UNIVERSITÉ DE LILLE

FACULTÉ DE MÉDECINE HENRI WAREMBOURG

Année : 2023

THÈSE POUR LE DIPLÔME D'ÉTAT

DE DOCTEUR EN MÉDECINE

ETUDE DU PARCOURS THERAPEUTIQUE DES PATIENTS APRES SURVENUE D'UNE PLAIE DES VOIES BILIAIRES LORS D'UNE CHOLECYSTECTOMIE POUR PATHOLOGIE LITHIASIQUE : ANALYSE D'UNE COHORTE NATIONALE DE 1 177 017 PATIENTS SUR 9 ANS

Présentée et soutenue publiquement le 21 juin 2023 à 18h00
au Pôle Recherche
par Florian PECQUENARD

_____

JURY

Président :
Monsieur le Professeur Emmanuel BOLESLAWSKI
Assesseurs :
Monsieur le Professeur David FUKS
Monsieur le Professeur Julien BRANCHE
Madame le Docteur Amélie BRUANDET

Directeur de thèse :
Madame le Professeur Stéphanie TRUANT

_____

Avertissement

La faculté n’entend donner aucune approbation aux opinions émises par l’auteur dans les thèses : celles-ci sont propres à leurs auteurs.

Liste des abréviations

BDI : Bile Duct Injury

CCAM : Classification Commune des Actes Médicaux

CCI : Charlson's Comorbidity Index

CIM-10 et ICD-10 : Classification Internationale des Maladies (10ème édition)

PMSI : Programme de Médicalisation des Systèmes d'Information

WSES : World Society of Emergency Surgery

Table des matières

Résumé

Etude du parcours thérapeutique des patients après survenue d'une plaie des voies biliaires lors d'une cholécystectomie pour pathologie lithiasique : analyse d'une cohorte nationale de 1 177 017 patients sur 9 ans

Introduction :

La complication la plus crainte au cours d'une cholécystectomie est la survenue d'une plaie des voies biliaires. Le parcours thérapeutique des patients porteurs d'une plaie est mal connu à l'échelle nationale. Le but de cette étude est d'évaluer l'incidence des plaies biliaires lors d'une cholécystectomie pour lithiase en France et d'évaluer le parcours thérapeutique des patients.

Méthodes :

Les données des patients majeurs opérés d'une cholécystectomie pour lithiase entre 2012 et 2020 ont été extraites du PMSI et analysées. Les patients présentant une plaie biliaire ont été identifiés à l'aide d'un algorithme basé sur des codes diagnostics (CIM-10) et des codes de procédures thérapeutiques en lien avec la plaie (radiologiques, endoscopiques et chirurgicales). Le rôle du délai diagnostic de la plaie était également étudié. Une plaie était précoce si diagnostiquée dans les 21j suivant la cholécystectomie index, elle était tardive si diagnostiquée au-delà.

Résultats :

1 177 017 patients ayant eu une cholécystectomie ont été identifiés. L'incidence des plaies biliaires était de 1.19%. Seulement 19.6% des patients étaient transférés en centre expert

après survenue d'une plaie en centre non expert. Parmi les procédures thérapeutiques, 65.4% étaient endoscopiques (47.2% pour les plaies précoces, 80.2% pour les plaies tardives, p<0.001), 23.5% étaient chirurgicales (44.8% pour les plaies précoces, 6% pour les plaies tardives, p<0.001) et 11.2% étaient radiologiques. La survie à un an était significativement négativement impactée par la survenue d'une plaie.

Conclusion :

La survenue d'une plaie biliaire lors d'une cholécystectomie impacte la mortalité des patients. Seuls 19.6% des patients présentant une plaie biliaire ont accès à un parcours thérapeutique optimal à travers un transfert en centre expert.

Introduction

La vésicule biliaire est un organe localisé à la face inférieure du foie. Elle est reliée au réseau biliaire par le canal cystique qui s'abouche dans la voie biliaire principale formant la convergence biliaire secondaire. La vascularisation artérielle de la vésicule biliaire se fait en situation modale par une artère cystique naissant de la branche droite de l'artère hépatique et cheminant dans une zone anatomique appelée « triangle de Calot » dont les côtés sont formés par le bord supérieur du canal cystique, le bord latéral droit de la voie biliaire principale et la face inférieure du foie. Il s'agit d'une zone anatomique dont l'identification est primordiale lors de l'exérèse chirurgicale de la vésicule biliaire appelée cholécystectomie. Sur le plan veineux, le drainage se fait directement vers le foie par le lit vésiculaire, zone de contact entre la vésicule biliaire et la face inférieure du foie. La vésicule biliaire est un organe de stockage de la bile produite par le foie. La bile va s'accumuler dans la vésicule entre les repas, puis la paroi de celle-ci va se contracter sous l'influence d'une enzyme, la cholécystokinine, produite par les cellules de la muqueuse du premier duodénum au contact des graisses et protéines endoluminales ingérées lors des repas(1). La bile ainsi évacuée va participer notamment à l'absorption des graisses présentes dans l'intestin.

Diverses pathologies, bénignes et malignes, peuvent concerner la vésicule biliaire. La plus fréquente reste cependant de loin la pathologie vésiculaire lithiasique.

En Europe, on estime que 15% de la population est concernée par la lithiase vésiculaire(2). Dans cette région, 90% des calculs vésiculaires sont de composition cholestérolique(3) et sont la conséquence d'une sursaturation de la bile en cholestérol, suivie

d’une phase de cristallisation puis de croissance dans un contexte d’hypomotilité vésiculaire menant à la formation de calculs parfois pluricentimétriques. La proportion restante de calculs correspond à des calculs pigmentaires composés le plus souvent de bilirubinate de calcium, conséquence d’une hyperbilirubinémie libre importante et prolongée notamment dans le cadre de pathologies hémolytiques chroniques. Les étiologies infectieuses de calculs pigmentaires sont quant à elles retrouvées plus fréquemment en Asie et sont rares en France. Pour environ 80% des personnes porteuses d’une lithiase vésiculaire, celle-ci restera asymptomatique(4) et, si elle est découverte notamment de façon fortuite lors de la réalisation d’examens d’imagerie pour une autre indication, ne nécessitera pas d’exploration complémentaire ni de traitement spécifique. L’apparition de symptômes en lien avec la lithiase vésiculaire témoigne d’une complication et va nécessiter une prise en charge étiologique. Les principales complications sont en lien avec une obstruction de l’écoulement biliaire et dépendent de la localisation de l’obstacle. C’est ainsi que les crises de colique hépatique correspondent à une obstruction temporaire de la partie proximale du canal cystique, et la cholécystite aiguë lithiasique correspond à une surinfection de bile stagnante en amont de ce même obstacle. L’angiocholite va découler d’une obstruction de la voie biliaire principale par un calcul et, en cas d’obstruction à la jonction entre la voie biliaire principale et le canal de Wirsung, même de façon temporaire, il existe un risque de pancréatite aiguë dite biliaire. Toutes ces complications vont nécessiter une prise en charge spécifique avec toutefois un élément commun : la nécessité d’envisager l’ablation chirurgicale de la source des calculs à savoir la vésicule biliaire et donc de réaliser une cholécystectomie.

La cholécystectomie est l'une des interventions chirurgicales les plus fréquemment réalisées en pathologie digestive, avec environ 120 000 interventions par an en France(5).

La première description de la procédure de cholécystectomie a eu lieu en 1882 par laparotomie sous costale droite chez un patient de 43 ans dans un contexte de coliques hépatiques récidivantes et est attribuée au chirurgien allemand Carl Johann August Langenbuch (1846-1901)(6). Après une brève période de débat entre l'intérêt de réaliser une cholécystectomie par rapport à une cholécystostomie seule, la moindre mortalité ainsi que la disparition des crises de coliques hépatiques après cholécystectomie à rapidement mené à l'essor de cette procédure dans le traitement de la pathologie vésiculaire lithiasique.

Une nouvelle voie d'abord chirurgicale va par la suite être développée notamment sous l'impulsion de gynécologues en particulier allemands avec pour objectif de diminuer la morbidité liée à la réalisation de laparotomies plus ou moins extensives. On rapporte ainsi dès le début du XXe siècle des procédures à but exploratoire et diagnostique de la cavité péritonéale par de courtes incisions. Le développement d'un matériel dédié de plus en plus sophistiqué va permettre la réalisation de procédures à but thérapeutique. Sur le plan digestif, sera ainsi réalisée la première appendicectomie en 1980 par le gynécologue allemand Kurt Semm (1927-2003) en utilisant cette nouvelle voie d'abord appelée « coelioscopie ».

La première procédure impliquant la vésicule biliaire réalisée par voie coelioscopique est quant à elle attribuée au chirurgien russe O.D. Lukichev qui réalisa une cholécystostomie en 1983. C'est un chirurgien allemand, le Pr Erich Mühe (1938-2005) qui réalisera la première cholécystectomie coelioscopique mais ce dernier ne parviendra pas à convaincre ses pairs de l'intérêt de changer les pratiques en cours et de remplacer la laparotomie par une approche coelioscopique. En revanche, en France, Le Dr Philippe Mouret (1938-2008)(7), qui réalisera la

première cholécystectomie coelioscopique en 1987 à la clinique de la Sauvegarde de Lyon va rencontrer le soutien de nombreux collègues, notamment en la personne du Pr Jacques Périssat (1933-), menant à l'acceptation et à la reconnaissance sur le plan académique de cette nouvelle voie d'abord. C'est le début de l'essor de la coelioscopie, parfois appelé « seconde révolution française ».

De nombreux chirurgiens ont par la suite poursuivi les efforts de standardisation de la procédure. On note en particulier les travaux du Pr Steven M. Strasberg, chirurgien américain insistant sur la bonne obtention de la « vue critique de sécurité » avant la section de toute structure lors de la cholécystectomie(8,9). Cette notion primordiale a pour but de limiter la complication la plus crainte de l'intervention par tout chirurgien à savoir la plaie des voies biliaires.

