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Comparison of Multidetector CT and Digital Subtraction Angiography Findings to Determine Accompanying Vascular Injuries in Patients with Detected Benign Biliary Injury after Laparoscopic Cholecystectomy and Investigation of Efficacy

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Abstract

There are many reasons for benign biliary strictures. Surgery is the most common reason for these injuries and laparoscopic cholecystectomy constitutes the main cause. Whether bile duct injuries are accompanied by vascular injuries after laparoscopic cholecystectomy is a point of interest.This study aimed to investigate the effect of vascular injury that occurred during laparoscopic cholecystectomy and whether vascular injuries might be shown using minimal invasive imaging modalities such as Computed Tomography (CT) angiography.The study was designed as a retrospective investigation. The study group included 30 patients who were referred with biliary strictures after laparoscopic cholecystectomy.Vascular injury was detected in 10 of 30 patients. Right hepatic artery injury was observed most frequently. With patients in whom Bismuth type 4 biliary stricture was detected, concomitant vascular injury was found to be more common.

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The average number of days before the onset of symptoms was very low and the average hospital residence time was high in the group who also had vascular injuries when compared to the other group. When the two groups' clinics during the hospital discharge were compared, there were no significant differences. After hospital discharge, the restenosis rates of the group who also had vascular injury were twice those of the other group.

Unlike biliary injuries, little attention is paid to vascular injuries because they do not lead to significant complications. However, why is it so difficult to treat bile duct injuries.Is it because this group of injuries is also accompanied by arterial injuriesIn recent years studies have shown that in patients who, after laparoscopic cholecystectomy, suffer bile duct injuries accompanied with hepatic arterial injuries, hepatic abscess and bilioenteric anastomosis strictures have been reported, compared to patients who have only bile duct injuries. The studies have shown that bile duct injuries accompanied by arterial injuries might cause liver necrosis or abscess and increase the risk of bleeding and recurrent stenosis during repair.

Accompanied vascular injuries have not previously been investigated in routine practice. But today there is a minimal invasive imaging modality called Computed Tomography Angiography (CTA), which has high accuracy rates in evaluating vascular structures. So CTA allows biliary-vascular injuries to be determined and post-operative pathologies to be encountered earlier, allowing an appropriate treatment algorithm.

Keywords: multidetector CT; digital subtraction angiography ; accompanying vascular injuries ; benign biliary injury ; laparoscopic cholecystectomy.

1. Introduction

There are many reasons for benign biliary strictures. Surgery is the most common reason for these injuries and laparoscopic cholecystectomy constitutes the main cause of them. The first laparoscopic cholecystectomy was performed in 1980 by Mühe, Dubois and Perissat in Europe, and by Reddick and Olsen in America. After the first attempt at laparoscopic cholecystectomy in 1980, the number of these initiatives increased rapidly. By the late 1980s, laparoscopic cholecystectomy had become the preferred treatment for acute cholecystitis and symptomatic gallstone disease, due to the fact that compared to open cholecystectomy patients required a shorter hospital stay, experienced better cosmetic results and less postoperative pain, and were able to return to daily activities sooner. However, laparoscopic cholecystectomy can result in high injury. Given the high number of laparosopic cholecystectomies it is easy to see why the number of biliary injuries is so high .Whether biliary injuries are accompanied by vascular injuries after laparoscopic cholecystectomy is a point of interest. This study aimed to investigate the effect of vascular injury occuring during laparoscopic cholecystectomy and whether vascular injuries might be detected using minimal invasive imaging modalities such as CT angiography.

2. Material and Methods

The study was designed as a retrospective investigation. The study group included 30 patients who were referred with biliary strictures after laparoscopic cholecystectomy. The group was evaluated for accompanying vascular injuries and effects of this injury. CT and Digital Subtraction Angiography (DSA) imaging findings were

compared.

3. Results

The group consisted of 21 women and 9 men and the average age was calculated as 47.2, ranging between 29 and 75.The patients were admitted most frequently with symptoms of jaundice and cholangitis. Vascular injury was detected in 10 of the 30 patients (33.3%). Compared with the literature this was observed as being markedly high. Right hepatic artery injury was observed most frequently.

The average number of days for the onset of symptoms in the group with vascular injuries was 48.2, and 183 days for the group that did not have vascular injuries.

Bizmuth type 3 and Bizmuth type 4 biliary injury were detected in 83.3% of patients. Concomitant vascular injury was found to be more common in those patients in whom Bismuth type 4 biliary stricture was detected.

