Complex bile duct injuries after laparoscopic cholecystectomy: a comparative outcomes analysis of patients treated in tertiary private and public health facilities in Cape Town, South Africa

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Background: The South African healthcare system has an under-financed public sector serving most of the population and a better resourced private sector serving a small fraction of the population. This study evaluated management and outcome in patients with complex bile duct injuries (BDIs) after laparoscopic cholecystectomy referred from either private or public hospitals.

Methods: The data of patients who underwent hepaticojejunostomy repair were retrieved from a prospectively maintained central departmental BDI database. Patients were treated either in the Surgical Gastroenterology Unit at Groote Schuur Hospital, University of Cape Town (UCT) or the Digestive Diseases Centre, UCT Private Academic Hospital by the same hepatobiliary surgical team. Relevant preoperative clinical data and postoperative complications and outcomes were compared between patients originating either in the public or private sector.

Results: One hundred and twenty-five patients were included, 58 from the public and 67 from the private sector. The type of BDI, time to diagnosis, referral and repair were similar. Patients referred from the private sector underwent more percutaneous cholangiograms prior to referral (11.9% vs 1.7%, p = 0.037). Patients referred from the public sector underwent more CT examinations (p = 0.044) and endoscopic retrograde cholangiography (p = 0.038) after admission to our centre. There were no statistically significant differences in 30-day postoperative complications. Primary patency rates were similar for public and private referrals (90% vs 88%, respectively). There were two BDI-related mortalities at 90 days.

Conclusions: Despite differences in public and private healthcare system resources, patients were referred early and appropriately from both sectors and had similar postoperative outcomes when treated in a specialised unit.

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Introduction

From the early 1990s to the present, laparoscopic cholecystectomy (LC) has made the transition from novel technique for gallbladder removal to the widely accepted standard of care. The increasing use of LC was reported as being associated with higher rates of LC associated bile duct injuries (BDIs), although recent population-based studies suggest the incidence of BDI has returned to open cholecystectomy rates.[1,2] The overall incidence of BDI in South Africa is not known. In the only report on outcomes after LC in a South African population to date, Mbatha et al. found an incidence of 1.2% for major BDIs in a single centre retrospective review of LCs over an 18-month period.[3]

A major BDI after LC is a serious complication, affecting patients' health and quality of life for years, even after successful surgical repair.[4,5] Injuries are often complex and require thorough investigation prior to surgical repair. To minimize morbidity and mortality, patients should be referred early to a multidisciplinary team (MDT) consisting of interventional radiologists, endoscopists and hepatopancreatobiliary (HPB) surgeons.[6,7] The preferred surgical repair is a hepaticojejunostomy (HJ), best performed by an HPB surgeon.[8,9]

In South Africa, patient access to the healthcare system is via two financially disparate sectors. The public sector serves 84% of the population and comprises less than half of the country's total health spending, while the private sector serves only 16% of the population, but comprises

more than 50% of the country's total health spending.[10,11] LC is commonly performed in both healthcare sectors. The Surgical Gastroenterology Unit at Groote Schuur Hospital and the Digestive Diseases Centre University of Cape Town (UCT) Private Academic Hospital function as a single unit within the Department of Surgery at UCT and serve both public and private sectors in which patients are managed by the same MDT. This organizational structure provides the unique opportunity to objectively study how differences in healthcare resources and patient populations may influence the management and outcomes of patients with BDIs. This study assessed the implications of diagnostic and referral delay and outcome in two cohorts of patients with complex BDIs after LC who were initially treated and then referred from either private or public healthcare facilities.

Methods

A retrospective review was performed of a prospectively maintained ethics approved database (HREC: R023/2014). The database includes all patients treated for major BDI at a single tertiary referral centre from 1991 to the present. Only patients who underwent a HJ repair of a major BDI after LC were included. Relevant patient characteristics, preoperative investigations, type of injury defined according to the Strasberg-Bismuth classification, timing of diagnosis, referral and repair, geographical distance from referral centre and postoperative complications classified using the Modified Accordion Grading System (MAGS) were retrieved.[12,13] Primary and secondary patency after BDI repair were assessed using recently proposed definitions.[14] Patient outcome was compared based on which healthcare sector they were referred from.