La survenue d'une plaie biliaire au cours d'une cholécystectomie a pour conséquence une majoration importante de la morbidité et de la mortalité liées au geste(10). On relève par ailleurs une altération de la qualité de vie significative après survenue de cette complication(11). Toutefois, en définissant la plaie des voies biliaires comme une atteinte traumatique de l'arbre biliaire survenant lors d'une cholécystectomie, on regroupe sous le même terme des lésions de localisation anatomique le long des voies biliaires extra-hépatiques différente et de prises en charge variées. Dans la même optique, afin de pouvoir comparer les résultats d'études portant sur le sujet, une standardisation des différents types de plaie des voies biliaires pouvant survenir au cours d'une cholécystectomie s'avère nécessaire et passe par l'instauration d'une classification. C'est ainsi que vont se succéder voire s'accumuler différentes classifications au cours du temps dont trois des principales sont

abordées ci-après. Une des plus anciennes fut établie par l'équipe du Pr Henri Bismuth de l'hôpital Paul Brousse en 1982 et comprend cinq types correspondant à des sténoses classées selon leur proximité avec la convergence biliaire supérieure (type I à IV) ou concernant un canal hépatique sectoriel droit indépendant (type V)(12). Aux différents types de plaie biliaire identifiés dans cette classification, basée sur l'expérience en laparotomie, ont par la suite été associé le type de réparation chirurgicale permettant d'obtenir les meilleures chances de succès(13). Avec le développement de l'approche coelioscopique, les types de plaies biliaires se sont modifiés en lien avec une utilisation différente de l'électrocoagulation et une moins bonne identification de la voie biliaire principale. La classification de Bismuth ne couvrant pas toutes les situations rencontrées, Strasberg et al. ont publié en 1995 une classification qui intègrera toute section d'un élément de l'arbre biliaire extrahépatique avec ou sans ligature préalable (Type A à D) en plus des différentes sténoses déjà décrites pas Bismuth et al. (classées Strasberg E1 à E5)(8). Il est important de noter que le type A de Strasberg intègre dans les plaies des voies biliaires l'atteinte de la voie biliaire accessoire représentée par le canal cystique ainsi que celle du lit vésiculaire, deux éléments exclus de la classification de Bismuth mais dont le surplus de morbimortalité est démontré. En plus de ces deux classifications, on peut citer la classification de Hanovre publiée en 2007 par Bektas et al(14). Cette dernière va permettre une classification très précise du type de plaie en reprenant les éléments principaux de la classification de Strasberg qui vont être sous-catégorisés, et en intégrant notamment l'association éventuelle d'une lésion artérielle à la plaie biliaire. Ce dernier élément est important pour la discussion du traitement de la plaie à envisager.

La survenue d'une plaie des voies biliaires au cours d'une cholécystectomie, qu'elle soit réalisée par laparotomie ou par voie coelioscopique, est un évènement rare mais grave.

L'incidence de ces plaies lors des procédures réalisées par laparotomie est estimée entre 0 et 0,5%(15). Lors de l'avènement de la coelioscopie, on note initialement une majoration de l'incidence des plaies jusqu'à 2,8% puis une baisse progressive(15). Cependant, les rapports récents font état d'une incidence allant de 0,08 à 1,5% qui reste supérieure à celle décrite lors des procédures réalisées par laparotomie(10,16–21).

Il existe plusieurs situations pouvant mener au diagnostic d'une plaie des voies biliaires. La plaie peut tout d'abord être suspectée et / ou diagnostiquée en peropératoire par un écoulement de bile dans le champ opératoire, la section de plus de vaisseaux / canaux qu'habituellement ou encore par une fuite de produit de contraste ou l'absence d'opacification d'une portion de l'arbre biliaire lors d'une cholangiographie peropératoire. Dans la littérature, la proportion de diagnostic peropératoire de plaie est très variable, allant de 19 à 80% selon les auteurs(20,22). La découverte de la plaie peut par ailleurs avoir lieu en postopératoire dans un contexte de collection sous hépatique, de péritonite biliaire témoignant d'une fistule, ou bien d'ictère pouvant correspondre, en dehors d'un calcul obstructif résiduel, à une sténose biliaire. On note parfois la présence d'atrophie hépatique ou d'abcès intrahépatique souvent en lien avec une atteinte artérielle associée. Dans tous les cas, il convient de respecter certains principes avant d'envisager une réparation chirurgicale ou non. Ainsi, lors du diagnostic de plaie biliaire, toute tentative de réparation doit avoir lieu après identification claire du type de plaie, de la présence d'une plaie artérielle associée, de l'état inflammatoire / septique local et général du patient ainsi que du délai entre la cholécystectomie et le diagnostic de plaie. Afin d'obtenir toutes les informations nécessaires, il peut être nécessaire de réaliser des explorations complémentaires notamment radiologiques, par scanner injecté comprenant un temps artériel, bili-IRM et parfois

endoscopiques notamment par cholangiographie rétrograde. Dans tous les cas (à l'exclusion peut-être des plaies de type A de Strasberg isolées), la réparation ne doit être envisagée que par un chirurgien expérimenté en chirurgie hépatobiliaire. C'est ainsi qu'en l'absence d'expertise il ne faut pas hésiter, devant notamment la découverte peropératoire d'une plaie complexe, à discuter d'un transfert dans un centre disposant d'une expertise en chirurgie hépatobiliaire mais également en radiologie et endoscopie digestive afin d'optimiser la prise en charge du patient. L'importance de cette expertise est par ailleurs soulignée dans les récentes recommandations de la WSES publiées en 2021 défendant qu'il convient de transférer les patients porteurs de plaie biliaire au décours d'une cholécystectomie en l'absence d'expertise locale(23). Ces différentes précautions doivent permettre de planifier au mieux la réparation de la plaie qui pourra prendre plusieurs formes.

Le type de traitement d'une plaie des voies biliaires au décours d'une cholécystectomie varie selon le délai de découverte, du type de plaie, de l'existence d'une lésion artérielle associée ainsi que de l'état inflammatoire du site opératoire et général du patient. C'est ainsi que selon les circonstances, pourront être envisagés des actes thérapeutiques concernant différentes spécialités chirurgicales. Ainsi, des actes radiologiques peuvent être réalisés, à type de drainage de collection ou de voie biliaire sous contrôle échographique ou scannographique. Par ailleurs, de nombreuses situations seront adaptées à la réalisation de gestes thérapeutiques endoscopiques, tel que des drainages biliaires, traitement de fistule par endoprothèse ou encore dilatation de sténose. Enfin, une réparation chirurgicale peut avoir lieu et se présenter sous plusieurs formes, allant du drainage de collection jusqu'à la nécessité d'une hépatectomie voire d'une transplantation hépatique pour les situations les plus défavorables (ex : cirrhose biliaire secondaire)(24,25). Ainsi, alors que la plupart des

publications ne prennent en compte que la réparation chirurgicale d'une plaie dans leurs analyses(26,27), il apparaît primordial d'inclure les autres modalités thérapeutiques afin d'explorer au mieux le cheminement thérapeutique des patients porteurs de plaie des voies biliaires.

En conclusion de cette introduction, les plaies des voies biliaires survenant au cours d'une cholécystectomie pour pathologie lithiasique sont des complications rares mais potentiellement grave. L'incidence de cette complication rapportée dans la littérature se base essentiellement sur des données issues de centres experts avec une interrogation légitime sur la possibilité de généraliser ces résultats à la population générale. Par ailleurs, les quelques études réalisées à l'échelle nationale ne prennent pas en compte l'ensemble des possibilités thérapeutiques disponibles et tendent à se concentrer sur la réparation chirurgicale(26,27). L'incidence réelle des plaies des voies biliaires en est ainsi probablement sous-estimée. Enfin, le cheminement thérapeutique des patients porteurs de plaie est peu connu notamment à l'échelle nationale.

L'objectif de ce travail de thèse est d'explorer l'incidence des plaies des voies biliaires après cholécystectomie pour pathologie lithiasique en France, ainsi que le cheminement thérapeutique des patients concernés et l'impact de la survenue d'une plaie sur la mortalité. Ce travail, mené sur les données de plus d'un million de patients extraites du PMSI sur une période de 9 ans est la première étude à l'échelle nationale évaluant la prise en charge thérapeutique multidisciplinaire des plaies des voies biliaires après cholécystectomie. Il constitue une base pour l'identification d'améliorations possibles à apporter à la prise en charge des patients.

WHAT IS THE THERAPEUTIC PATHWAY OF PATIENTS FOLLOWING BILE DUCT INJURY (BDI) DURING CHOLECYSTECTOMY FOR CHOLELITHIASIS? ANALYSIS OF A NATIONWIDE COHORT OF 1,017,177 PATIENTS OVER 9 YEARS

Florian Pecquenard, MD[*‡], Xavier Lenne, MSc[†‡], Amélie Bruandet, MD, PhD[†‡], Didier Theis, MD[†‡], François-René Pruvot, MD, PhD[*‡], Mehdi El Amrani, MD, PhD[*‡], Stéphanie Truant, MD, PhD[*‡]

[*] Department of Digestive Surgery and Transplantation, Lille University Hospital, Univ. Lille, F-59000 Lille, France

[†] Medical Information Department, Lille University Hospital, Lille, France

[‡] University of Lille, Lille, France

Abstract:

Objective: This study explored post cholecystectomy Bile Duct Injury (BDI) epidemiology and therapeutic interventions performed and notably the referral to a tertiary center along with BDI impact on mortality.

Summary Background Data: Cholecystectomy for cholelithiasis is one of the most-frequently performed surgery in France. BDI is the most feared complication with a reported frequency of 0.08% to 1.5%. The therapeutic pathway of BDI patients is poorly known.

Methods: All patients aged 18 years or older who underwent cholecystectomy for cholelithiasis in France from 2012 to 2020 were extracted from the French National Medico Administrative Database (PMSI database). Patients with BDI were identified using an algorithm based on ICD-10 diagnosis and BDI-related therapeutic intervention codes (surgical, endoscopic and radiological). BDI identified within or beyond 21 days after cholecystectomy were categorized as “early BDI” and “late BDI” respectively.

Results: Overall 1,017,177 patients with cholecystectomy for cholelithiasis were extracted, of whom 12,141 BDI patients (1.19%) were identified. Only 1204 (19.6%) of 6,128 patients who had cholecystectomy and BDI diagnosis outside tertiary centers had a therapeutic intervention for BDI in a tertiary center. Among therapeutic procedures, 65.4% were endoscopic treatment (47.2% for early BDI, 80.2% for late BDI, $p<0.001$), 23.5% were surgical (44.8% for early BDI, 6% for late BDI, $p<0.001$), and 11.2% were radiological. One-year survival analysis confirmed the impact of BDI occurrence on patients’ survival.

Conclusions: BDI after cholecystectomy has an important impact on mortality. Only 19.6% of patients access optimal therapeutic pathway through referral to a tertiary center and centralization of BDI treatment need wider consideration.

Introduction

Cholecystectomy is one of the most frequently performed general surgery procedure with an annual caseload of about 120,000 patients in France(5). The vast majority of these procedures are performed in the context of cholelithiasis(5). The most feared complication of the procedure is the occurrence of a bile duct injury (BDI)(9,23). Recent studies estimate the risk of BDI being of 0.08 to 1.5% with most studies being on the lower end(10,16–21). BDI may or may not be recognized during the cholecystectomy procedure and often requires complex and multiple procedures to be treated, with some situations even requiring a liver resection or transplantation surgery(24,25,28). Even though BDI incidence is relatively low, the large number of cholecystectomy procedures performed each year combined to the potentially high induced morbidity make of BDI a public health concern(10). In order to minimize the impact of the BDI and optimize its treatment, it is recommended to refer the patient to a center with an expertise in hepato-biliary surgery as soon as a BDI is identified(23). The last nationwide study analyzing BDI during cholecystectomy in France performed in 2011 was not able by its design to evaluate BDI incidence(29). To date, the therapeutic pathway of BDI patients is poorly known, especially the rate of referral to expert center and its impact. The aim of this study was to explore the BDI epidemiology and therapeutic interventions performed and notably the referral to a tertiary center along with BDI impact on mortality.

