARTURO HINOJOSA BECERRIL, Médico Residente de cuarto año de la Especialidad de Cirugía General, se le considere como tema de tesis para realizar los trámites de la Diplomación Oportuna.

Atentamente,

Dr. Luis E. Uscanga Domínguez
Director de Enseñanza

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Acute bile duct injury.

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Department of Surgery, National Institute of Medical Sciences and Nutrit Salvador Zubiran, Vasco de Quiroga 15, Mexico City 14000, Mexico.

Background: An immediate repair is considered optimal in acute biliary c injuries; however, it may prove to be a challenge, because such repairs ar usually performed on small ducts whose viability cannot always be determined. Methods: We performed a retrospective review of the charts patients with acute bile duct injury who underwent repair at a tertiary car academic university hospital. A total of 204 patients with acute bile duct injury were seen between 1989 and 2002. Of these, 30 were repaired with minutes to hours after the injury. These patients were divided into two gr Group I patients had a Roux-en-Y hepatojejunostomy below the hepatic junction; Group II patients had a Roux-en-Y hepatojejunostomy at the junction level. We then performed a long-term evaluation of anastomosis function in these patients, using clinical, radiological, and laboratory. Res Twenty-eight injuries were secondary to a laparoscopy; the other two resu from open cholecystectomies. All of the patients suffered complex injurie with complete section of the duct and substance loss (Strasberg E). There 12 patients in group I and 18 in group II. Three cases in group I (25%) an one in group II (5%) developed anastomosis dysfunction. Mean follow-u 56 months (range, 12-80) in group I and 52 months (range, 10-76) in grou Two cases in group I (16%) and none in group II (0) required reoperation <0.05). Conclusions: In the acute setting, complex lesions should be treat with a high bilioenteric anastomosis (at the junction level) in the first atte at repair. Lower-level anastomoses are associated with a higher dysfuncti rate and the need for radiological manipulation and reoperation. Also, ste of the anastomosis secondary to undetected duct ischemia in the acute rep more frequent in low bilioenteric anastomoses.

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Acute bile duct injury: the need for a high repair

Dear Dr. Mercado.

On behalf of the Editorial Board, I am pleased to inform you that your manuscript has been accepted for publication pending revision according to the reviewer comments.

When the North American Editorial Office receives three copies of the final manuscript (including figures and tables) as well as a disk and a detailed explanation of the changes made, we will be able to do a final evaluation for acceptance and process your manuscript for publication. It is also essential that the revised manuscript be edited by a native English speaking doctor.

Your revised version must be received in the editorial office within two months of receipt of this letter, by 03/13/2003. Your paper will no longer be accepted for publication if we do not receive your revision or a notification of delay by 03/13/2003.

It is important that we have your current email address, since proofing will now be handled electronically.

Best regards,
Bruce V. MacFadyen Jr. MD
Bruce V. MacFadyen, Jr., MD

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Acute bile duct injury

The need for a high repair

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Abstract

Background: An immediate repair is considered optimal in acute biliary duct injuries; however, it may prove to be a challenge, because such repairs are usually performed on small ducts whose viability cannot always be determined. *Methods:* We performed a retrospective review of the charts of patients with acute bile duct injury who underwent repair at a tertiary care academic university hospital. A total of 204 patients with acute bile duct injury were seen between 1989 and 2002. Of these, 30 were repaired within minutes to hours after the injury. These patients were divided into two groups. Group I patients had a Roux-en-Y hepatojejunostomy below the hepatic junction; Group II patients had a Roux-en-Y hepatojejunostomy at the junction level. We then performed a long-term evaluation of anastomosis function in these patients, using clinical, radiological, and laboratory. *Results:* Twenty-eight injuries were secondary to a laparoscopy; the other two resulted from open cholecystectomies. All of the patients suffered complex injuries with complete section of the duct and substance loss (Strasberg E). There were 12 patients in group I and 18 in group II. Three cases in group I (25%) and one in group II (5%) developed anastomosis dysfunction. Mean follow-up was 56 months (range, 12–80) in group I and 52 months (range, 10–76) in group II. Two cases in group I (16%) and none in group II (0) required reoperation ($p < 0.05$). *Conclusions:* In the acute setting, complex lesions should be treated with a high bilioenteric anastomosis (at the junction level) in the first attempt at repair. Lower-level anastomoses are associated with a higher dysfunction rate and the need for radiological manipulation and reoperation. Also, stenosis of the anastomosis secondary to undetected duct ischemia in the acute repair is more frequent in low bilioenteric anastomoses.