Patient Management

All preoperative investigations and interventions were recorded, including those performed at the referring hospitals prior to patient arrival at the referral centre. After arrival, patients completed a standard evaluation to fully assess the extent of the injury. Evaluation included cross-sectional imaging with contrast-enhanced computed tomography (CE-CT) and/or magnetic resonance imaging (MRI) with magnetic resonance cholangiopancreatography (MRCP). This was followed by percutaneous transhepatic cholangiography (PTC) and endoscopic retrograde cholangiography (ERC), when indicated. PTC routinely included placement of a percutaneous biliary drain which allowed for drainage of an obstructed biliary system or subhepatic collections and facilitated intraoperative identification of the site of the BDI. If biliary peritonitis, sepsis or organ failure was present, percutaneous drainage of abdominal collections was performed with delayed surgical repair only after sepsis was resolved and the patient's general condition was optimised. A standard operative technique was used for bile duct reconstruction, the technical details of which have been published previously.[15]

Statistical Analysis

Non-parametric continuous data (i.e. days to diagnosis of BDI) is presented as medians with ranges. Categorical data is given as numbers and percent. The Mann Whitney-U test was used for non-parametric continuous variables and Fisher's exact test for categorical variables. A p-value < 0.05 was considered significant. Data analysis was performed in SPSS Statistics for MacIntosh, Version 25.0 (IBM Corp., Amronk, NY, USA).

Results

Patient Demographic and Clinical Characteristics

Patient demographic and clinical characteristics are summarised in Table 1 and pre-repair interventions are summarised in Table 2. One hundred and twenty-five patients

Table 1. Comparison of patient demographic and clinical characteristics between patients referred from the public and private health care sectors to a tertiary referral centre for surgical management of major BDIs

Characteristic	Public Referral. n = 58 (%)	Private Referral. n = 67 (%)	p-value
Median age in years (range)	43.5 (22-80)	47 (18-78) *	0.762
Gender (female)	51 (87.9)	51 (76.1)	0.108
> 500 km from referral centre	17 (29.3)	30 (44.1)	0.096
Strasberg-Bismuth Classification			
E1	8 (13.8)	6 (9.0)	0.411
E2	29 (50.0)	37 (55.2)	0.593
E3	13 (22.4)	13 (19.4)	0.826
E4	5 (8.6)	8 (11.9)	0.574
E5	3 (5.2)	3 (4.5)	1.000
Converted to open	14 (24.1)	17 (25.4)	1.000

*One patient with an unknown age.

Non-parametric continuous data (i.e. age) is presented using medians with ranges and categorical data is presented using numbers and percent. The Mann Whitney-U test was used for age and Fisher's exact was used for categorical variables. A p-value of < 0.05 was considered significant.

Table 2. Pre-repair investigations and interventions performed before and after referral from the public versus private sector to a tertiary referral centre for surgical repair of a major BDI

Investigation or intervention	Before referral			After referral			Total		
	Public n=58 (%)	Private n=67 (%)	p-value	Public n=58 (%)	Private n=67 (%)	p-value	Public n=58 (%)	Private n=67 (%)	p-value
US	10 (17.2)	8 (11.9)	0.451	11 (19.0)	12 (17.9)	1.000	21 (36.2)	20 (29.9)	0.567
CE-CT	7 (12.1)	7 (10.4)	0.784	21 (36.2)	13 (19.4)	0.044	28 (48.3)	20 (29.9)	0.043
MRI/MRCP	4 (6.9)	11 (16.4)	0.166	20 (34.5)	20 (29.9)	0.701	24 (41.4)	31 (46.3)	0.594
ERC	16 (27.6)	18 (26.9)	1.000	19 (32.8)	11 (16.4)	0.038	35 (60.3)	29 (43.3)	0.073
PTC	1 (1.7)	8 (11.9)	0.037	40 (69.0)	46 (68.7)	1.000	41 (70.7)	54 (80.6)	0.214
Percutaneous drain	4 (6.9)	2 (3.0)	0.415	9 (15.5)	9 (13.4)	0.802	13 (22.4)	11 (16.4)	0.496
Laparoscopy	2 (3.4)	5 (7.5)	0.449	1 (1.7)	0	0.464	3 (5.2)	5 (7.5)	0.724
Laparotomy*	17 (29.3)	21 (31.3)	0.847	1 (1.7)	1 (1.5)	1.000	18 (31.0)	22 (32.8)	0.850

