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ORIGINAL ARTICLE

Biliary Complications Secondary to Post-Cholecystectomy Clip Migration: A Review of 69 Cases

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Abstract
Introduction Post-cholecystectomy clip migration (PCCM) is rare and can lead to complications which include clip-related biliary stones. Most have been reported as case reports. This study reviews cases of clip migration reported in the literatures.
Method Searches and reviews of the literatures from "PubMed," "EMBASE," and "Google Scholar" search engines using the keywords "clip migration" and "bile duct stones" were carried out. Eighty cases from 69 publications were identified but details for only 69 cases were available for the study.
Results The median age at presentations of PCCM was 60 years old (range, 31 to 88 years; female, 61.8%) and the median time from the initial cholecystectomy to clinical presentations was 26 months (range, 11 days to 20 years). Of primary surgeries, 23.2% was for complicated gallstones disease. The median number of clips placed during surgery was six (range, two to more than ten clips). Common diagnoses at presentations of PCCM were obstructive jaundice (37.7%), cholangitis (27.5%), biliary colic (18.8%), and acute pancreatitis (8.7%). The median number of migrated clip was one (range, one to six). Biliary dilatation and strictures were encountered in 74.1% and 28.6%, respectively. Of the 69 cases of PCCM-associated complications, 53 (77%) were successfully treated with endoscopic retrograde cholangiopancreatography (ERCP), 14 (20.2%) with surgery, and one (1.4%) with successful percutaneous transhepatic cholangiography treatment. One patient had spontaneous clearance of PCCM. There was no reported mortality related to PCCM.
Conclusion PCCM can occur at any time but typically occur at a median of 2 years after cholecystectomy. Clinical presentations are similar to those with primary or secondary choledocholithiasis. Most can be managed successfully with ERCP.

Keywords Cholecystectomy · Complications · Clip migrations · Iatrogenic biliary stones · Endoscopic retrograde cholangiopancreatography

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Introduction

Gallstones disease is common and cholecystectomy is the treatment of choice for symptomatic disease. Cholecystectomy is one of the most common operations in clinical practice, and in the United States, over half a million procedures are carried out annually.[1] Since the introduction of the laparoscopic technique, laparoscopic cholecystectomy (LC) has become the gold standard for the management of symptomatic gallstones disease.[1,2] Complications in association with LC have been reported to be <5%. However, this is still higher than that of open cholecystectomy (OC).[3–5] Recent reports have shown lower and comparable complications rates.[6] Complications can be categorized into early or late.[7] Early complications include bile duct injuries, bleeding, and wound infections. Fortu-

nately, most are minor and easily managed. However, serious early complications such as major bile duct injuries are associated with prolonged hospital stay, requirement for further surgeries, and potential long-term complications such as strictures, all resulting in increased health care cost.[7,8] They are also associated with litigation.[9] Late complications include biliary strictures and post-cholecystectomy clip migration (PCCM).

Since its introduction, surgical hemostatic clips have been widely used and are generally considered very safe. Migration of clip into the bile duct with resultant stone formations is well recognized.[10] The first case of PCCM was reported in 1978.[11] Despite the increasing number of cholecystectomy being performed annually, PCCM remains rare. Apart from migration into the biliary tree, PCCM resulting in other complications such as duodenal ulcer or clip embolism have also been reported.[12–14] This study reviewed the literatures and presents the characteristics and treatment outcomes of 69 cases of PCCM that had resulted in biliary complications.

Methods

Publications on PCCM were identified from the literatures through three search strategies. The first search strategy involved searches through the "PubMed" and "EMBASE" databases using the keywords "clip migration" and "bile duct stones." The "PubMed" citations were then used to obtain details of the reported cases. The second strategy involved using the "Google Scholar" search engine using the same keywords. The third strategy involved the review of the references for further relevant articles on PCCM cited by relevant publications identified through the initial two strategies.