Keywords: Bile duct injury, Cholecystectomy complications, Roux-en-Y hepatojejunostomy, Bilioenteric anastomosis, Iatrogenic injuries

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Biliary injury is a demanding challenge for patient and surgeon alike. It is a complex condition induced by the surgeon in an otherwise healthy (and usually young) patient that is associated with significant morbidity and—although the mortality rule is low—can cause death in the long term. It is generally

accepted that the incidence of injuries has increased because of the widespread use—and probable overuse—of laparoscopic cholecystectomy; the incidence now ranges from <Author Query 2: 0.3% to 0.6%> in most hospitals worldwide [1]. Several causal factors have been implicated in the occurrence of such lesions [12], but it is very difficult to prevent them completely. They continue to occur even after the learning curve has been surpassed and even at the hands of the most experienced surgeons. Strasberg et al. have developed a classification that describes the entire spectrum of lesions produced by laparoscopy [13] and includes all the possibilities that may be observed. Within the Strasberg classification, type A refers to external biliary fistula, type B to the section of accessory ducts, type C to leakage secondary to injury of the accessory ducts, type D to lateral lesion of the duct, and type E (and subtypes) complete lesion of the duct at different levels.

Most lesions are recognized in the early postoperative period (torpid postoperative evolution with ileus, biliary ascites, and/or jaundice). Less frequently (<50%), the injuries are recognized intraoperatively. In the remaining cases, the lesions are detected in the late postoperative period; *patients present mainly with symptoms of cholangitis and biliary obstruction* [2].

Early repair is considered optimal, and a better outcome for the patient can to be expected when the injury is recognized intraoperatively. Immediate conversion to an open procedure is indicated after detection of the injury and repair according to its type. Most surgeons would agree that a biliodigestive (Roux-en-Y hepatojejunostomy) is the treatment of choice for complex injuries that include complete duct section and loss of substance (Strasberg E) [7].

Other options, such as duct-to-duct or hepatoduodenum anastomosis, have not had good long-term results. The repair should be performed only if the surgeon feels confident; otherwise, a surgeon with ample experience in biliary tract surgery should be called in. If an expert is not available, the patient should be referred to a tertiary care center for the repair.

Herein we review our experience with biliary-injured patients who were reconstructed in an acute setting (within minutes to hours after the injury). We compare two groups of patients: those with a high bilioenteric anastomosis vs those with a low bilioenteric anastomosis.

Patients and methods

Between April 1989 and April 2002, 204 patients were referred to our surgical team for biliary tract reconstruction after bile duct injury. A total of 30 cases were operated on in an acute setting, which was defined as an operation performed minutes to hours (<24 h) after the injury. Six cases were repaired during the same operation in which the injury occurred, and 22 cases were referred from other hospitals within hours of the injury. Patients were operated on after stabilization.

The charts of these patients were analyzed, and they were divided into the following two groups: group I, patients with Roux-en-Y hepatojejunostomy with a low anastomosis (below the hepatic junction), and group II, patients with Roux-en-Y hepatojejunostomy with a high anastomosis (at the level of the hepatic junction). All patients had complex injuries with complete section of the duct and substance loss (Strasberg E).

Anastomosis dysfunction was diagnosed when the patients showed clinical or laboratory evidence of obstruction: obstructive jaundice, cholangitis, and/or abnormalities of liver function tests (increased bilirubin and alkaline phosphatase). Percutaneous cholangiography was initially performed in these

cases to evaluate the patients' anastomosis status, after which they were reoperated.

Groups were compared using Fisher's exact test.

Results

General data for the 30 cases are shown in Table 1. *Twenty-eight injuries resulted from a laparoscopy,* six were created after conversion to an open procedure (according to the referring surgeon's report), and two were secondary to an open procedure. All of the patients had complex injuries at different levels with complete duct section.

There were 12 patients in group I and 18 in group II. All cases were repaired by our team. Six were repaired during the operation in which the injury occurred. Twenty-four were referred from other hospitals; a drainage system had been placed in the subhepatic area in 17 patients, and seven arrived packed with gauze in the upper abdominal quadrant. Electrolyte abnormalities were corrected after arrival.