*Laparotomy includes exploratory laparotomies for bile peritonitis or intraabdominal sepsis only and does not include laparotomies for laparoscopic converted to open cholecystectomies.

Data are presented using numbers and percent. Fisher's exact test was used for all comparisons. A p-value of < 0.05 was considered significant.

US – ultrasound, CE-CT – contrast-enhanced computed tomography, MRI/MRCP – magnetic resonance imaging/magnetic resonance cholangiopancreatography, ERC – endoscopic retrograde cholangiography, PTC – percutaneous transhepatic cholangiogram

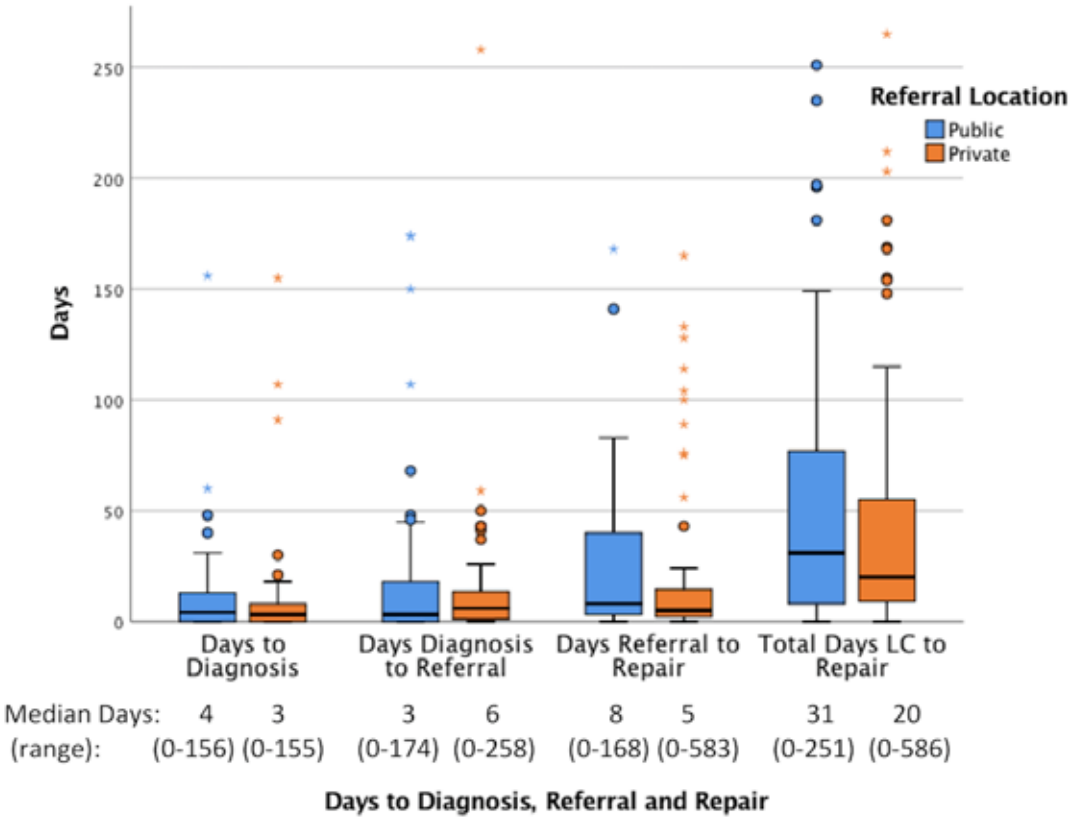

Figure 1. Comparison of median days to diagnosis, referral and repair for patients referred from the public and private health care sectors to a tertiary referral centre for surgical management of a major BDI. A solid colored circle represents days to diagnosis, referral or repair that are greater than 1.5 times the value of the third quartile. A colored asterisk represents days to diagnosis, referral or repair that are greater than 3 times the value of the third quartile. The Mann-Whitney U test was performed to compare differences in distribution of days from laparoscopic cholecystectomy to diagnosis (p = 0.262), diagnosis to referral (p = 0.301), referral to repair (p = 0.188) and total days LC to repair (p = 0.612) between the public and private referral groups. A p-value of < 0.05 was considered significant.

were included in the study, 58 of which were referred from the public sector and 67 from the private sector. Nearly half of patients referred from the private sector came from a geographic distance greater than 500 km from the referral centre (n = 30, 44.1%) compared to 29.3% (n = 17) of patients referred from the public sector (p = 0.096). Nine patients migrated to the public sector because of financial constraints and four patients chose to transfer to the private sector for further management, resulting in 63 surgical repairs performed in the public and 62 in the private sector. There were nine patients in the public sector with a BDI after LC performed at our centre who were subsequently referred to our unit for management. For all measured variables of patient and clinical characteristics, there were no differences between patients referred from the public versus the private healthcare sector (all p > 0.05). Patients referred to our unit from the private sector were more likely to undergo PTC with biliary catheter placement prior to referral (11.9% vs 1.7%, p = 0.037). However, after admission to our unit, patients referred from the public sector were more likely to undergo a CE-CT and ERC prior to repair (p = 0.044 and p = 0.038, respectively). When total pre-repair investigations and interventions were compared between public and private referrals, CE-CT prior to repair was more common in public sector referrals (48.3% vs 29.9%, p = 0.043).