Overall, 69 publications reporting 80 cases were identified from the three search strategies. Fifty-seven publications were identified from "PubMed" and "EMBASE,"[11,15–70] one from "Google Scholar" which was not indexed in either "PubMed" or "EMBASE,"[71] and finally another 11 publications from reviewing the references of the initial 57 publications.[72–82] The final strategy identified mostly articles published in the non-English literatures. These 11 publications were also not indexed in either the "PubMed" or "EMBASE" database but could be retrieved from the journal website or through the "Google Scholar" search engine using specific details, i.e., title of publications.

The total number of publications and cases reported are shown in Fig. 1. Most of the publications had originated almost equally from the three major continents: Europe (n=20, 29.1%), Asia (n=25, 36.2%), and North America (n=23, 33.3% [United States, n=22 and Canada, n=1]). One publication originated from South America (n=1, 1.4%).

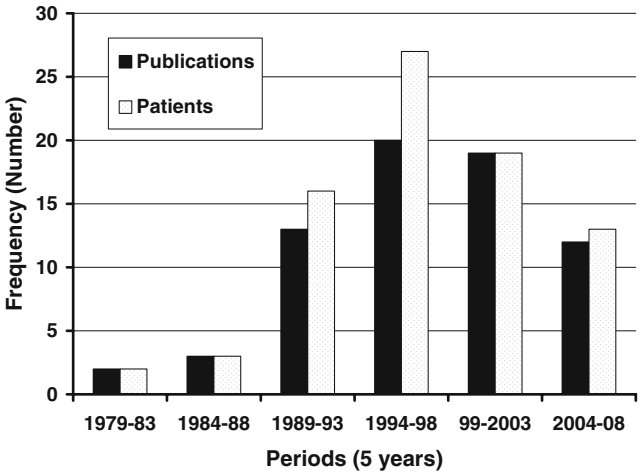

Figure 1 The numbers of publications in 5-year blocks (*dark columns*) and the number of cases reported (*lighter columns*).

Majority of the publications reported a single case and four reported multiple cases (three reported two cases and one reported four cases).

Attempts were made to retrieve all the identified publications. In cases where full articles were not available, the abstracts that had been published in English were carefully reviewed. Only abstracts that had provided adequate details were included. Overall, six publications that had reported a total of 11 cases provided inadequate details and were excluded, leaving 69 cases for the review.[32,40,47,62,63,78] Most of the excluded publications were published in non-English journals. For the articles published in non-English journals and where full publication articles were available, full translations were obtained through interpreters. The corresponding authors were also contacted via e-mail when required. All available publications were carefully analyzed. Clinical data were collected on demographics (age and gender), presentations, diagnoses, primary operative details (OC or LC: uneventful or complicated and details of complications), and number of clips used during the primary operation (stated or counted from radiological imaging provided). Data on the presence of ductal dilatations and strictures (stated or through imaging provided), treatment provided (surgery, endoscopic retrograde cholangiopancreatography [ERCP], or percutaneous transhepatic cholangiography [PTC]) and outcomes, laboratory investigations, and the number of clips found to have migrated were retrieved.

Results

The median age at presentations was 60 years old (range, 31 to 88 years) with more females being affected (n=42, 61.8%). The majority had no premorbid conditions reported.

Most of the cholecystectomies were carried out for symptomatic gallstones diseases with the exception of two cases: one for gallbladder polyp and another was carried out as part of orthotopic liver transplantation (OLT). Overall, 23.2% of the surgeries were done for complicated gallstones disease. Details of indications and types of operations carried out are shown in Table 1. Metal clips were used in all cases except for two cases where absorbable clips were used. The median number of clips used was six (range, two to 14).

The median time from cholecystectomies to clinical presentation of symptoms related to PCCM was 26 months (range, 11 days to 20 years). Three cases of PCCM occurred within 4 weeks of cholecystectomies and all occurred without stone formation.

Reported clinical symptoms and admitting diagnoses of PCCM are shown in Table 2. The most common clinical presentations were abdominal pain, jaundice, and fever. At presentations, the most common admitting diagnoses were obstructive jaundice, cholangitis, and biliary colic.