Digital Subtraction Angiography was performed on 10 patients in whom vascular injury was detected on the CT angiography for the purpose of verification, and the diagnosis was confirmed.

Prior to surgery, percutan transhepatic cholangiography (PTC) and drainage procedure were performed in all patients except two, in order to relieve clinical symptoms and to determine stricture levels. Two patients underwent balloon dilation. In one patient a biloma was detected on the CT scan and this was drained percutaneously. In one patient an arteriovenous fistula was detected and a fistula embolization was performed. In one patient in whom an intrahepatic abscess was detected, drainage was performed using ultrasound. Endoscopic retrograde cholangiopancreatography (ERCP) was performed in 17 patients. One patient underwent stent replacement; two patients underwent balloon dilation; one patient had a papillotomy; and one patient underwent a sphincterotomy. In 20 patients Roux-Y hepaticojejunostomy was performed, two patients underwent a choledochoduodenostomy, one patient had a laparotomy and drainage, one patient underwent a right hepatectomy, and drainage was performed in one patient with a biloma and in another with an intrahepatic abscessanother.

In the period after surgery, one patient developed a fever, four developed a wound infection and one patient developed abdominal pain. Two of these patients were patients with vascular injury.

In the period after right hepatectomy surgery, a collection of fluid was detected in the hepatectomy region.

Incisional hernia was observed in two patients.

One patient required a re-operation and was discharged with a biliary reconstruction plan.

One patient was discharged with a controlled biliary fistula which was to undergo intervention later.

Hospital post-discharge clinics and hospital residence times were compared between the two groups. In patients with vascular injury the average hospital residence time was calculated as 103.5 days and in the other group the

time was calculated as 78.35 days.

Twenty-three of the patients were discharged with healing. After hospital discharge, six patients were lost in the long-term follow-up. In 24 patients, mean follow-up time was calculated as 19.12 months after hospital discharge. During this follow-up time one patient died due to other nonrelated diseases. Restenosis developed in four patients. Fifty percent of restenosis cases were accompanied by vascular injury. In the accompanied-vascular injury group restenosis rates were two times more than the other group.