Patients and methods

Data Sources

Data for the current study were extracted from the French National Medico Administrative Database (PMSI database) which compiles discharge abstracts for every admission to French healthcare facilities as described elsewhere(30–33). PMSI is considered as a comprehensive and all-inclusive database, which collects information from every inpatient visit, based on standardized hospital discharge reports. All diagnoses and therapeutic procedures were carefully collected and summarized using a dedicated coding system. Discharge abstracts contained patients' demographics, diagnosis based on the International Classification of Disease 10^{th} edition (ICD-10) and therapeutic procedures performed based on the Classification Commune des Actes Médicaux (CCAM). The reliability and validity of PMSI data have already been assessed(34,35).

Study Population

All patients who underwent cholecystectomy for cholelithiasis in France from January 2012 to December 2020 were identified using the ICD-10 codes for lithiasis related gallbladder diseases and CCAM codes for cholecystectomy. Patients with BDI were identified using an algorithm based on a combination of ICD-10 diagnosis and BDI-related therapeutic intervention codes (See "Annexe"). Patients younger than 18 years, undergoing cholecystectomy for other indications and those experienced BDI during hepatectomy were excluded. The study complied with French National Health guidelines on research involving human subjects.

Primary outcome and definition of variables

Primary outcome included BDI incidence further classified as early and late BDI. Early BDI was defined as a BDI diagnosed less than 21 days after cholecystectomy while late BDI included patients with diagnosis of injury established at least 21 days after cholecystectomy as previously reported(36). We also determined 30-day and 1-year mortalities after BDI. Other data such as age, sex, diagnosis leading to cholecystectomy, Charlson's Comorbidity Index (CCI), cholecystostomy history and surgical approach were also extracted. Diagnoses were categorized as "cholelithiasis", "cholecystitis" (both acute and chronic) and "others" including biliary pancreatitis and other related biliary diseases.

To analyze the therapeutic pathway of cholecystectomy-related BDI patients, BDI related therapeutic procedures were analyzed. These therapeutic procedures were classified into 3 groups: surgical, endoscopic and radiological procedures. Single patient therapeutic pathway was not specifically studied.

To further describe this therapeutic pathway, treatment procedures were subsequently stratified based on the type of hospital they were performed into. In the French healthcare system, four different healthcare facilities groups are involved in cholelithiasis surgical treatment along with cholelithiasis treatment related adverse events management. Primary and secondary public hospitals were grouped here as Public Hospitals. Tertiary public hospitals correspond to referral expert centers and were listed as University Hospitals. The remaining two categories were Private Hospitals and Others, the later referring to not-for-profit privately owned hospitals.

Statistical analysis

Qualitative variables are expressed as percentages and quantitative variables as median and interquartile range (IQR) or mean and standard deviation (SD). Chi-square tests were used for comparison of qualitative data and non-parametric Mann–Whitney tests were used for quantitative data. Multivariable logistic regression was performed to determine the risk factors of BDI occurrence and BDI treatment in referral center. This model was adjusted based on sex, CCI class, age class, diagnosis and history of abdominal surgery. A random-effect term was introduced to take into any potential variation in the risk between groups of patients in different hospitals. One-year survival analysis was performed. Censoring criteria were death or end of follow-up. The survival distribution between no BDI and BDI was compared by log-rank test. All p values presented were for a 2-sided test, and the threshold of significance was set at $p < 0.05$. These statistical analyses were performed using STATA 13 (StataCorp, College Station, TX).

Results

Patients' Characteristics

A total of 1,017,177 patients aged 18 years old or older who underwent cholecystectomy for cholelithiasis in France between January 2012 and December 2020 were identified (See Figure 1). Among them, 12,141 (1.19%) patients had cholecystectomy-related BDI. Early BDI according to the above-mentioned definition represented 8,049 (66.3%) patients and late BDI accounted for 4,092 (33.7%) patients (Table 1). The main indications for cholecystectomy in BDI patients were cholecystitis for 77.3% of cases and uncomplicated cholelithiasis for 20.6%.

BDI occurrence

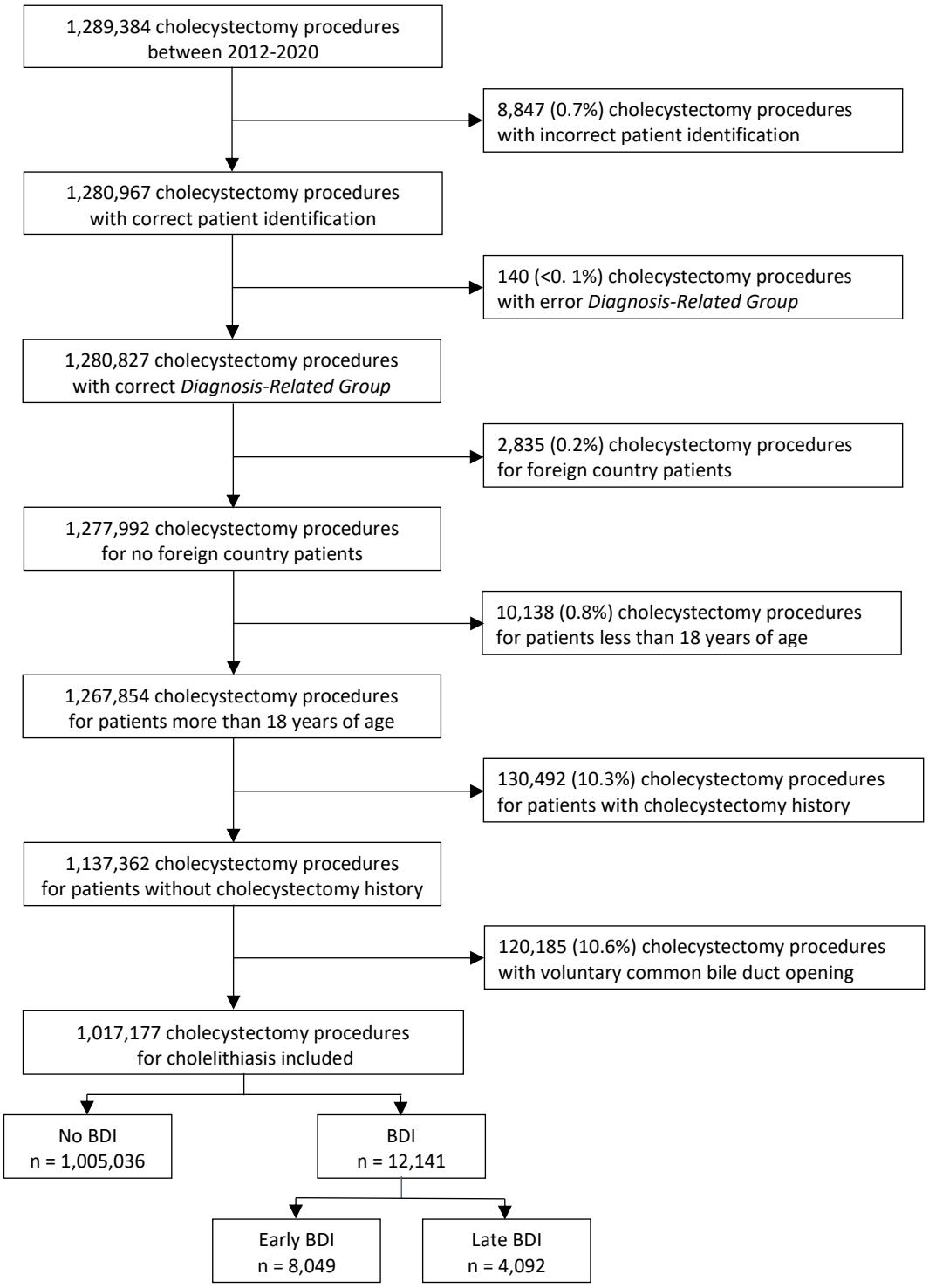


FIGURE 1. Flow Chart of Included Patients

TABLE 1. Patients' Characteristics

	Total Procedures (n = 1,017,177)	**No BDI (n = 1,005,036)**	**BDI (n = 12,141)**	***P***	**Early BDI (n = 8,049)**	**Late BDI (n = 4,092)**	***P***
Age, y							
Mean (sd)	54.7 (17.7)	54.6 (17.7)	62.5 (17.1)	<0.001	61.4 (17.4)	64.6 (16.6)	<0.001
Sex, n (%)							
Female	667,293 (65.6%)	661,142 (65.8%)	6,151 (50.7%)	<0.001	4,185 (52.0%)	1,966 (48.0%)	<0.001
Male	349,884 (34.4%)	343,894 (34.2%)	5,990 (49.3%)		3,864 (48.0%)	2,126 (52.0%)	
Diagnosis, n (%)							
Cholecystitis	786,384 (77.3%)	776,277 (77.2%)	10,107 (83.2%)	<0.001	6,784 (84.3%)	3,323 (81.2%)	<0.001
Cholelithiasis	209,644 (20.6%)	208,091 (20.7%)	1,553 (12.8%)		1,000 (12.4%)	553 (13.5%)	
Others‡	21,149 (2.1%)	20,668 (2.0%)	481 (4.0%)		265 (3.3%)	216 (5.3%)	
Hospital Status, n (%)							
University Hospital	112,323 (11.0%)	110,469 (11.0%)	1,854 (15.3%)	<0.001	1,187 (14.7%)	667 (16.3%)	<0.001
Public Hospital	351,698 (34.6%)	347,073 (34.5%)	4,625 (38.1%)		3,018 (37.5%)	1,607 (39.3%)	
Private Hospital	476,227(46.8%)	471,594 (46.9%)	4,633 (38.2%)		3,101 (38.5%)	1,532 (37.4%)	
Others	76,929 (7.6%)	75,900 (7.6%)	1,029 (8.5%)		743 (9.2%)	286 (7.0%)	
CCI*, n (%)							
0	881,653 (86.7%)	872,826 (86.8%)	8,827 (72.7%)	<0.001	5,984 (74.3%)	2,843 (69.5%)	<0.001
1	91,217 (9.0%)	89,278 (8.9%)	1,939 (16.0%)		1,237 (15.4%)	702 (17.2%)	
≥ 2	44,307 (4.4%)	42,932 (4.3%)	1,375 (11.3%)		828 (10.3%)	547 (13.4%	
CCI* components, n (%)							
Diabetes	59,192 (5.8%)	57,798 (5.8%)	1,394 (11.5%)	<0.001	854 (10.6%)	540 (13.2%)	<0.001
Moderate/severe liver disease	1,389 (0.1%)	1,326 (0.1%)	63 (0.5%)	<0.001	36 (0.4%)	27 (0.7%)	0.123
Renal disease	10,502 (1.0%)	10,150 (1.0%)	352 (2.9%)	<0.001	223 (2.8%)	129 (3.2%)	0.236
COPD	25,032 (2.5%)	24,524 (97.6%)	508 (4.2%)	<0.001	334 (4.1%)	174 (4.3%)	0.790
Congestive heart failure	15,038 (1.5%)	14,586 (1.5%)	452 (3.7%)	<0.001	314 (3.9%)	138 (3.4%)	0.146
Cerebrovascular disease	5,955 (0.6%)	5,805 (0.6%)	150 (1.2%)	<0.001	103 (1.3%)	47 (1.1%)	0.537
Obesity (BMI>30)	82,989 (8.2%)	81,702 (8.1%)	1,287 (10.6%)	<0.001	892 (11.1%)	395 (9.7%)	0.016
Surgical approach, n (%)							
Laparoscopy	974,774 (95.8%)	964,982 (96.0%)	9,792 (80.7%)	<0.001	6,406 (79.6%)	3,386 (82.7%)	<0.001
Laparotomy	42,403 (4.2%)	40,054 (4.0%)	2,349 (19.3%)		1,643 (20.4%)	706 (17.3%)	

90-day mortality[†], n (%)	5,511 (0.5%)	5,225 (0.5%)	286 (2.4%)	<0.001	208 (2.6%)	78 (1.9%)	0.02

[‡] Include biliary pancreatitis and other related diseases

*Charlson's Comorbidity Index

[†] 90-day mortality following index cholecystectomy

was higher in case of cholecystitis (1.29%) than for cholelithiasis (0.74%). BDI patients were more likely to be older (62.5 vs 54.6 for patients with no BDI, p<0.001) and to be male (BDI incidence of 1.71% vs 0.92% in female, p<0.001). Patients with BDI displayed higher CCI and were more likely to have had cholecystostomy before cholecystectomy (0.4% vs 0.1%, p<0.001). Cholecystectomy procedure was performed entirely by laparoscopic approach in 96% of patients. However, in BDI patients, 19.3% of cholecystectomy procedures were performed by or converted to laparotomy.