All of the patients had varying amounts of free bile (200–2000 ml) disseminated in the peritoneal cavity. The hepatic hilus was explored after profuse peritoneal lavage. Careful dissection under magnification was carried out, preserving the small arterial branches as much as possible. The duct had a bile leak in all but two cases, where partially occluding clips were identified. Packed patients also had vascular injuries and/or bleeding at different levels—three from the gallbladder bed and at the level of Calot's triangle, two with small injuries to the right portal vein, and one in the left portal vein. This last case required a concomitant left hepatectomy; the others underwent primary repair of the vessels using standard vascular techniques.

After we had identified the ligament of Treitz, a 40–50-cm Roux-en-Y loop was constructed, and the anastomosis was performed under magnification using separate 5-0 polyglycolic acid stitches. A transhepatic stent was used in all cases. The anastomosis level depended on finding a healthy duct, as determined by the operating surgeon and team. In cases with a high repair, the anastomosis was done at the junction level <Author Query 3: >(Fig. 1). The confluence of the ducts was identified intraluminally, and a longitudinal anterior section of the left hepatic duct was performed. Cases treated with a low repair were those in which a longitudinal anterior section of the common hepatic duct was performed without reaching the duct confluence. Subhepatic and suprahepatic drains were placed and extracted through separate incisions. There were no operative deaths.

Three cases developed small supra- and infrahepatic collections that required CT-guided percutaneous drainage. Patients were discharged when their general condition improved and oral intake with intestinal transit was demonstrated.

Mean hospital stay was 7.3 days (range, 5–16). In the 2nd postoperative week, a cholangiography was obtained, and the transhepatic stents were closed if adequate bile passage and no leaks were seen. Patients were instructed to flush the stents two to three times a week. Stents were removed between the 5th and 7th postoperative months, based on cholangiographic findings. Radiological intervention was carried out if there was evidence of stenosis and/or obstruction with or without lithiasis. The cases that failed to dilate after radiological manipulation were reoperated, and a new hepatojejunostomy was performed. Three patients (25%) in group I needed radiological instrumentation; the technique was unsuccessful in two cases, which were reoperated (<Author

Query 4: > Fig. 2). In the high repair group, only one patient needed radiological instrumentation. There was evidence only of bile sludge; no stenosis was seen at the anastomosis level.

All but three patients were available for follow-up. These three were lost after the 1st postoperative year (one in group I, two in goup II). Mean follow-up was 56 months (range, 12–80) for group I and 52 months (range, 10–76) for group II. The lost patients were asymptomatic at the time of their last visit after removal of the transhepatic stent.

All dysfunctions were detected in the 1st postoperative year, early after removal of the stent (between the 6^{th} and 12^{th} postoperative months). Eleven patients (89%) in group I are currently doing well; all 11 have achieved complete clinical rehabilitation, including the two reoperated patients. One patient has persistently elevated alkaline phosphatase but no other symptoms. In group II, 16 patients (87%) were available for follow-up, and all have had good long-term results.

Significant differences were found when reoperations and anastomosis stenoses were compared; both comparisons favored the group with a high repair, where there were no reoperations and no anastomotic dysfunction.

Discussion

There is no doubt that the increase in indications for cholecystectomy and the introduction of the laparoscopic approach are directly responsible for the dramatic growth in the number of biliary duct lesions. The data presented in this report show a higher failure rate for patients in whom a repair was done at the level of the common hepatic duct and a better outcome for patients in whom the reconstruction was done at the level of the biliary junction, where better-quality ducts can be found. Anastomotic dysfunction occurred early in the postoperative period (within the 1st postoperative year).

Due to the nature of their mechanisms, laparoscopic injuries have unique features that produce a wide spectrum of lesions, ranging from small orifices and bile duct leaks (main and accessories) to complete ablation of the duct. Strasberg's classification describes a spectrum of lesions produced by laparoscopy [13], in which all the possibilities that might be observed are included.