Table 1 Details of Indications and Initial Operations

Details	*n* (%)
Indications	
Uncomplicated gallstones disease	51 (73.8)
Complicated gallstones disease	16 (23.2)[a]
Others	2 (2.9)[b]
Types of operations	
LC	47 (68.1)
Uneventful	13 (27.7)
Complicated	7 (14.9)
Bile leak	5 (10.6)
Gall bladder rupture	1 (2.1)
Bleeding	1 (2.1)
Converted to OC	3 (6.4%)
No data available	24 (51.0)[c]
OC	25 (36.2)
Uneventful	7 (28.0)[d]
Complicated	4 (16.0)[e]
Converted from LC	3 (12.0)
No data available	11 (44.0)

[a] Included acute or chronic cholecystitis (n=10), acute gangrenous cholecystitis (n=1), gallstones with CBD stone extractions (n=4), and chronic granulomatous cholecystitis (n=1)

[b] Included gallbladder polyp (n=1) and surgery part of OLT (n=1)

[c] Included common bile perforation (n=1), bleeding (n=1), and technical failure (n=1)

[d] Included bile duct exploration (n=3), part of OLT (n=1), operation for gangrenous cholecystitis (n=1), and uneventful OC (n=2)

[e] Included retained stone that passed spontaneously (n=1), bleeding (n=1), stricture formation (n=1), and friable cystic duct stump (n=1)

Table 2 The Clinical Presentations and Diagnoses of Patients with PCCM

	n (%)
Clinical symptoms	
Abdominal pain	58 (84.1)
Jaundice	53 (76.8)
Fever	22 (31.9)
Nausea/vomiting	18 (26.1)
Loss of appetite	5 (7.2)
Pruritus	3 (4.3)
Weight loss	1 (1.4)
Admitting diagnosis	
Obstructive jaundice	26 (37.7)
Cholangitis (± septic shock)	19 (27.5)
Biliary colic	13 (18.8)
Acute pancreatitis	6 (8.7)
Incidental finding	
Abnormal liver function test/pruritus	1 (1.4)
Clip in abnormal position on radiography	2 (2.9)

Overlap occurred as some patients had multiple symptoms and diagnosis

The median number of migrated clip was one (range, one to six). Thirteen cases (18.8%) had clip migrations without inducing stone formations. All of these PCCM occurred within 12 months after cholecystectomies with the exception of one case which occurred at 168 months. Overall, PCCM without stone formation occurred at a significantly shorter time interval between surgeries and presentation of PCCM (median, 5.5 months; range, 0.37 to 168 months) compared to PCCM with stone formations (median, 36 months; range, 3 to 240 months; $p<0.001$, Mann–Whitney test).

Biliary dilatation (Fig. 2) and strictures (Fig. 3) were reported in 74.1% and 28.6%, respectively. Strictures were located near the cystic duct remnant. The postulated mechanisms that contributed to PCCM and subsequent biliary complications included: bile duct injuries secondary to incorrect clip placements, inadvertent placement into the biliary tree, clip slippage resulting in wound dehiscence, bile leak and biloma formation with or without infection, placement of too many clips, and difficult operations either secondary to inflammatory state or bleeding. Mechanisms contributing to stone formation include presence of clip as nidus, lithogenic bile, and bacterobilia. Figure 4 shows the possible mechanisms of PCCM and biliary complications.

Managements

Overall, of the 69 cases of PCCM-associated complications, 53 (77%) were successfully treated with ERCP, 14 (20.2%)

Figure 2 Cholangiogram showing dilated CBD, two metal clips at the cystic duct remnant site, and clip-related stone captured in the basket.

with surgery, and one (1.4%) with successful PTC. One patient had spontaneous passage of clip after PCCM without requiring any intervention. All patients were successfully treated (Table 3). There was no reported mortality directly related to PCCM.