Patients' characteristics according to hospital type

Concerning hospital status impact (Table 2), 46.8% of cholecystectomy procedures were performed in Private Hospitals, 34.6% in Public Hospitals, 11.0% in University Hospitals and 7.6% in others. BDI incidence was higher in University Hospitals (1.7%) than in Public Hospitals (1.3%), Private Hospitals (1.0%) and others (1.3%) (p<0.001). The proportion of cholecystectomy procedures for cholecystitis was significantly lower in University Hospital compared to other centers, but with a higher proportion of biliary pancreatitis and other related diseases. CCI was higher in patients who had surgery in University Hospitals compared to other centers, with more patients with diabetes, moderate/severe liver disease, renal disease, chronic obstructive pulmonary diseases, congestive heart failure and cerebrovascular diseases (p<0.001) in University Hospitals. Less obese patients had cholecystectomy in Private Hospitals. More patients had cholecystostomy in University Hospitals compared to other centers (0.3% vs 0.1%, p<0.001).

TABLE 2. Patients' Characteristics according to Hospital Type

	Total (n=1,017,177)	**University Hospital (n=112,323)**	**Public Hospital (n=351,698)**	**Private Hospital (n=476,227)**	**Others (n=76,929)**	***P***
BDI, n (%)						
Yes	12,141 (1.2%)	1,854 (1.7%)	4,625 (1.3%)	4,633 (1.0%)	1,029 (1.3%)	<0.001
Early BDI	8,049 (0.8%)	1,187 (1.1%)	3,018 (0.9%)	3,101 (0.7%)	743 (1.0%)	<0.001
Late BDI	4,092 (0.4%)	667 (0.6%)	1,607 (0.5%)	1,532 (0.3%)	286 (0.4%)	
Age, n (%)						
18-39 yrs	239,543 (23.5%)	28,414 (25.3%)	80,245 (22.8%)	112,345 (23.6%)	18,539 (24.1%)	<0.001
40-49 yrs	163,999 (16.1%)	17,125 (15.2%)	52,211 (14.8%)	81,810 (17.2%)	12,853 (16.7%)	
50-59 yrs	183,071 (18.0%)	19,395 (17.3%)	58,577 (16.7%)	90,864 (19.1%)	14,235 (18.5%)	
60-69 yrs	196,176 (19.3%)	20,572 (18.3%)	66,590 (18.9%)	93,977 (19.7%)	15,037 (19.5%)	
≥ 70 yrs	234,388 (23.0%)	26,817 (23.9%)	94,075 (26.7%)	97,231 (20.4%)	16,265 (21.1%)	
Sex, n (%)						
Female	667,293 (65.6%)	67,923 (60.5%)	223,521 (63.6%)	324,002 (68.0%)	51,847 (67.4%)	<0.001
Male	349,884 (34.4%)	44,400 (39.5%)	128,177 (36.4%)	152,225 (32.0%)	25,082 (32.6%)	
Diagnosis, n (%)						
Cholecystitis	786,384 (77.3%)	66,029 (58.8%)	247,484 (70.4%)	413,009 (86.7%)	59,862 (77.8%)	<0.001
Cholelithiasis	209,644 (20.6%)	40,352 (35.9%)	94,620 (26.9%)	58,757 (12.3%)	15,915 (20.7%)	
Others‡	21,149 (2.1%)	5,942 (5.3%)	9,594 (2.7%)	4,461 (0.94%)	1,152 (1.5%)	
CCI*, n (%)						
0	881,653 (86.7%)	89,456 (79.6%)	294,247 (83.7%)	430,944 (90.5%)	52,733 (68.5%)	<0.001
1	91,217 (9.0%)	12,714 (11.3%)	37,251 (10.6%)	34,229 (7.2%)	7,023 (9.1%)	
≥ 2	44,307 (4.4%)	10,153 (9.0%)	20,200 (5.7%)	11,054 (2.3%)	2,900 (3.8%)	
CCI* components, n (%)						
Diabetes	59,192 (5.8%)	8,544 (7.6%)	24,824 (7.1%)	21,599 (4.5%)	4,225 (5.5%)	<0.001
Moderate/severe liver disease	1,389 (0.1%)	371 (0.3%)	619 (0.2%)	313 (0.1%)	86 (0.1%)	<0.001
Renal disease	10,502 (1.0%)	2,783 (2.5%)	4,434 (1.3%)	2,663 (0.6%)	622 (0.8%)	<0.001
COPD	25,032 (2.5%)	3,698 (3.3%)	10,244 (2.9%)	8,728 (1.8%)	2,362 (3.1%)	<0.001
Congestive heart failure	15,038 (1.5%)	3,246 (2.9%)	7,760 (2.2%)	3,261 (0.7%)	771 (1.0%)	<0.001
Cerebrovascular disease	5,955 (0.6%)	1,279 (1.1%)	3,053 (0.9%)	1,267 (0.3%)	356 (0.5%)	<0.001
Obesity (BMI>30)	82,989 (8.2%)	10,194 (9.1%)	33,438 (9.5%)	32,246 (6.8%)	7,111 (9.2%)	<0.001
Surgical approach, n (%)						
Laparoscopy	974,774 (95.8%)	102,894 (91.6%)	331,063 (94.1%)	466,233 (97.9%)	74,584 (97.0%)	<0.001

Laparotomy	42,403 (4.2%)	9,429 (8.4%)	20,635 (5.9%)	9,994 (2.1%)	2,345 (3.0%)	
90-day mortality[†], n (%)	5,511 (0.5%)	1,002 (0.9%)	2,842 (0.8%)	1,391 (0.3%)	276 (0.4%)	<0.001

[‡] Include biliary pancreatitis and other related diseases

*Charlson's Comorbidity Index

[†] 90-day mortality following index cholecystectomy

Therapeutic interventions

Among the 12,141 patients with BDI, 7,159 (59.0%) had an identified BDI-specific therapeutic intervention (Table 3). In more details, 46.0% and 84.4% of patients with early and late BDI had an identified therapeutic intervention, respectively. In the treatment of early BDI, 34.1% of the procedures performed were surgical, 56.5% were endoscopic and 9.4% were radiological. For late BDI treatment, proportions for surgical, endoscopic and radiological procedures were respectively 5.1%, 82.6% and 12.4%. Overall, 14.1% of early BDI patients and 25.8% of late BDI patients were referred to tertiary centers and had a therapeutic procedure performed there. Among these patients, 68.5% had no identified therapeutic procedure performed before referral (59.2% for early BDI, 74.2% for late BDI). The median time from cholecystectomy to referral for BDI treatment was 14 days [8-54] for early BDI and 116 days [40-255] for late BDI patients. For late BDI patients treated in University Hospitals (See Table 4), a higher proportion of patients (9.1%) had surgery compared to Public Hospitals (3.6%), Private Hospitals (2.7%) and Others (3.8%; $p<0.001$).

TABLE 3. Therapeutic interventions for Bile Duct Injuries (BDI)

	Total BDI patients (n = 12,141)	**Early BDI (n = 8,049)**	**Late BDI (n = 4,092)**	***P***
BDI treatment, n (%)				
Yes	7,159 (59.0%)	3,705 (46.0%)	3,454 (84.4%)	<0.001
No	4,982 (41.0%)	4,344 (54.0%)	638 (15.6%)	
Referral to tertiary center leading to intervention, n (%)†				
Yes	1,204 (19.6%)	456 (14.1%)	748 (25.8%)	<0.001
No	4,924 (80.4%)	2,768 (85.9%)	2,156 (74.2%)	
No intervention before referral, n (%)	825 (68.5%)	270 (59.2%)	555 (74.2%)	<0.001
Time from BDI to intervention in referral center, days [IQR]	60 [15-208]	14 [8-54]	116 [40-255]	<0.001
Treatment procedures, n (%)*				
Total	12,911 (100.0%)	6,170 (100.0%)	6,741 (100.0%)	
Surgical	2,443 (18.9%)	2,101 (34.1%)	342 (5.1%)	<0.001
Endoscopic	9,052 (70.1%)	3,486 (56.5%)	5,566 (82.6%)	
Radiological	1,416 (11.0%)	583 (9.4%)	833 (12.4%)	

†n (%) of this section are expressed according to the total number of cholecystectomies performed outside referral centers
*n (%) of this section are expressed according to the total numbers of Treatment procedures and not BDI numbers

TABLE 4. Impact of Hospital Status on Intervention Performed for Bile Duct Injury (BDI) Treatment

	University Hospital		**Public Hospital**		**Private Hospital**		**Others**	
	Early BDI (n=1,466)	**Late BDI (n=2,226)**	**Early BDI (n=1,544)**	**Late BDI (n=1,384)**	**Early BDI (n=2,587)**	**Late BDI (n=2,630)**	**Early BDI (n=573)**	**Late BDI (n=501)**
Intervention type, n (%)								
Surgical	467 (31.9%)	203 (9.1%)	701 (45.4%)	50 (3.6%)	728 (28.1%)	70 (2.7%)	205 (35.8%)	19 (3.8%)
Endoscopic	784 (53.5%)	1,653 (74.3%)	747 (48.4%)	1,224 (88.4%)	1,636 (63.2%)	2,258 (85.9%)	319 (55.7%)	431 (86%)
Radiological	215 (14.7%)	370 (16.6%)	96 (6.2%)	110 (7.9%)	223 (8.6%)	302 (11.5%)	49 (8.6%)	51 (10.2%)

Risk factors for BDI occurrence and tertiary center referral

We first performed a multivariate analysis to identify risk factors of BDI occurrence after cholecystectomy for cholelithiasis (Table 5). Being a male was associated with a higher risk of BDI occurrence (OR=1.456, $CI_{95\%}$ [1.402-1.512]. Increasing age and CCI were also identified as risk factors for BDI occurrence with an OR of 2.514 ($CI_{95\%}$ [2.359-2.678]) for patients aged 70 or older and an OR of 1.884 ($CI_{95\%}$ [1.768-2.008]) for CCI equal to or above 2. A diagnosis of cholecystitis or an history of abdominal surgery also confirmed to be risk factors (OR=1.723, $CI_{95\%}$ [1.625-1.826] and OR=1.237, ($CI_{95\%}$ [1.113-1.376] respectively).