In some cases, there are concomitant complex vascular injuries [15]. Dissection of the misidentified main duct under scope magnification enables the ligature to be done with clips and/or the electrocoagulation of small branches of the hepatic artery, which are important for duct viability. Biliary leaks produced in the presence of duct continuity (Strasberg A) can be resolved by means of an endoscopic and/or a radiological approach. There are <Author Query 5: several ways to resolve injured> ducts that drain isolated segments that are not in continuity with the main duct, including drainage with late spontaneous occlusion (with late atrophy of the drained segments); surgical occlusion, if the duct is very small; or a biliodigestive anastomosis, if the duct has a diameter of >2–3 mm [11]. Liver resection is seldom necessary; it is needed only in patients with refractory cholangitis and/or persistent fistula. For Strasberg E lesions, surgical reconstruction is the only option and is mandatory.

Surgeons called on to repair these lesions may be confronted with several scenarios:

1. Acute setting (minutes to hours after the injury)
2. Late acute setting (days after the injury)
3. Late setting (weeks after the injury). These cases are characterized by external biliary fistulas or biliary obstruction, with or without cholangitis. Many of them cases have undergone previous attempts at repair. Most reported series of iatrogenic injuries involve this type of patient.

In the acute setting, patients are generally in good status and/or can be rapidly corrected. Most of the severed ducts can be identified. The flow of bile can be seen through the hilar components, without inflammatory reaction. Clips or sutures occluding the branches of the hepatic artery or the right hepatic artery can usually be identified. After the duct is identified, instrumentation of the duct with dilators is done to identify the right and left ducts. When the duct is completely severed, it is difficult to obtain a cholangiogram, so the ducts have to be identified via careful instrumentation.

Reconstruction should always be attempted. We do not support a policy of waiting for spontaneous occlusion of the duct and dilation after an external fistula [4]. In our experience, bile produces an inflammatory reaction, leading to localized and generalized peritonitis with systemic repercussions for the patient. Adequate drainage of the cavity can diminish, but not always preclude, this situation.

Bile duct ligation can produce hepatic dysfunction, as well as cholangitis. <Author Query 6: For this reason, we do not recommend ligating> the duct and waiting for dilation if, as in most cases, the repair can be completed. An acutely ligated duct is not comparable to malignant obstruction of the duct (intrinsic or extrinsic), in which a slow increase of bile pressure produces dilation of the duct without acute consequences. This is why immediate attempt of repair is always recommended, except in cases where the patient is in a poor general state with hydroelectrolitic abnormalities and/or septic conditions. Percutaneous drainage and/or limited surgical drainage is the treatment of choice for these cases. In some cases, surgery must be deferred for weeks until the inflammatory reaction diminishes [8].

We favor the reconstruction of complex cases (Strasberg E) with a Roux-en-Y hepatojejunostomy. Loss of substance and ischemic compromise of the duct are the rule in these lesions, making an end-to-end (duct-to-duct) anastomosis risky, because tension generated at the anastomosis level subsequently produces leakage, ischemia, and stenosis.

In patients who were operated on for a late repair, the stricture was one level higher than the level of the original injury, as described by Bismuth and Manjo [4]. This was probably due to a late ischemic event. In the acute setting, the evaluation of the duct can be deceptive because the relatively fresh end is seen with a minimal inflammatory reaction, making it difficult to assess the stump's circulatory status. The surgeon tends to preserve a duct as long as possible; and in some instances, an ischemic stump that is preserved will produce a stricture in the late postoperative period. A late biliary fistula (4^{th} to 10^{th} postoperative day) can also result from an ischemic duct rather than a technically deficient anastomosis.

In Strasberg E injuries, by definition, ablation of the duct deprives it from the arterial circulation provided by the gastroduodenal and pancreaticoduodenal arteries. In these lesions, blood to the duct is totally <Author Query 7: dependent on the hepatic artery, a> situation that closely resembles that of liver transplantation, in which patency and preservation of the hepatic artery and their branches are critical for the viability of the duct [16].

Thus, we routinely favor a high dissection of the duct, at the level of the junction where no inflammatory reaction is found and no evidence of the first surgery can be seen. This technique also results in adequate microcirculatory status of the ducts, assuring the successful results of a carefully executed anastomosis. When performing this dissection, it is advisable to prevent damage to the arterial branches close to the ducts so as to avoid circulatory compromise. Circulation can be preserved if only the anterior aspect of the ducts is dissected at the junction level.