ERCP extractions were attempted in 62 patients and were successful in only 53 (84.5%). This included seven patients who had spontaneous clips/stones passage after failed ERCP extractions. One patient had a successful ERCP extraction of a migrated clip that had occurred within 11 days of cholecystectomy. However, this was complicated by slippage of the remaining cystic duct clip causing bile peritonitis that required surgery. This case was considered as successful ERCP extraction. Two patients required two ERCPs for complete clearance. One patient had failed an initial ERCP and PTC attempts before a successful second ERCP. Another patient had endoscopic surgery (ES)-related bleeding complicating the initial ERCP that was managed with biliary stenting before a successful second ERCP. Overall, failures of ERCP clearances were due to large stone, orientation of stone, or presence of stricture.

Fifteen patients had surgical interventions with a success rate of 93.3%. Four patients had surgery as the initial interventions, while the remainder had surgery after failed ERCP/PTC attempts. Reasons for choosing surgery as the initial interventions were: experienced endoscopist not available (n=1), endoscopic removal facility not available (n=2), and suspected common bile duct (CBD) cancer (n=1). The only patient who failed the initial surgical intervention was a patient who had emergency surgery for perforated secondary bile duct. Laparotomy showed bile peritonitis and the perforation was treated with patch repair. A bile duct stone was missed during surgery. This patient underwent ERCP 3 days later for persistent bile leak. Cholangiography showed bile leak and a stone with a metallic clip at the center. This was successfully extracted after ES with resolution of bile leak.

Three patients had attempted PTC extractions and only one was successful (33.3%). This man (57 years old) had obstructive jaundice 6 years after LC. Initial imaging showed a hepatic mass suspected to be cholangiocarcinoma. This was later diagnosis to be a clip-induced stone and was successfully extracted with PTC. Of the other two cases, a second ERCP performed under general anesthesia was successful in one, while the other case proceeded to surgical extraction as part of another operation.

Spontaneous passage of migrated clip occurred in one patient without requiring any intervention 15 days after LC. This patient had a pre-LC ERCP extraction of two CBD stones after ES. The clip passage resulted in self-limiting acute pancreatitis.

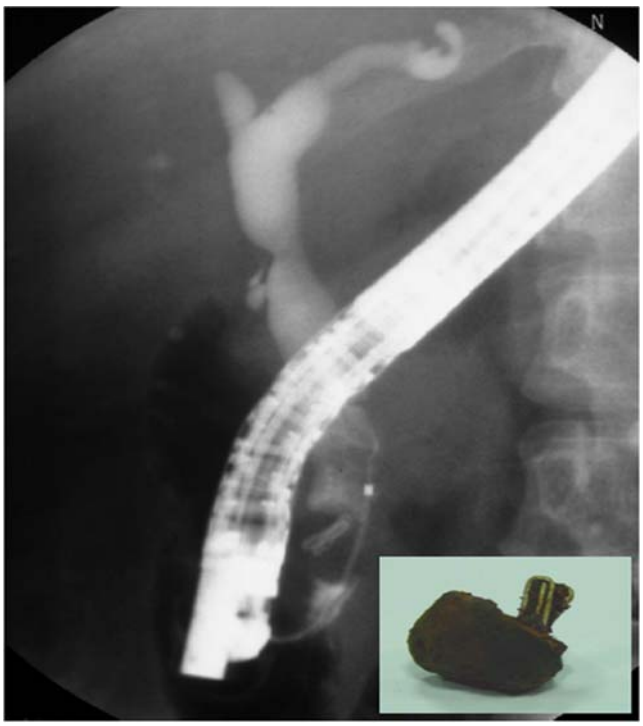

Figure 3 Cholangiogram showing stone with two clips at the center and a stricture at the cystic duct remnant site. There was no significant bile duct dilatation. *Inset* shows extracted stone with two embedded metal clips acting as nidus for stone formation.