Another multivariate analysis was conducted to identify risk factors for referral of BDI patients to a tertiary center. The older the patients, the fewer referral were observed with an OR for patients aged 70 or older of 0.548 ($CI_{95\%}$ [0.452-0.665]). The main risk factor identified was the presence of a late BDI with an OR of 4.405 ($CI_{95\%}$ [3.895-4.982]).

Impact of BDI on patients' survival

Ninety days after cholecystectomy 0.5% of patients with no BDI were deceased (Table 1) which was lower than the 2.4% observed in the BDI patients group ($p<0.001$). Ninety-day mortality following BDI identification was higher in late BDI patients than in early BDI patients (5.8% vs 2.6%, $p<0.001$). In addition, a 1-year survival analysis was performed and confirmed the impact of BDI occurrence on patients' survival ($p<0.001$; Figure 2).

TABLE 5. Risk Factors of BDI occurrence and BDI treatment in referral center

	BDI occurrence			BDI treatment in referral center		
	OR	***P***	**95% CI**	**OR**	***P***	**95% CI**
Sex						
Female	Ref.	.	.	Ref.	.	.
Male	1.456	<0.001	[1.402 ; 1.512]	1.210	0.002	[1.073 ; 1.363]
Age group		<0.001			<0.001	
18-39 yrs	Ref.	.	.	Ref.	.	.
40-49 yrs	1.223	<0.001	[1.133 ; 1.320]	0.727	0.008	[0.574 ; 0.919]
50-59 yrs	1.422	<0.001	[1.324 ; 1.526]	0.767	0.016	[0.618 ; 0.952]
60-69 yrs	1.793	<0.001	[1.677 ; 1.917]	0.646	<0.001	[0.525 ; 0.795]
≥70 yrs	2.514	<0.001	[2.359 ; 2.678]	0.548	<0.001	[0.452 ; 0.665]
CCI*		<0.001			0.061	
0	Ref.	.	.	Ref.	.	.
1	1.511	<0.001	[1.433 ; 1.594]	1.150	0.087	[0.980 ; 1.351]
≥2	1.884	<0.001	[1.768 ; 2.008]	1.204	0.048	[1.002 ; 1.446]
Diagnosis						
Cholelithiasis	Ref.	.	.	Ref.	.	.
Cholecystitis	1.723	<0.001	[1.625 ; 1.826]	1.076	0.424	[0.900 ; 1.286]
Abdominal Surgery History						
No	Ref.	.	.	Ref.	.	.
Yes	1.237	<0.001	[1.113 ; 1.376]	1.203	0.253	[0.877 ; 1.651]
Late BDI						
No	-	-	-	Ref.	.	.
Yes	-	-	-	4.405	<0.001	[3.895 ; 4.982]

*Charlson's Comorbidity Index

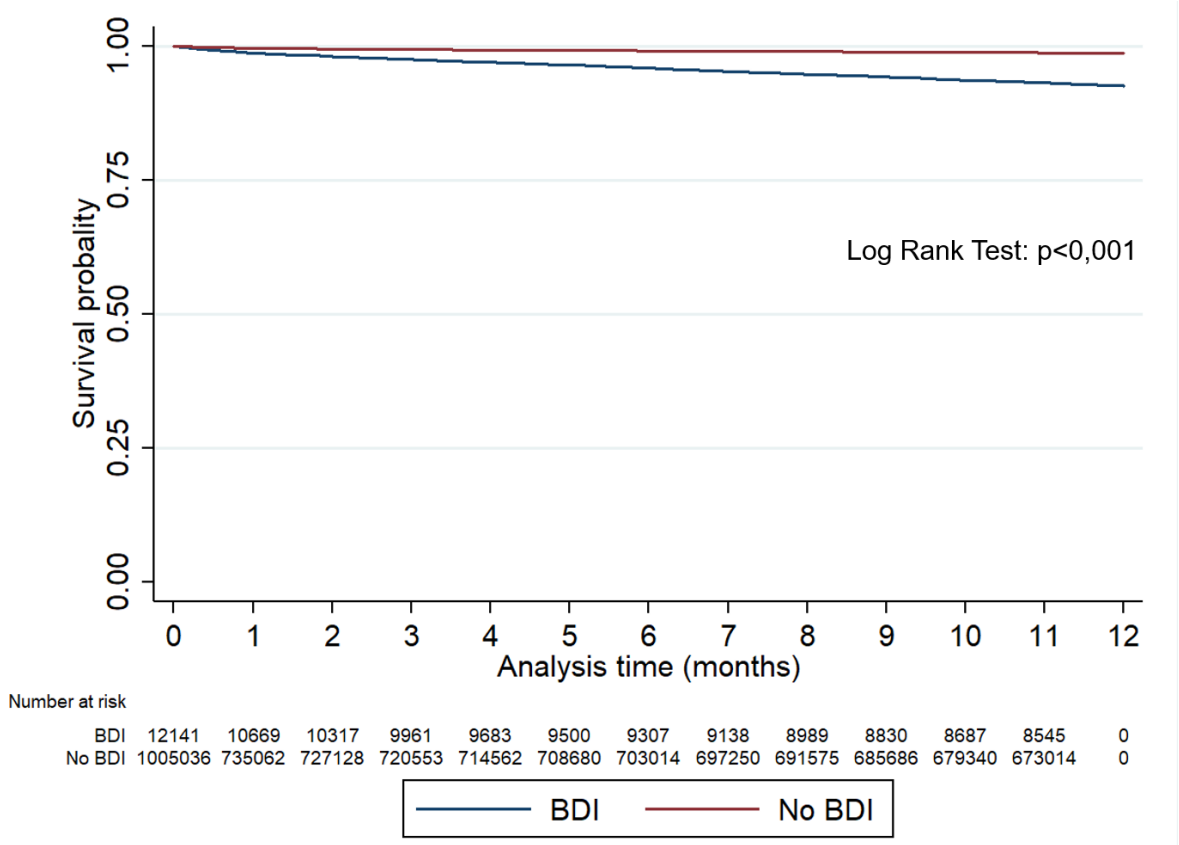


FIGURE 2. 1-year survival analysis for patients with and without Bile Duct Injury (BDI) during cholecystectomy for cholelithiasis

Discussion

In this nationwide study, BDI occurrence in France appears higher than usually reported. Among 1,017,177 cholecystectomy procedures performed over a 9-year period, the incidence was 1.19%. Only 59.0% of BDI patients had a surgical, endoscopic or radiological therapeutic procedure. Most of the procedures performed in the treatment of BDI consisted in endoscopic procedures. More interestingly, no more than 19.6% of BDI patients were referred to tertiary centers for BDI treatment. The most important risk factor for referral to tertiary center was the presence of late BDI. On survival analysis, the impact of BDI during cholecystectomy for cholelithiasis was significant with a higher 90-day and 1-year mortality of patients with BDI compared to patients without BDI.

In the current study, the incidence of BDI during cholecystectomy for cholelithiasis appears higher than usually reported in the literature, ranging from 0.08 to 1.5% (19,21,27,37–39). One previous study from El-Dhuwaib et al. attempted to report BDI occurrence in this context on a national scale(26). This study conducted in England covering a 12-year period gathered 572,223 cholecystectomy procedures with a 0.09% BDI incidence. However, only the need for bile duct reconstruction surgery within one year after index cholecystectomy was used as a surrogate for BDI, excluding other potential therapeutic procedures. Herein surgery accounted for 18.9% of BDI therapeutic procedures. Therefore, considering BDI patients only as patients who had bile duct reconstruction surgery may underestimate BDI incidence.

Of note in the current study 41% of the BDI patients did not have further therapeutic procedure after BDI diagnosis, although this high percentage included per-cholecystectomy BDI suture and surgical drainage used at the end of the cholecystectomy procedure as no CCAM code enable their identification as therapeutic procedures. Drain placement is mostly used in cases of difficult cholecystectomy with extensive cystic pedicle inflammation or after subtotal cholecystectomy in fear of potential bile leak and can be considered a therapeutic procedure(8,40). Patients with such low grade BDI have a favorable evolution in up to 90% of cases with initial direct suture, surgical drainage(40) or endoscopic treatment(20,41). Yet bile leak from cystic duct or liver bed (type A) should be considered as BDI(8), as reported by Strasberg et al. in a largely adopted BDI classification. Bile leaks alone after cholecystectomy were reported with an incidence of 0.5% in a study that analyzed 711,454 procedures(10). Medico-economic impact and over-mortality of these minor BDI patients have also been demonstrated(9,29). By considering bile leaks as BDI, our results may be a better reflection on a national scale of BDI incidence after cholecystectomy for cholelithiasis.

Regarding risk factors for BDI occurrence identified in the current study, male sex, more advanced age, multiple comorbidities, cholecystitis diagnosis and abdominal surgery history were highlighted in agreement with previous studies(19,22,26,42,43). The higher BDI incidence observed in patients from University Hospital is to be balanced with a higher CCI in this group of patients compared to other hospitals. Indeed, evidence exists that preexisting liver disease or obesity are associated with a higher BDI risk and that renal, respiratory, cardiocirculatory or neurovascular comorbidities expose to a higher post-operative mortality risk(19,43). In addition, more cholecystostomy procedures were performed in University Hospital patients with a higher risk of cholecystectomy-related BDI. Based on the cholecystostomy indications from the 2018 Tokyo Guidelines(44), this reflects both a higher comorbid situation and inflammatory state leading to organ insufficiency in University Hospital patients. Finally, a large proportion of cholecystectomy procedures in University Hospitals are performed by young surgeons contrary to other centers, which is known to be a risk factor for BDI(43).

There is no actual consensus cutoff in the literature to define early and late BDI. Different cutoffs were used from 72 hours up to 6 weeks and even 1 year(45–47). A 21-day cutoff was arbitrarily selected for this study, as this 3-week period could negatively impact therapeutic procedures success because of local peri-hilar adherences formation and inflammation. Besides, Perera et al. used this 3-week cut-off to show that early BDI repair by non-hepatobiliary surgeons have a worse outcome than early repair by hepatobiliary surgeons(36). There is clear evidence that BDI repair success rate is higher when initially performed by a hepatobiliary expert surgeon. Indeed, when bile duct repair is attempted before patient referral to an expert center, only 17 to 27% of the patients will not need further intervention.

This is opposed to a 79 to 94% success rate if initial repair is performed by an expert hepatobiliary surgeon(48,49).

We showed herein that late BDI patient had a 90-day mortality as high as 5.8% after BDI diagnosis. In this group, 84.4% had a therapeutic procedure performed with only 25.8% being referred to a tertiary center (Table 3). Besides, tertiary centers performed the majority of the surgical therapeutic procedures for late BDI, which is explained by the need for more technically demanding procedures such as complex bile duct reconstruction, hepatectomy or liver transplantation(24,25). Such centers also propose endoscopic and radiological expertise such that multidisciplinary expert discussion appears preferable to make optimal BDI therapeutic strategy decision with highest success chances. Herein, late BDI was clearly identified as a risk factor for patient referral in multivariate analysis. When referred, time to referral appeared very long in our study, possibly impairing treatment success. In this regard early contact and referral discussion with tertiary hepatobiliary centers should be encouraged with the objective of lowering BDI impact on mortality.