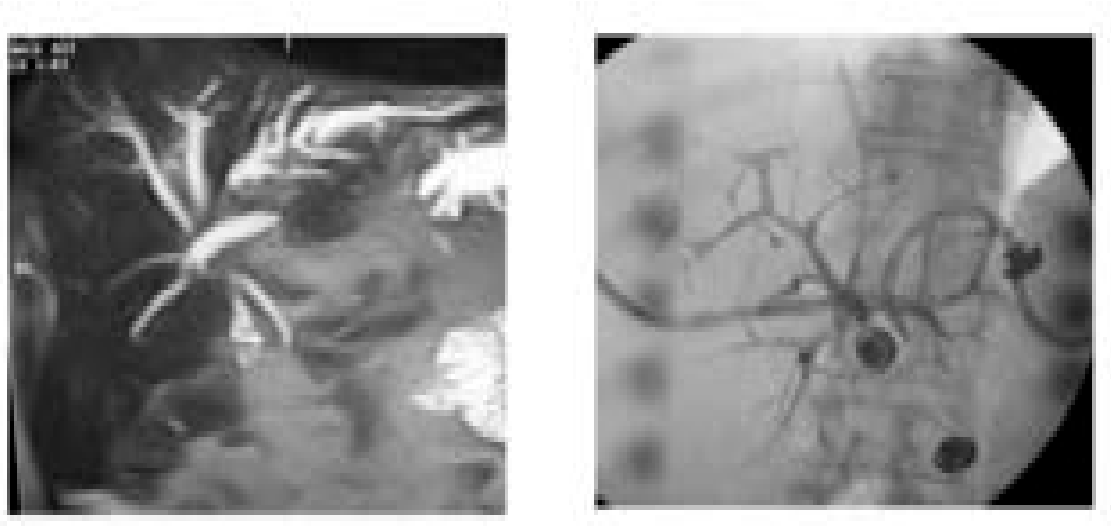

Figure 1: Bizmuth type 4 biliary stricture on MRCP and PTC images

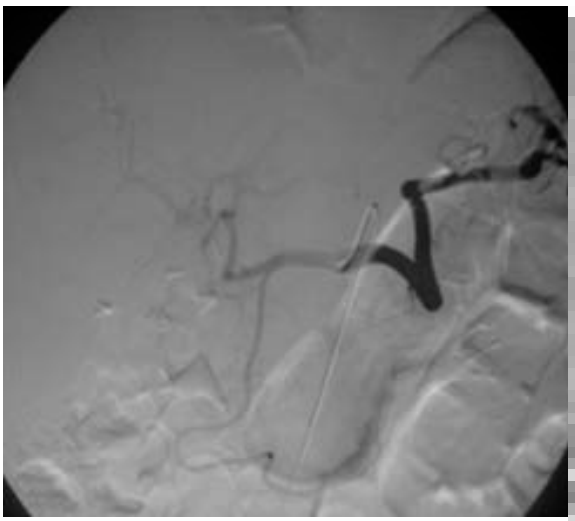

Figure 2: Sağ hepatic arterial injury on DSA

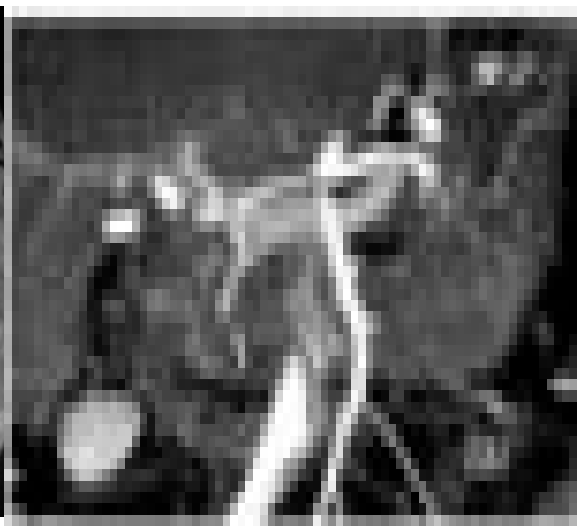

Figure 3: CTA reconstruction images shows hepatic Arterial injury.

4. Discussion

There are many reasons for benign biliary strictures. Post-surgery strictures, post-traumatic strictures, after liver transplantation, papillary stenosis, duodenal diverticule, biliary atresia, coledocal cysts, hepatic cysts, polycystic

liver disease, sclerosind cholangitis, cholangiohepatitis, cholangitis after chemotherapy, cholangitis secondary to AIDS, parasitic infections, tuberculosis, sarcoidosis, acute and chronic pancreatitis, impacted biliary calculi, and Mirizzi syndrome can all be counted as causes of benign biliary strictures. Surgery is the most common reason for these injuries and laparoscopic cholecystectomy constitutes the main cause. The first cholecystectomy was performed in 1882 by Langebuch. The first laparoscopic cholecystectomy in Europe was performed in 1980 by Mühe, Dubois and Perissat, and in America by Reddick and Olsen. After the first attempt at laparoscopic cholecystectomy in 1980, the number of these initiatives increased rapidly. By the late 1980s, laparoscopic cholecystectomy had become the preferred treatment for acute cholecystitis and symptomatic gallstone disease, due to the fact that compared to open cholecystectomy, patients required a shorter hospital stay, experienced better cosmetic results and less postoperative pain, and were able to return to daily activities sooner. However, laparoscopic cholecystectomy can result in high rates of injury. The causes of injuries related to laparoscopic cholecystectomy are listed as technical factors and wrong interpretation of anatomy. Wrong interpretation of anatomy can be divided into two factors: confusing the common bile duct as a cystic duct and confusing an aberrant right hepatic duct as a cystic duct. Technical factors can be listed as: insufficiency in clipping cystic duct, dissection into the liver, improper use of the cautery, excessive traction of the cystic duct, the misuse of clip and inadequate ductal exploration. In 1971, Warren and his colleagues conducted a study that consisted of 958 patients in whom benign biliary stricture had been detected [1]. The reasons for the strictures were divided into three groups: previous biliary surgery (918 patients), gastric operation in (nine patients) and pancreatic procedures (two patients). Only 29 patients had no history of surgery. In 1993 a study involving 77,604 patients revealed that bile duct injuries were decreased and this opinion was based on the increased experience of the operation team. However, currently when compared with the open operation, the injury rate during laparoscopic cholecystectomy has remained markedly high (0.2–0.3% / 0.5–0.8%) [2]

Fletcher and his colleagues pointed out that in the years 1991-1994 njuries after laparoscopic cholecystectomies were reduced[3].

Schmidt and his colleagues in 2002, published an article reporting on 170 patients who over the last decade still had high rates of complications after having undergone laparoscopic cholecystectomy [4] .

Given the high number of laparosopic cholecystectomies it is easy to see why the number of biliary injuries is so high. Whether biliary injuries are accompanied by vascular injuries after laparoscopic cholecystectomy is a point of interest.