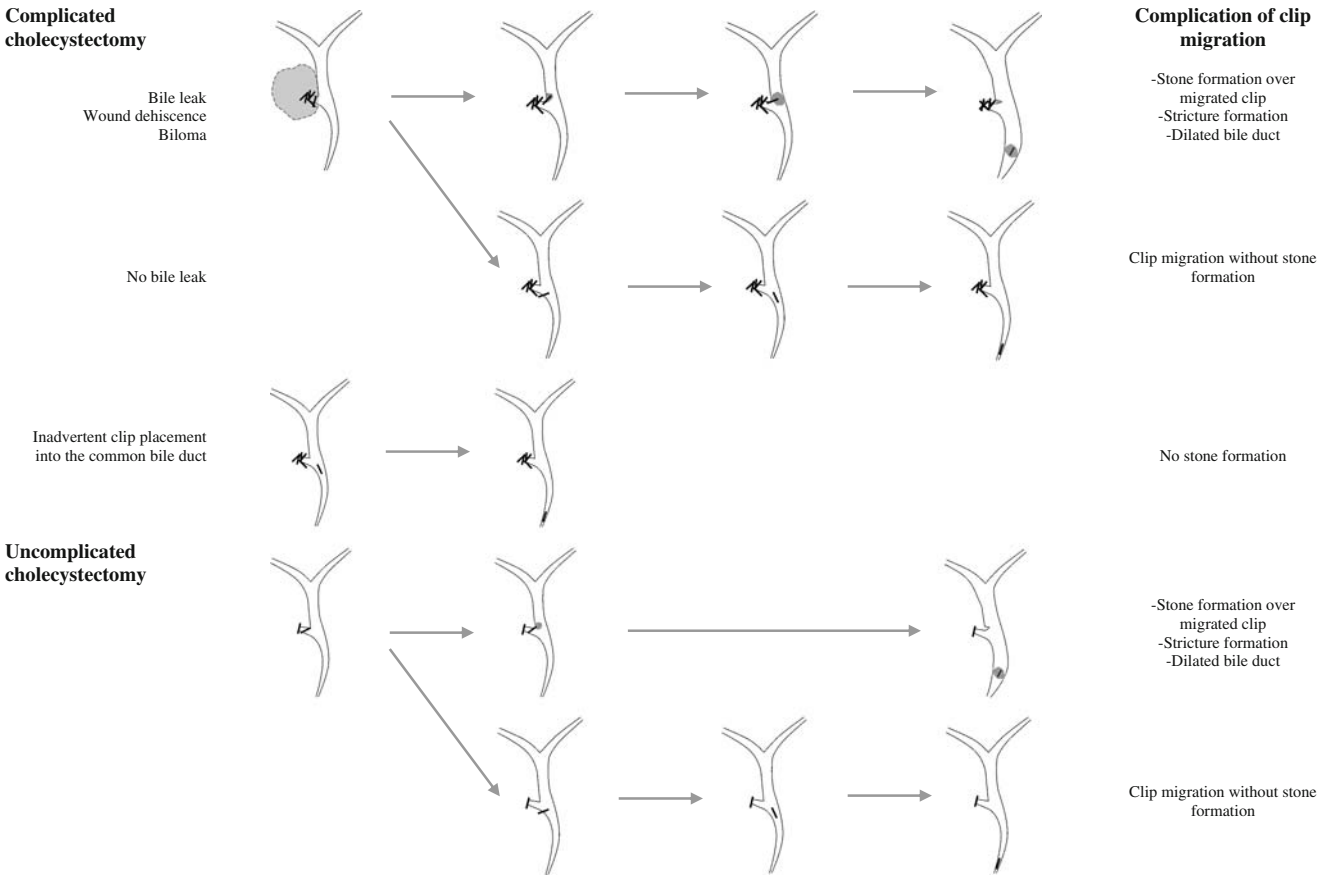

Figure 4 Schematic representations showing the various postulated mechanisms of PCCM.