There are so far no French guidelines about the transfer of BDI patients in tertiary centers but the 2020 World Society of Emergency Surgery guidelines(23) addressed the management of cholecystectomy-related BDI. For intra-operatively diagnosed BDI, they report a strong recommendation (GRADE 1C) for early repair (defined there as < 72h after cholecystectomy) and referral to a hepatobiliary center if sufficient hepatobiliary expertise is not available locally. Referral is also advocated for post-operatively diagnosed BDI and especially for major BDI in the absence of hepatobiliary surgical expertise. In France, most of expert hepatobiliary surgeons are attached to a University Hospital making of University Hospitals the main resource for patient referral when seeking hepatobiliary expertise. In agreement with

literature data, we found that BDI occurrence during cholecystectomy for cholelithiasis has a negative impact on patient survival both at 90-day and on 1-year survival analysis(10,26). This stresses the efforts needed to optimize the therapeutic pathway after BDI diagnosis in order to limit BDI's impact on mortality in the future.

This study has several limitations. Multiple critical parameters are not available in the PMSI database. Thus, the analysis of BDI type according to existing classifications, surgeon experience, radiological BDI confirmation, treatment outcome or surgical approach conversion rate was not possible. Nonetheless, the main objective of this work was to capture the overall incidence of BDI during cholecystectomy for cholelithiasis as we assumed the literature to underestimate it. This study is based on data from an administrative database with a specific risk of bias, such as coding errors, though compensated by the large sample size and exhaustive inclusion methods. However, numerous data have been published with internal and external validation recognizing the PMSI database as an accurate data source(50–52). Despite these limitations, this study is the first and the largest nationwide study able to identify all BDI after cholecystectomy for cholelithiasis based on all therapeutic interventions and not only focusing on surgical procedures.

Conclusion

In conclusion, BDI occurrence during cholecystectomy for cholelithiasis has a higher incidence than expected, with a significant impact on mortality. Only 19.6% of BDI patients access optimal therapeutic pathway through referral to a tertiary center, with possible negative impact on outcome. Studies designed to assess BDI treatment centralization on outcome should be encouraged.

Bibliography

1. Xu D, Yu BP, Luo HS, Chen LD. Control of gallbladder contractions by cholecystokinin through cholecystokinin-A receptors on gallbladder interstitial cells of Cajal. World J Gastroenterol. 2008 May 14;14(18):2882–7.

2. Muhrbeck O, Ahlberg J. Prevalence of gallstone disease in a Swedish population. Scand J Gastroenterol. 1995 Nov;30(11):1125–8.

3. European Association for the Study of the Liver (EASL). EASL Clinical Practice Guidelines on the prevention, diagnosis and treatment of gallstones. J Hepatol. 2016 Jul;65(1):146–81.

4. Festi D, Reggiani MLB, Attili AF, Loria P, Pazzi P, Scaioli E, et al. Natural history of gallstone disease: Expectant management or active treatment? Results from a population-based cohort study. J Gastroenterol Hepatol. 2010 Apr;25(4):719–24.

5. Bray F, Balcaen T, Baro E, Gandon A, Ficheur G, Chazard E. Increased incidence of cholecystectomy related to gallbladder disease in France: Analysis of 807,307 cholecystectomy procedures over a period of seven years. J Visc Surg. 2019 Jun;156(3):209–15.

6. Traverso LW. Carl Langenbuch and the first cholecystectomy. Am J Surg. 1976 Jul;132(1):81–2.

7. Polychronidis A, Laftsidis P, Bounovas A, Simopoulos C. Twenty years of laparoscopic cholecystectomy: Philippe Mouret--March 17, 1987. JSLS. 2008;12(1):109–11.

8. Strasberg SM, Hertl M, Soper NJ. An analysis of the problem of biliary injury during laparoscopic cholecystectomy. J Am Coll Surg. 1995 Jan;180(1):101–25.

9. Strasberg SM. A three-step conceptual roadmap for avoiding bile duct injury in laparoscopic cholecystectomy: an invited perspective review. J Hepatobiliary Pancreat Sci. 2019 Apr;26(4):123–7.

10. Fong ZV, Pitt HA, Strasberg SM, Loehrer AP, Sicklick JK, Talamini MA, et al. Diminished Survival in Patients with Bile Leak and Ductal Injury: Management Strategy and Outcomes. Journal of the American College of Surgeons. 2018 Apr;226(4):568-576e1.

11. Hariharan D, Psaltis E, Scholefield JH, Lobo DN. Quality of Life and Medico-Legal Implications Following Iatrogenic Bile Duct Injuries. World J Surg. 2017 Jan;41(1):90–9.

12. Bismuth H. Postoperative strictures of the bile ducts. Blumgart LH. 1982. 209–18 p. (New-York : Churchill-Linvingstone; vol. The biliary tract V).

13. Bismuth H, Majno PE. Biliary strictures: classification based on the principles of surgical treatment. World J Surg. 2001 Oct;25(10):1241–4.

14. Bektas H, Schrem H, Winny M, Klempnauer J. Surgical treatment and outcome of iatrogenic bile duct lesions after cholecystectomy and the impact of different clinical classification systems. Br J Surg. 2007 Sep;94(9):1119–27.

15. McMahon AJ, Fullarton G, Baxter JN, O'Dwyer PJ. Bile duct injury and bile leakage in laparoscopic cholecystectomy. Br J Surg. 1995 Mar;82(3):307–13.

16. Alexander HC, Bartlett AS, Wells CI, Hannam JA, Moore MR, Poole GH, et al. Reporting of complications after laparoscopic cholecystectomy: a systematic review. HPB (Oxford). 2018 Sep;20(9):786–94.

17. Hogan NM, Dorcaratto D, Hogan AM, Nasirawan F, McEntee P, Maguire D, et al. Iatrogenic common bile duct injuries: Increasing complexity in the laparoscopic era: A prospective cohort study. Int J Surg. 2016 Sep;33 Pt A:151–6.

18. Fletcher R, Cortina CS, Kornfield H, Varelas A, Li R, Veenstra B, et al. Bile duct injuries: a contemporary survey of surgeon attitudes and experiences. Surg Endosc. 2020 Jul;34(7):3079–84.

19. Nuzzo G, Giuliante F, Giovannini I, Ardito F, D'Acapito F, Vellone M, et al. Bile duct injury during laparoscopic cholecystectomy: results of an Italian national survey on 56 591 cholecystectomies. Arch Surg. 2005 Oct;140(10):986–92.

20. Karvonen J, Salminen P, Grönroos JM. Bile duct injuries during open and laparoscopic cholecystectomy in the laparoscopic era: alarming trends. Surg Endosc. 2011 Sep;25(9):2906–10.

21. Söderlund C, Frozanpor F, Linder S. Bile duct injuries at laparoscopic cholecystectomy: a single-institution prospective study. Acute cholecystitis indicates an increased risk. World J Surg. 2005 Aug;29(8):987–93.

22. Krähenbühl L, Sclabas G, Wente MN, Schäfer M, Schlumpf R, Büchler MW. Incidence, risk factors, and prevention of biliary tract injuries during laparoscopic cholecystectomy in Switzerland. World J Surg. 2001 Oct;25(10):1325–30.

23. de'Angelis N, Catena F, Memeo R, Coccolini F, Martínez-Pérez A, Romeo OM, et al. 2020 WSES guidelines for the detection and management of bile duct injury during cholecystectomy. World J Emerg Surg. 2021 Jun 10;16(1):30.

24. Truant S, Boleslawski E, Zerbib P et al. Liver resection in management of post-cholecystectomy biliary injury: a case series. Hepatogastroenterology. 2012 Nov-Dec;59(120):2403-2406.

25. Chiche L, Guieu M, Bachellier P, Suc B, Soubrane O, Boudjema K, et al. Liver transplantation for iatrogenic bile duct injury during cholecystectomy: a French retrospective multicenter study. HPB (Oxford). 2022 Jan;24(1):94–100.

26. El-Dhuwaib Y, Slavin J, Corless DJ, Begaj I, Durkin D, Deakin M. Bile duct reconstruction following laparoscopic cholecystectomy in England. Surg Endosc. 2016 Aug;30(8):3516–25.

27. Flum DR, Cheadle A, Prela C, Dellinger EP, Chan L. Bile duct injury during cholecystectomy and survival in medicare beneficiaries. JAMA. 2003 Oct 22;290(16):2168–73.

28. Truant S, Boleslawski E, Lebuffe G, Sergent G, Pruvot FR. Hepatic resection for post-cholecystectomy bile duct injuries: a literature review. HPB (Oxford). 2010 Jun;12(5):334–41.

29. Iannelli A, Paineau J, Hamy A, Schneck AS, Schaaf C, Gugenheim J. Primary versus delayed repair for bile duct injuries sustained during cholecystectomy: results of a survey of the Association Francaise de Chirurgie. HPB (Oxford). 2013 Aug;15(8):611–6.

30. El Amrani M, Clement G, Lenne X, Rogosnitzky M, Theis D, Pruvot FR, et al. The Impact of Hospital Volume and Charlson Score on Postoperative Mortality of Proctectomy for Rectal Cancer: A Nationwide Study of 45,569 Patients. Ann Surg. 2018 Nov;268(5):854–60.

31. El Amrani M, Clement G, Lenne X, Farges O, Delpero JR, Theis D, et al. Failure-to-rescue in Patients Undergoing Pancreatectomy: Is Hospital Volume a Standard for Quality Improvement Programs? Nationwide Analysis of 12,333 Patients. Ann Surg. 2018 Nov;268(5):799–807.

32. El Amrani M, Clément G, Lenne X, Laueriere C, Turpin A, Theis D, et al. Should all pancreatic surgery be centralized regardless of patients' comorbidity? HPB (Oxford). 2020 Jul;22(7):1057–66.

33. Roussel E, Clément G, Lenne X, Pruvot FR, Schwarz L, Theis D, et al. Is Centralization Needed for Patients Undergoing Distal Pancreatectomy?: A Nationwide Study of 3314 Patients. Pancreas. 2019 Oct;48(9):1188–94.

34. Olive F, Gomez F, Schott AM, Remontet L, Bossard N, Mitton N, et al. [Critical analysis of French DRG based information system (PMSI) databases for the epidemiology of cancer: a longitudinal approach becomes possible]. Rev Epidemiol Sante Publique. 2011 Feb;59(1):53–8.

35. Goueslard K, Cottenet J, Benzenine E, Tubert-Bitter P, Quantin C. Validation study: evaluation of the metrological quality of French hospital data for perinatal algorithms. BMJ Open. 2020 May 12;10(5):e035218.

36. Perera MTPR, Silva MA, Hegab B, Muralidharan V, Bramhall SR, Mayer AD, et al. Specialist early and immediate repair of post-laparoscopic cholecystectomy bile duct injuries is associated with an improved long-term outcome. Ann Surg. 2011 Mar;253(3):553–60.