In some instances, partial liver resection of segments IV and V [9, 14] can be done. This maneuver allows identification and exposure of the anterior aspect of the ducts. In the acute setting, it is usually not possible to find a dilated duct. On the contrary, in most—if not all—cases, small-diameter ducts are found. Thus, the repairing surgeon has two options: a terminolateral anastomosis of the duct at the level at which he or she believes a healthy duct is found, and second, a longitudinal incision of the anterior aspect so as to obtain a wider anastomosis (Hepp-Couinaud) [5]. Even with the latter approach, the development of a late stenosis due to ischemia is possible if the circulatory status of the duct is altered.

Koffron et al. studied vascular biliar injury in patients with a failed primary surgery of the injured duct. In an angiographic study of 18 patients with failure of reconstruction, vascular injury was seen in 61%. A high injury increased the probability of finding concomitant arterial damage. They also concluded that arterial disruption might affect the outcome of the first repair attempt [6].

Bachellier et al. advocate the reconstruction of severed arteries, in an attempt to reestablish the arterial flow to the hepatic lobe [3]. This reconstruction probably does not reestablish duct circulation, although circulation to the hepatic lobe can be restored. The use of a stent is advisable for these high, small-duct anastomoses [10]. Although the anastomosis is performed on a healthy duct, it usually has a small diameter. The <Author Query 8: maintenance of low bile pressure> in the ducts is advisable to prevent leakage and subsequent fistula with a perianastomotic inflammatory reaction that can produce ischemia and late scarring.

We recommend that all complex injuries (Strasberg E) in the acute setting be treated from the beginning with a high bilioenteric (junction level) anastomosis. Arguably, the failure of a high repair can be disastrous, because there is no further chance to perform another anastomosis. In our experience, however, a carefully performed anastomosis with healthy ducts has a low probability of failure.

We began to treat these lesions with a high repair because we had the impression that a low reconstruction was associated with a higher rate of stenosis. In this retrospective comparative study, better results were achieved in patients in whom the lesion had been treated with a high repair, although the long-term results for the two groups were comparable. We consider that it is virtually impossible to conduct a prospective controlled randomized study comparing high with low repairs because of the shortage of cases (30 cases in 10 years) and the almost individual anatomical and functional nature of each lesion.

Although we are in no way against a low repair, we believe that a higher repair has a more favorable outcome with a lower probability of reoperation. We are certain that if an adequate duct is found (one with no ischemia and no inflammatory process), a good result can be obtained even with a low repair. However, in the acute setting, the status of the duct is difficult to evaluate; thus, a high repair is a better choice.

ur proposal of a high repair *de principe* is intended for acute lesions in which the common duct ameter is normal or even smaller than normal (which is almost the rule in injured ducts). It is not commended for a dilated duct, found in some cases of elective repairs. Dilated ducts are easily ıastomosed; although scarring occurs, the final diameter of the anastomosis is sufficient for long-rm patency. Patients with dilated ducts are usually not referred to tertiary care centers because they ın be treated in most large hospitals and specific experience in bile duct injury repairs is not :cessarily required.

high repair is recommended for acute cases with normal or subnormal diameter in which the rculatory status of the duct cannot be assessed because of the fresh nature of the injury. The high :pair generally requires greater surgical expertise and experience in dissection of the liver hilus, aking it a technically more challenging operation. The decision to perform a lower anastomosis is :rhaps easier, but the higher probability of failure should be weighed carefully against the difficulty of ıe high anastomosis and its greater likelihood of success.

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.eferences

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Tables

Table 1. Patient data

Figures

Figure 1
Figure 1 (large scale)

Fig. 1. Patent bilioenteric anastomosis done at the junction level.

Figure 2
Figure 2 (large scale)

Fig. 2. Late stenosis at the level of the hepatic common duct. Failed radiological instrumentation led to the need for reoperation.

Queries

Author Query 1
Verify address and pls translate into English

Author Query 2
Unclear whether the 0.3 to 0.6% refers to BD injury or use of LC; pls clarify

Author Query 3
Placement of ref. to fig 1 ok?

thor Query 4
Placement of fig 2 correct?
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thor Query 6
As meant?
thor Query 7
"dependent on the hepatic artery" or "independent of the hepatic artery"? unclear
thor Query 8
As meant? How do you ensure that bile pressure is low?
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Provide names of all aus for all refs. (1, 7, 3, 6, 8, 9, 10, 11) do not use et al
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