Discussion

This review showed that PCCM with resultant biliary complications are uncommon with only 80 cases reported despite the large number of cholecystectomies carried out annually. The majority of the published reports had originated from the three major continents (North America, Europe, and Asia), reflecting the large number of cholecystectomies performed in these regions. The number of reported PCCM in the literature peaked in the period of 1994–1998 and this correlated with the introduction of LC. This also correlated with higher complication rates of LC reported during the initial period and this had been attributed to the learning curve for this procedure.[83] As LC became the standard management of gallstones disease coupled with better training programs, complication rates of LC declined. This probably accounted for the subsequent decline in the number of cases reported.[8] There were only 13 cases reported in 12 publications in the last 5-year period (2004–2008).[51–58,66–73]

The gender and age predilections for PCCM reflected the epidemiology of gallstones disease which is more common among females and the older age group.[84] Similarly, the manifestations of PCCM-related biliary complications were not different from the non-iatrogenic choledocholithiasis. Most of the patients presented with typical symptoms of choledocholithiasis. Imaging will be required to distinguish between post-cholecystectomy primary CBD stones from PCCM-related biliary complications. Simple abdominal radiography may show abnormal positions of the metal clips.[32,65]

The managements of PCCM with biliary complications are similar to that of non-iatrogenic choledocholithiasis. Based on current recommendations, ERCP should be the modality of choice with surgery or PTC reserved as rescue procedures especially in the presence of difficult biliary strictures or large stones.[85,86] Surgical extractions were utilized in the earlier period as ERCP techniques were still at its infancy and facilities and expertise were not widely available. This is highlighted by the cases where surgical interventions were chosen as the intervention to deal with biliary complications of PCCM.[11,16,27] Overall, surgical interventions had a success rate of 93.3%. The only case that had failed surgical intervention was due to the failure to detect a CBD stone during surgery.[55] The complicated nature of this particular case was probably an important factor.

Table 3 Details of Management and Outcomes of PCCM

Types of interventions	*n* (%)
ERCP	62 (89.9)
Successful clearance	
ERCP clearance	44
Spontaneous stone passage	7
Failed initial surgical clearance	1
Failed initial PTC clearance	1
Unsuccessful attempts requiring surgery	9[a]
Surgery	15(21.7)
Successful clearance	
Initial open procedure	4
Failed initial ERCP clearance	9[a]
Failed initial PTC clearance	1
Unsuccessful attempt needing ERCP extraction	1
PTC	3(4.3)
Successful	
Initial PTC clearance	1
Unsuccessful	
Successful ERCP	1
Surgical clearance	1
Spontaneous passage without intervention	1(1.4)[b]

Percentages presented in brackets do not add up to 100% due to overlapping of procedures as some patients had different treatment modalities before successful clearance

[a] Reasons: failed cannulation (n=1), stricture/failed extractions (n=2), unsuccessful extraction due to large stone, orientation of stone, and technically difficult ERCP (n=3), no details mentioned (n=2), impacted basket (n=1)

[b] Patient had pre-LC ERCP and endoscopic sphincterotomy

ERCP became the modality of choice in the later period (previous 10 years) with a success rate of 84.5%. This is consistent with the success rate reported for non-iatrogenic choledocholithiasis.[85] Even if we had included the publication that had reported on the six cases of PCCM that were successfully managed with ERCP, the overall success rate was only slightly better at 86.4%.[40] In most cases, only a single ERCP attempt was required for successful clearance. Two ERCP sessions were required in two cases.[43,57] Like the management of non-iatrogenic choledocholithiasis, it is important that an adequate ES is performed as it may facilitate spontaneous passage even if the initial ERCP extraction had failed. Most spontaneous passages of clip/stones had occurred within weeks of ERCP. The presence of strictures or stones that were too big or orientated in difficult positions was an important factor contributing to failures of ERCP extractions.

The exact pathogenesis of PCCM is unknown but is likely to involve complex sets of events occurring simultaneously as previously reported.[10] The underlying pathogenesis probably shares some similarities to the migrations of other foreign bodies into the biliary tree that included surgical sutures, ingested materials such as seeds, vegetables matters, and toothpicks, and projectiles objects such as bullet and shrapnel.[10] The process involves the initial migrations of clip into the biliary tree and later followed by stone formations.