37. Halbert C, Pagkratis S, Yang J, Meng Z, Altieri MS, Parikh P, et al. Beyond the learning curve: incidence of bile duct injuries following laparoscopic cholecystectomy normalize to open in the modern era. Surg Endosc. 2016 Jun;30(6):2239–43.

38. Harboe KM, Bardram L. Nationwide quality improvement of cholecystectomy: results from a national database. Int J Qual Health Care. 2011 Oct;23(5):565–73.

39. Rystedt J, Lindell G, Montgomery A. Bile Duct Injuries Associated With 55,134 Cholecystectomies: Treatment and Outcome from a National Perspective. World J Surg. 2016 Jan;40(1):73–80.

40. Kimura T, Suzuki K, Umehara Y, Kawabe A, Wada H. Features and management of bile leaks after laparoscopic cholecystectomy. J Hepatobiliary Pancreat Surg. 2005;12(1):61–4.

41. Haidar H, Manasa E, Yassin K, Suissa A, Kluger Y, Khamaysi I. Endoscopic treatment of post-cholecystectomy bile leaks: a tertiary center experience. Surg Endosc. 2021 Mar;35(3):1088–92.

42. Georgiades CP, Mavromatis TN, Kourlaba GC, Kapiris SA, Bairamides EG, Spyrou AM, et al. Is inflammation a significant predictor of bile duct injury during laparoscopic cholecystectomy? Surg Endosc. 2008 Sep;22(9):1959–64.

43. Giger UF, Michel JM, Opitz I. Risk factors for perioperative complications in patients undergoing laparoscopic cholecystectomy: analysis of 22,953 consecutive cases from the Swiss Association of Laparoscopic and Thoracoscopic Surgery database. J Am Coll Surg. 2006 Nov;203(5):723–8.

44. Okamoto K, Suzuki K, Takada T, Strasberg SM, Asbun HJ, Endo I, et al. Tokyo Guidelines 2018: flowchart for the management of acute cholecystitis. J Hepatobiliary Pancreat Sci. 2018 Jan;25(1):55–72.

45. Kaman L, Behera A, Singh R, Katariya RN. Management of major bile duct injuries after laparoscopic cholecystectomy. Surg Endosc. 2004 Aug;18(8):1196–9.

46. de Reuver PR, Grossmann I, Busch OR, Obertop H, van Gulik TM, Gouma DJ. Referral pattern and timing of repair are risk factors for complications after reconstructive surgery for bile duct injury. Ann Surg. 2007 May;245(5):763–70.

47. Sicklick JK, Camp MS, Lillemoe KD, Melton GB, Yeo CJ, Campbell KA, et al. Surgical management of bile duct injuries sustained during laparoscopic cholecystectomy: perioperative results in 200 patients. Ann Surg. 2005 May;241(5):786–92; discussion 793-795.

48. Stewart L, Way LW. Bile Duct Injuries During Laparoscopic Cholecystectomy: Factors That Influence the Results of Treatment. Archives of Surgery. 1995 Oct 1;130(10):1123–8.

49. Chapman WC, Halevy A, Blumgart LH, Benjamin IS. Postcholecystectomy bile duct strictures. Management and outcome in 130 patients. Arch Surg. 1995 Jun;130(6):597–602; discussion 602-604.

50. Lorgis L, Cottenet J, Molins G, Benzenine E, Zeller M, Aube H, et al. Outcomes after acute myocardial infarction in HIV-infected patients: analysis of data from a French nationwide hospital medical information database. Circulation. 2013 Apr 30;127(17):1767–74.

51. Quantin C, Benzenine E, Hägi M, Auverlot B, Abrahamowicz M, Cottenet J, et al. Estimation of national colorectal-cancer incidence using claims databases. J Cancer Epidemiol. 2012;2012:298369.

52. Quantin C, Cottenet J, Vuagnat A, Prunet C, Mouquet MC, Fresson J, et al. [Quality of perinatal statistics from hospital discharge data: comparison with civil registration and the 2010 National Perinatal Survey]. J Gynecol Obstet Biol Reprod (Paris). 2014 Nov;43(9):680–90.

Annexe

BILE DUCT INJURY IDENTIFICATION ALGORITHM

1. Selection of patients

1.1. Selection of patients with biliary lithiasis

- **Included ICD-10 Diagnostics**

  - K80.0 - Calculus of gallbladder with acute cholecystitis
  - K80.1 - Calculus of gallbladder with other cholecystitis
  - K80.2 - Calculus of gallbladder without cholecystitis
  - K80.3 - Calculus of bile duct with cholangitis
  - K80.4 - Calculus of bile duct with cholecystitis
  - K80.5 - Calculus of bile duct without cholangitis or cholecystitis
  - K81.0 - Acute cholecystitis
  - K81.1 - Chronic cholecystitis
  - K81.8 - Other cholecystitis
  - K81.9 - Cholecystitis, unspecified
  - K82.0 - Obstruction of gallbladder
  - K82.1 - Hydrops of gallbladder
  - K83.0 - Cholangitis
  - K83.1 - Obstruction of bile duct
  - K85.1 - Biliary acute pancreatitis

- **Excluded ICD-10 Diagnostics**

  - K80.8 - Other cholelithiasis
  - K82.2 - Perforation of gallbladder
  - K82.3 - Fistula of gallbladder
  - K82.4 - Cholesterolosis of gallbladder
  - K82.8 - Other specified diseases of gallbladder
  - K82.9 - Disease of gallbladder, unspecified
  - K83.2 - Perforation of bile duct
  - K83.3 - Fistula of bile duct
  - K83.4 - Spasm of sphincter of Oddi
  - K83.5 - Biliary cyst
  - K83.8 - Other specified diseases of biliary tract
  - K83.9 - Disease of biliary tract, unspecified
  - K85.0 - Idiopathic acute pancreatitis
  - K85.2 - Alcohol-induced acute pancreatitis
  - K85.3 - Drug-induced acute pancreatitis
  - K85.8 - Other acute pancreatitis
  - K85.9 - Acute pancreatitis, unspecified

1.2. Selection of patients with cholecystectomy for biliary lithiasis without intraoperative choledochotomy (bile duct injury repair related procedure were not excluded)

- **Included CCAM Procedures**

- HMFA001 - Cholecystectomy with choledochojejunostomy, by laparotomy
- HMFA004 - Cholecystectomy with transcystic stone removal from the common bile duct, by laparotomy
- HMFA005 - Cholecystectomy by laparoscopy, with choledochojejunostomy by laparotomy
- HMFC001 - Cholecystectomy with transcystic removal of a stone from the common bile duct, by laparoscopy
- HMFC004 - Cholecystectomy, by laparoscopy
- HMFC005 - Cholecystectomy with choledocojejunostomy, by laparoscopy
- HMFA007 – Cholecystectomy, by laparotomy

- **Excluded CCAM Procedures**

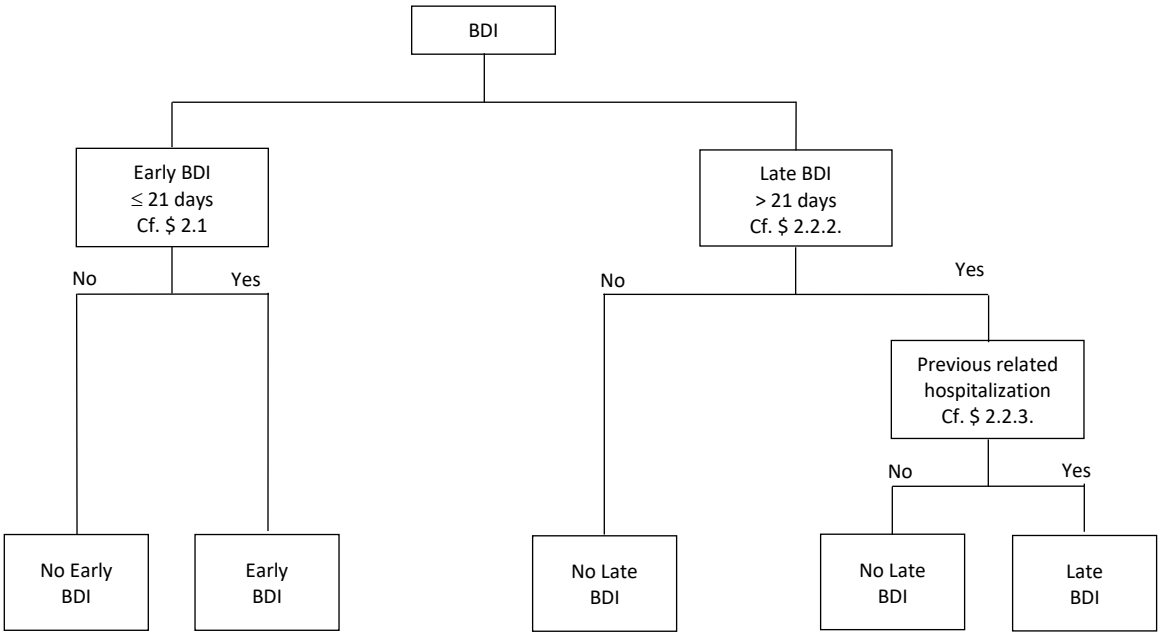
  - HMFA002 - Cholecystectomy with choledochogastrostomy or choledochoduodenostomy, by laparotomy
  - HMFA003 - Cholecystectomy by laparoscopy, with removal of stones from the common bile duct by choledochotomy, by laparotomy
  - HMFA006 - Cholecystectomy with stone removal from the common bile duct by choledochotomy, by laparotomy
  - HMFA008 - Cholécystectomie avec ablation de calcul de la voie biliaire principale par cholédochotomie, par laparotomie
  - HMFC002 - Cholecystectomy with removal of a stone from the common bile duct by choledochotomy, by laparoscopy
  - HMFC003 - Cholecystectomy with choledochogastrostomy or choledochoduodenostomy, by laparoscopy

1.3. Exclusion criteria for patient with cholecystectomy in digestive oncological context

- **Excluded ICD-10 Diagnostics**

  - C25.x - Malignant neoplasm of pancreas
  - C16.x - Malignant neoplasm of stomach
  - C17.0 - Malignant neoplasm of duodenum
  - C22x - Malignant neoplasm of liver and intrahepatic bile ducts
  - C787 - Secondary malignant neoplasm of liver and intrahepatic bile duct
  - C788 - Secondary malignant neoplasm of other and unspecified digestive organs

2. Bile duct injury (BDI)



2.1. Early bile duct injury

- BDI identified within or beyond 21 days after cholecystectomy

Comment: Within 21 days after index cholecystectomy procedure, all the following situations were considered bile duct injury related to the cholecystectomy surgery in the absence of BDI specific code.