Comparison of the timing of repair

When the days from LC to diagnosis, diagnosis to referral and referral to repair were compared between the two referral groups, there was no statistically significant difference in median days for any of the time periods (Figure 1). The total time from LC to repair was not significantly different between the public and private referral groups (Figure 1).

Short- and long-term post-repair outcomes

There was no statistically significant difference in 30-day postoperative complications between the public versus private healthcare sector referral groups (Table 3). Long-term outcome was assessed using primary and secondary patency rates, which were similar between public and private referrals (Table 4). Although secondary patency rates were lower in the group of patients referred from the private sector, this difference was not statistically significant (p = 0.567). There were no differences in need for post-repair percutaneous reintervention or surgical revision between the two referral groups (p = 0.724 and p = 1.000, respectively, Table 4).

Discussion

This study investigated the difference between management and outcomes of major BDIs in patients referred from and treated at public and private healthcare facilities at a single tertiary referral centre in South Africa. Although there were differences between the two sectors in pre-repair investigations, this did not translate into a statistically significant difference in short- or long-term outcomes. Additionally, there were no unequal delays in time to diagnosis or in time to receiving care after diagnosis between the two healthcare sectors despite a large proportion of patients being referred from a geographical distance greater than 500 km from our referral centre.

The Surgical Gastroenterology Unit at Groote Schuur Hospital, UCT and the Digestive Diseases Centre, UCT Private Academic Hospital, function as a single unit serving both sectors. In general, there are major discrepancies in the availability and access to diagnostic, interventional and surgical facilities between public and private healthcare services. However, the UCT-affiliated services are comparable in the level of and access to facilities and both are served by the same hepatobiliary MDT. The more frequent use of PTC with placement of biliary catheters prior to referral in the private sector is likely a result of better resources and easier access to interventional radiologists compared to the public sector.