There are many factors that contribute to the migration process. These include inaccurate clip placements with resultant bile duct injuries, local suppurative inflammatory processes, bile leak with resultant biloma formation, and local infective processes.[10] In fact, it has been shown that, once a clip gets embedded within the bile duct wall, the process of clip migrations will continue.[37] The location of the stricture indicated the probable site of clip injury and migration. Inadvertent placement of clips inside the bile duct during the initial operation has also been suggested. This can lead to early manifestations and probably accounted for those cases of early presentations soon after the initial surgeries. The number of clips used during the initial surgery is also an important factor. The use of more than four clips had been shown to be associated with clip migrations.[37] The median numbers of clips used in the cases of PCCM were six. The indications for cholecystectomy were also important. In the acute inflammatory settings of acute cholecystitis or pancreatitis, dense adhesions and inflammations will distort the anatomy, increasing the risk for injuries. In our review, complicated gallstones disease accounted for 23.2% of cases with PCCM with resultant biliary complications. However, this number might have been higher as the full details of the initial surgeries were not available in some of the reports. LC itself may be a risk factor for complications. Generally, LC is technically more difficult and complications rates have been reported to be slightly higher compared to OC.[5] Previous abdominal surgeries will further increase the risk.[87] Apart from biliary complications, PCCM resulting in nonbiliary complications such duodenal ulcer and embolizations had also been reported and the underlying pathogeneses are probably similar.[12–14,88,89]

In order to avoid PCCM complications, all the discussed factors need to be considered and avoided. Ideally, only two clips should be left behind after cholecystectomy. Others have advocated to the use of absorbable clips. However, PCCM have also reported where absorbable clips had been used.[19,67] Clipless cholecystectomy using ultrasound-activated harmonic scalpel may be an option. It has been shown to be effective, efficient, and a safe alternative for dissection and hemostasis.[90–92] In addition, harmonic scalpel has also been shown to be associated with fewer complications (mild or major bile leaks and gallbladder perforation) and shorter operation time. Use in acute cholecystitis has also shown to be safe.[93]

As technology advances, newer and less invasive techniques are being developed and adapted for the management of many clinical disorders including gallstones disease. These

include the use of fewer or single port LC and the natural orifice transluminal endoscopic surgery. In fact, such modalities have been shown to be feasible for the management of gallstones disease and are already being used in some centers.[94–96] Therefore, it will be interesting to see if there will be an increase in the number of complications related to these newer modalities as complications are associated with the learning curve for these procedures.

Overall, PCCM is rare. However, it is possible that the true incidence of PCCM with resultant biliary complications is underestimated. First, clip migrations may go unnoticed as spontaneous clip passages had been reported. Seven of the reported cases had spontaneous clips/stones migrations either after failed ERCP extractions or after LC.[20,29,33,36,38,63,69] All had ES done during ERCP. Therefore, the routine use of precholecystectomy ERCP with ES may be an important factor. Second, it is possible that additional publications especially in the non-indexed, non-English journals might have been missed. Finally, cases of PCCM might have gone unreported or have been included as part of other type of publications.[40] However, the overall number of missed cases is likely to be small.

In conclusion, although rare, PCCM with biliary complications need to be considered in the differential diagnosis for patients presenting with typical symptoms even many years after cholecystectomies. The clinical manifestations are similar to that of primary or secondary non-iatrogenic choledocholithiasis and ERCP is currently the treatment of choice. The recent number of reported cases of PCCM with biliary complications has shown a declining trend, probably as a result of better training programs. However, it will be interesting to see if the there will be any increase in the complications rates of cholecystectomies, including PCCM, as newer techniques are being introduced for the management of symptomatic gallstones disease.

Permission to use Figs. 2 and 3 has been obtained from the publisher (Singapore Med J. 2004;45(11):533–535).

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Conflict of Interest None.

Financial Disclosure None.

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