Diezel and his colleagues, in a study consisting of 77,604 patients, reported that 16% of biliary injuries were accompanied by vascular injuries. Most frequently the right hepatic artery injury rate of 0.05% was observed in this group [5,6]. The frequency at autopsy series in open surgery was found to be about 7%. This increases in patients with bile duct injury (12%–39%).

Buell and his colleagues have reported that vasculary injuries increased mortality rates. However in the same study, no relationship was established between the degree of stricture and vascular injuries[7] . Arnoud and his colleagues have reported that postoperative complications are not affected by vascular injuries [8]. Cadaveric

studies have shown that vascular restenosis rates were unrelated to the vascular injuries. Unlike biliary injuries, little attention is paid to vascular injuries because they do not lead to significant complications [9,10] .

However, why is it so difficult to treat high bile duct injuries .Is it because these injuries are often accompanied by arterial injuries?

In recent years, studies have found that after laparoscopic cholecystectomy, hepatic abscess and bilioenteric anastomosis strictures have been reported in patients in whom bile duct injuries are accompanied with hepatic arterial injuries, compared to patients who have suffered only bile duct injuries[11].

In the literature, four patients have been reported because of recurrent cholangitis, intrahepatic abscess formation and right hepatic lobe resection due to ischemic necrosis of the right hepatic lobe detected because of combined injury to the bile duct and hepatic artery during laparoscopic cholecystectomy[11]. In addition, two patients have been reported as needing liver transplantation due to secondary biliary cirrhosis because of combined biliary and vascular injury [12].

Although a consensus cannot be reached about the effect of bile duct injuries accompanied by arterial injuries, studies have shown that bile duct injuries accompanied by arterial injuries might cause liver necrosis or abscess and increase the risk of bleeding and recurrent stenosis during repair.

When we compare our results with the literature:

Buell and his colleagues found no relationship between the biliary stricture degrees and accompanied vascular injuries, whereas in our study, in patients in whom Bismuth type 4 biliary stricture was detected, we observed statistically significant vascular injury.

Arnoud and his colleagues have revealed that postoperative complication rates were not affected by vascular injury. Whereas in our study postoperative complication rates were observed as being statistically significantly higher in patients in whom biliovascular complex injury was detected.

In cadaver studies, restenosis rates are unrelated to vascular injury, and in Koffro and his colleagues ’s work similar results were found[10]. Whereas in our study, restenosis rates were found to be two times more in the accompanied-vascular injury group. A large case series should be considered in order for these results to be statistically justified.

Postoperative clinical recovery period and postoperative complication rates are affected by accompanying vascular injuries. But in routine practice accompanied-vascular injuries have not been investigated because although biliary-vascular complex injuries have had an effect on morbidity rates, mortality rates have not been affected. Digital subtraction angiography is the gold standard in the evaluation of hepatobiliary vascularity and vascular injury. But this is an invasive method and can lead to complications, therefore accompanying vascular injuries have not been investigated in routine practice.

However, detecting accompanying vascular injuries is important because these can lead to difficulties in biliary repair, bleeding during surgery and postoperative septic embolic complications and recurrent strictures.In addition, for patients in whom hepatectomy is planned, hepatic vascular anatomy must be evaluated correctly.

Therefore, todayCTA is a minimal invasive modality, and with the developments in patients with biliary stricture, accompanying vascular injuries can be determined early with high accuracy rates.

When compared to DSA, CTA :

- is a minimally invasive modality

- has a broad area of clinical application

- achieves rapid image

- has high patient comfort

- costs less

- can obtain volumetric image data

- has very good tissue characterization

- can obtain axial plan

- can show the relation with neighboring tissues of vascular structures

- is less dependent on the operator

Must hepatic vascular injuries be reconstructed with bile duct injuries? Extensive research based on larger case series will clarify this issue.

5. Conclusion

1-Previously vascular injuries accompanied biliary injuries haven't been fatal and DSA was the only imaging modality for evaluating accompanied vascular injuries. So accompanied vascular injuries haven't been investigated in routine practice previously.

2-But nowadays there is a minimal invazive imaging modality called CTA and has high accuracy rates in evaluating vascular structures. So CTA allows determining biliary-vascular injuries earlier and allows an appropriate treatment algorithm.

3- Also postoperatively encountered pathologies which cannot be detected by the DSA process can be

assessed by CT.

4- CTA vascular reconstruction images are needed to exclude arterial and portal injuries in patients with hepatic parenchymal necrosis and for evaluating vascular anatomy before hepatectomy surgery.

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