The discrepancies in availability and access to advanced diagnostic and interventional investigations are often discussed and highlighted as an obstacle to optimal management of patients in the public service. However, these data show that patients in the public sector underwent preoperative evaluation with cross sectional imaging more often compared to the private sector. ERC was available and performed with similar frequencies in both groups. The only discernible difference was the availability of sophisticated interventional radiology including PTCs in the private sector. This however, had no influence on ultimate outcome

Table 3. 30-day post-repair complications using the Modified Accordion Grading System for patients referred from the public versus private sector to a tertiary referral centre for surgical management of major BDIs

Modified Accordion Grade	Public Referral. n=58 (%)	Private Referral. n=67 (%)	p-value
Mild	4 (6.9)	8 (11.9)	0.380
Moderate	20 (34.5)	21 (31.3)	0.849
Severe (3)	5 (8.6)	3 (4.5)	0.470
Severe (4)	3 (5.2)	2 (3.0)	0.662
Severe (5)	0	2 (3.0)	0.499
Total Complications*	**32 (55.2)**	**36 (53.7)**	**0.205**

*There were no deaths at 30 days, however there were two mortalities at 90 days.

Data were presented using number and percent. Fisher's exact was used for all comparisons. A p-value of < 0.05 was considered significant.

Table 4. Comparison of long-term outcomes after surgical repair of major BDIs between patients referred from the public versus the private health care sectors

	Public Referral. n=58 (%)	Private Referral. n=67 (%)	p-value
Primary Patency	52 (89.7)	59 (88.1)	1.000
	n=5 (%)	**n=7 (%)**	
Secondary Patency*	4 (80.0)	4 (57.1)	0.567
Post-repair Interventions	**n=58 (%)**	**n=67 (%)**	
Percutaneous Intervention	3 (5.2)	5 (7.5)	0.724
Surgical Revision	2 (3.4)	3 (4.5)	1.000

*Two patients died before secondary patency could be achieved and were not included in the analysis.

Data are presented using numbers and percent. Primary and secondary patency were defined using recently proposed methods.[14] Fisher's exact was used for all comparisons. A p-value of < 0.05 was considered significant.

because this intervention was subsequently provided at the tertiary level prior to reconstruction. Achieving the above was facilitated by a common expeditious, standardized evaluation and treatment algorithm that apply to all patients regardless of the treatment facility, i.e. public or private.

Despite a poorly resourced and overburdened public sector, there was no statistically significant increase in delays in diagnosis, referral or repair for patients referred from the public sector compared to the private sector. Although not statistically significant, total median days LC to repair was eleven days longer for the public sector referral cohort, which could arguably be considered a clinically relevant difference. Longer time to repair means higher costs to the patient and healthcare system as well as increased personal costs to the patient in terms of time lost at work, time away from family and overall quality of life.[4,5] Interestingly, the greater proportion of patients in the private sector who were referred from a geographical distance farther than 500 km away did not seem to influence time to referral or repair.

Importantly, despite the statistically significant differences in preoperative investigations and interventions as well as the non-significant, but perhaps clinically relevant differences in time to repair, there were no statistically significant differences in long-term outcomes between the two sectors. Although not statistically significant, there was a difference in secondary patency rates between the public and private sectors. This difference is largely due to patient choice. There were two patients referred from the private sector who requested no further surgical intervention and opted for PTC-only management of biliary anastomotic strictures after initial surgical repair, preventing them from achieving secondary patency.[14]

There are limitations for this research that should be acknowledged. This study was retrospective in design and is subject to biases inherent to observational retrospective studies. Data on pre-repair investigations and interventions performed at referring hospitals was included in the analysis, and although the database is prospectively maintained, it is possible that incomplete information regarding preoperative evaluations was included in the referral documentation, resulting in underreporting of imaging investigations and interventions. Finally, obtaining long-term follow-up on patients within our healthcare system is a challenge due to patient and system factors.

Conclusion

Despite variation in the investigation profile of complex LC bile duct injuries in public and private healthcare systems in this study, patients were referred early and appropriately and had similar postoperative outcomes when treated in a specialised unit, regardless from which healthcare sector they were referred.

Ethics approval

Research ethics board approval for this study was obtained from the Department of Surgery and the Faculty of Health Sciences Human Ethics and Research Committees (HREC: 731/2018).

Author Contribution

All authors equally contributed to the conception, design, analysis and interpretation of data, the drafting and critical revising of the article and have given their final approval of the version to be published.

Conflicts of interest

The authors have no conflicts of interest to declare.

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