- ICD-10 Diagnosis K65.8 - Other peritonitis with ZCQA001 - Exploration of the abdominal cavity, by laparotomy or ZCQC002 - Exploration of the abdominal cavity, by laparoscopy CCAM procedures
- ICD-10 Diagnosis S36.11 - Traumatic lesion of the liver and gallbladder, with intra-abdominal injury
- ICD-10 Diagnosis T81.2 - Accidental puncture and laceration during a procedure, not elsewhere classified
- Association ICD-10 Diagnosis: K83.1 - Obstruction of bile duct and T81.8 - Other complications of procedures, not elsewhere classified
- Association ICD-10 Diagnosis: K83.2 - Perforation of bile duct and T81.8 - Other complications of procedures, not elsewhere classified
- Association ICD-10 Diagnosis: K83.3 - Fistula of bile duct and T81.8 - Other complications of procedures, not elsewhere classified
- Association ICD-10 Diagnosis: K83.8 - Other specified diseases of biliary tract and T81.8 - Other complications of procedures, not elsewhere classified

2.2. Late bile duct injury

2.2.1. BDI identified beyond 21 days after cholecystectomy

Comment: With a longer interval since index cholecystectomy, simple code association will identify situations not related to the initial cholecystectomy surgery. In the absence of specific BDI codes, it is necessary to use codes potentially related to BDI treatment and exclude the situations where these codes are not related to BDI treatment to identify BDI patients.

2.2.2. Surgical, endoscopic and radiological CCAM management procedures used to identify BDI

- HMAE002 - Retrograde dilation of the bile duct, by oesogastro-duodenoscopy
- HMAH001 - Dilation of the bile duct, by a transcutaneous drain already in place with ultrasound and/or radiological guidance
- HMAH002 - Dilation of the bile duct, transcutaneously with ultrasound and/or radiological guidance
- HMGH002 - Removal or replacement of biliary stent, transcutaneously with ultrasound and/or radiological guidance
- HMGH003 - Removal or change of biliary stent, by a transcutaneous drain already in place with ultrasound and/or radiological guidance
- HMJA001 - Transparietal bile duct drainage [External bile drainage], during an intra-abdominal procedure
- HMJH001 - External drainage of several bile ducts with placement of an endoprosthesis, transcutaneously with ultrasound and/or radiological guidance
- HMJH002 - Internalized drainage of a bile duct, transcutaneously with ultrasound and/or radiological guidance
- HMJH003 - External drainage of several bile ducts, transcutaneously with ultrasound and/or radiological guidance
- HMJH004 - External bile duct drainage, transcutaneously with CT guidance
- HMJH005 - External drainage of a bile duct with placement of an endoprosthesis, transcutaneously with ultrasound and/or radiological guidance
- HMJH006 - External drainage of a bile duct, transcutaneously with ultrasound and/or radiological guidance
- HMJH007 - Internalized drainage of several bile ducts, transcutaneously with ultrasound and/or radiological guidance
- HMKE001 - Change of a biliary endoprosthesis, by oesogastro-duodenoscopy
- HMKE002 - Change of several biliary endoprostheses, by oesogastro-duodenoscopy
- HMKH001 - Change of bile drain, transcutaneously with ultrasound and/or radiological guidance
- HMLE002 - Placement of a biliary endoprosthesis, by oesogastro-duodenoscopy
- HMLE003 - Placement of several biliary endoprostheses, by oesogastro-duodenoscopy
- HMLH001 - Placement of a biliary stent, by oesogastro-duodenoscopy and transcutaneously with ultrasound and/or radiological guidance
- HMLH002 - Placement of several endoprostheses in previously drained bile ducts, with ultrasound and/or radiological guidance
- HMLH003 - Placement of a stent in a previously drained bile duct, with ultrasound and/or radiological guidance
- HMMA001 - Secondary internalization of an external biliary drainage already in place
- HMMA002 - Secondary internalization of several external biliary drainages already in place

2.2.3. Previous codes not associated with BDI in the presence of the following ICD-10 and CCAM codes since cholecystectomy

- ICD-10 diagnostics

  - C16.x - Malignant neoplasm of pancreas
  - C17.0 - Malignant neoplasm of duodenum
  - C22.x - Malignant neoplasm of liver and intrahepatic bile ducts
  - C23 - Malignant neoplasm of gallbladder
  - C24.x - Malignant neoplasm of other and unspecified parts of biliary tract
  - C25.x - Malignant neoplasm of pancreas
  - C78.7 - Secondary malignant neoplasm of liver and intrahepatic bile duct
  - C78.8 - Secondary malignant neoplasm of other and unspecified digestive organs
  - D13.1 - Benign neoplasm of stomach
  - D13.2 - Benign neoplasm of duodenum
  - D13.4 - Benign neoplasm of liver
  - D13.5 - Benign neoplasm of extrahepatic bile ducts
  - D13.6 - Benign neoplasm of pancreas
  - D13.7 - Benign neoplasm of endocrine pancreas
  - K80.3 - Calculus of bile duct with cholangitis
  - K80.5 - Calculus of bile duct without cholangitis or cholecystitis
  - K82.3 - Perforation of gallbladder
  - K83.5 - Biliary cyst
  - S36.4 - Injury of rectum
  - Y60.6 - Unintentional cut, puncture, perforation or haemorrhage during aspiration, puncture and other catheterization

- ICD-10 diagnostics CCAM procedures

  - HGFA014 - Excision of the major duodenal papilla, by laparotomy
  - HMFA010 - Resection of the pedicular and intrapancreatic common bile duct with biliodigestive anastomosis, by laparotomy
  - HMGC001 - Removal of stones from the common bile duct by choledochotomy, by laparoscopy
  - HMGA001 - Removal of common bile duct stone by choledochotomy, by laparotomy
  - HMGE002 - Removal of a stone from the common bile duct, by oesogastro-duodenoscopy
  - HMGH001 - Removal of a stone from the common bile duct, by oesogastro-duodenoscopy and by the transcutaneous route with ultrasound and/or radiological guidance
  - HMQA001 - Intraoperative endoscopy of the bile ducts, by transcystic approach or by choledochotomy
  - HMNE001 - Mechanical lithotripsy of the bile ducts, by oesogastro-duodenoscopy
  - HMNE002 - Lithotripsy of the bile ducts by shock waves, by retrograde cholangioscopy
  - HMNJ002 - Lithotripsy of the bile ducts by shock waves, by cholangioscopy by a transcutaneous drain already in place
  - HMNJ003 - Lithotripsy of the bile ducts by shock waves, by transcutaneous cholangioscopy
  - HMNG002 - Lithotripsy of the bile ducts by shock waves, by transcutaneous cholangioscopy
  - HMNM001 - Extracorporeal lithotripsy of the bile ducts
  - HMGH004 - Removal of stones from the bile ducts, transcutaneously with ultrasound and/or radiological guidance
  - HLEA001 - Whole Liver Transplantation
  - HLEA002 - Reduced liver transplant

- HLFA005 - Right hepatic lobectomy [Right hepatectomy extended to segment IV], by laparotomy
- HLFA006 - Hepatic trisegmentectomy, by laparotomy
- HLFA009 - Hepatic bisegmentectomy, by laparotomy
- HLFA010 - Central hepatectomy, by laparotomy
- HLFA011 - Left hepatic lobectomy, by laparotomy
- HLFA017 - Right hepatectomy, by laparotomy
- HLFA018 - Left hepatectomy, by laparotomy
- HLFA019 - Atypical resection of the liver, by laparotomy
- HLFA020 - Hepatic unisegmentectomy, by laparotomy
- HLFC002 - Left hepatic lobectomy, by laparoscopy
- HLFC003 - Atypical resection of the liver, by laparoscopy
- HLFC004 - Hepatic unisegmentectomy, by laparoscopy
- HLFC027 - Hepatic bisegmentectomy, by laparoscopy
- HLFC032 - Hepatic trisegmentectomy, by laparoscopy
- HLFC037 - Left hepatectomy, by laparoscopy
- HLFC801 - Right hepatectomy, by laparoscopy
- HMCA002 - Choledochoduodenostomy, by laparotomy
- HMCA006 - Choledochoduodenostomy, by laparoscopy
- HMCA007 - Biliodigestive anastomosis above the convergence involving several bile ducts, by laparotomy
- HMCA008 - Biliodigestive anastomosis bearing on the convergence of the hepatic ducts, by laparotomy
- HMCC001 - Choledochojejunostomy, by laparoscopy
- HMCC002 - Choledochoduodenostomy, by laparoscopy
- HMFA001 - Cholecystectomy with choledochojejunostomy, by laparotomy
- HMFA005 - Cholecystectomy by laparoscopy, with choledochojejunostomy by laparotomy
- HMFA009 - Resection of the pedicle common bile duct with biliodigestive anastomosis, by laparotomy
- HMFC005 - Cholecystectomy with choledoco jejunostomy, by laparoscopy
- HMLA001 - Placement of biliary endoprosthesis by choledochotomy, by laparotomy
- HMLC001 - Placement of biliary endoprosthesis by choledochotomy, by laparoscopy

AUTEUR : Nom : Pecquenard **Prénom : Florian**

Date de soutenance : 21 juin 2023

Titre de la thèse : Etude du parcours thérapeutique des patients après survenue d'une plaie des voies biliaires lors d'une cholécystectomie pour pathologie lithiasique : analyse d'une cohorte nationale de 1 177 017 patients sur 9 ans.

Thèse - Médecine - Lille 2023

Cadre de classement : *Médecine*

DES + FST/option : *Chirurgie générale*

Mots-clés : *cholécystectomie, plaie des voies biliaires, parcours thérapeutique*

Résumé :

Introduction : La complication la plus crainte au cours d'une cholécystectomie est la survenue d'une plaie des voies biliaires. Le parcours thérapeutique des patients porteurs d'une plaie est mal connu à l'échelle nationale. Le but de cette étude est d'évaluer l'incidence des plaies biliaires lors d'une cholécystectomie pour lithiase en France et d'évaluer le parcours thérapeutique des patients.

Méthode : Les données des patients majeurs opérés d'une cholécystectomie pour lithiase entre 2012 et 2020 ont été extraites du PMSI et analysées. Les patients présentant une plaie biliaire ont été identifiés à l'aide d'un algorithme basé sur des codes diagnostics (CIM-10) et des codes de procédures thérapeutiques en lien avec la plaie (radiologiques, endoscopiques et chirurgicales). Le rôle du délai diagnostic de la plaie était également étudié. Une plaie était précoce si diagnostiquée dans les 21j suivant la cholécystectomie index, elle était tardive si diagnostiquée au-delà.

Résultats : 1 177 017 patients ayant eu une cholécystectomie ont été identifiés. L'incidence des plaies biliaires était de 1.19%. Seulement 19.6% des patients étaient transférés en centre expert après survenue d'une plaie en centre non expert. Parmi les procédures thérapeutiques, 65.4% étaient endoscopiques (47.2% pour les plaies précoces, 80.2% pour les plaies tardives, $p<0.001$), 23.5% étaient chirurgicales (44.8% pour les plaies précoces, 6 % pour les plaies tardives, $p<0.001$) et 11.2% étaient radiologiques. La survie à un an était significativement négativement impactée par la survenue d'une plaie.

Conclusion : La survenue d'une plaie biliaire lors d'une cholécystectomie impacte la mortalité des patients. Seuls 19.6% des patients présentant une plaie biliaire ont accès à un parcours thérapeutique optimal à travers un transfert en centre expert.

<u>Composition du Jury</u> :

Président :

Monsieur le Professeur Emmanuel BOLESLAWSKI

Assesseurs :

Monsieur le Professeur David FUKS

Monsieur le Professeur Julien BRANCHE

Madame le Docteur Amélie BRUANDET

Directeur de thèse :

Madame le Professeur Stéphanie TRUANT