

COVID-19 lockdown impact on common general surgical acute presentations to a regional centre in New Zealand

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ABSTRACT

AIM: New Zealand's stated goal of eradicating COVID-19 included the enforcement of a national lockdown. During this time, a perceived decrease in hospital presentations nationwide was noted. This was also the experience of the Department of General Surgery, Bay of Plenty District Health Board (BOPDHB). We sought to quantify this reduction by analysing the frequency and severity of three common acute general surgical presentations; appendicitis, cholecystitis and diverticulitis.

METHODS: Data on presentations of patients with appendicitis, cholecystitis and diverticulitis were retrospectively collected for the national lockdown period (25 March 2020–27 April 2020) and the immediate pre-lockdown period (21 February 2020–25 March 2020). Data collected included patient demographics, duration of symptoms, method of diagnosis, treatment, severity of disease, length of stay and complications.

RESULTS: A reduction of 62.2% was noted in the frequency of appendicitis during the lockdown period compared to the pre-lockdown period. Patients presented later during lockdown and had a higher complication rate (5.4% versus 42.8%). Similarly, a 39.2% reduction in presentations of cholecystitis during lockdown was found. The lockdown group of patients had a longer length of stay (6.9 versus 4 days) and only one patient (9.1%, 1/11) was managed with laparoscopic cholecystectomy during the lockdown period, compared to 52.9% of patients (9/17) over the pre-lockdown period. No difference in frequency or severity of acute diverticulitis presentations between the two periods was found.

CONCLUSIONS: The COVID-19 lockdown led to fewer presentations, but these were often delayed, with more complications and a longer length of stay. This could be partly explained by patient fear around exposure to the virus and reluctance to attend hospital. More research is needed to study the flow-on effects of the COVID-19 lockdown on surgical presentations.

The COVID-19 pandemic of 2020 has forever altered the landscape in global healthcare. It has highlighted how healthcare systems are impacted by a global crisis that has challenged the capabilities of medical resources and facilities worldwide. At the time of submission of this paper, New Zealand was in the enviable position of having all but eradicated the disease, due in large part to stringent border control and population-wide isolation regulations. The New Zealand Government's stated goal of

eradicating COVID-19 included the enforcement of a national lockdown requiring New Zealanders to isolate at their current place of residence.¹ Travel was only allowed to and from essential services, thus visits to healthcare facilities were exempt from this restriction. It is interesting to review the impact on medical services and the acute general surgical service in particular, in a country where the anticipated pandemic impact never eventuated.

In the wake of the pandemic, a perceived reduction was noted in acute presentations to emergency departments nationwide. Similarly, review of our local data has shown a significant reduction in trauma presentations and admissions to hospitals in the Bay of Plenty over the lockdown period with a 30% reduction in non-major and 53% reduction in major trauma over this period.² These trauma reductions could be partly explained by the limited travel, outdoor activities and access to restaurants and bars allowed during this period, with a concomitant reduction in high-risk and alcohol-related activities. Internationally, similar trends have been seen with reduced presentations of subarachnoid haemorrhage and acute coronary syndromes,³⁻⁵ but as yet there is no published literature evaluating the effects of COVID-19 on surgical presentations. A similar reduction in acute surgical presentations to the two BOPDHB hospitals (Tauranga and Whakatāne) was noticed. The aim of this study was to ascertain how the national lockdown associated with the current COVID-19 pandemic influenced the rates of presentation and severity of three common general surgical presentations to a regional centre in New Zealand.

The three common acute surgical presentations selected for this review were appendicitis, cholecystitis and diverticulitis. It is well documented that delayed presentation may lead to complications in these conditions.⁶⁻⁹ As an example, it is well-known that rates of complicated appendicitis with perforation are higher in patients who delay their presentation.⁶ Similarly, a delayed presentation in patients with cholecystitis who then undergo acute laparoscopic cholecystectomy is more likely to lead to conversion to an open procedure, which in turn has greater morbidity and an increased length of stay.⁹ When considering diverticulitis, it is known that patients who delay their presentation have higher rates of perforation with a subsequent increased need for intervention and a consequent increase in morbidity.¹⁰

It is important that any government-imposed lockdown does not adversely affect the safety of patients in terms of access to appropriate healthcare or overall health outcomes. Because COVID-19 infection itself should not affect these three common

general surgical conditions directly, it could be assumed that rates of these conditions would be consistent over any period studied. Having said that, there appeared to be a reluctance of patients to leave their homes and access healthcare during the lockdown period, as a population-wide anxiety and fear of exposure to COVID-19 existed. Combining the presumed non-surgical impact of COVID-19 and population anxiety, we hypothesised that the national lockdown would lead to a reduced number of presentations, but also that these presentations would be delayed and therefore lead to an increase in the severity of disease and rates of complications.

Method

Data for acute presentations of patients with appendicitis, cholecystitis and diverticulitis to Tauranga Hospital and Whakatāne Hospital General Surgical Departments were collected for the entire lockdown period as well as for a matching, well-defined pre-lockdown period. The lockdown period was defined as the 33-day period from 11.59pm 25 March 2020 to 11.59pm 27 April 2020, and the pre-lockdown period defined as the 33 day period from 11.59pm 21 Feb 2020 to 11.59pm 25 March 2020. The dataset was obtained from the hospital's database of admissions. This uses a coding system in which diagnoses are automatically coded based on the contents of the digital discharge summary, which is produced by the junior doctors on the surgical teams. Codes 'appendicitis', 'cholecystitis', 'diverticulitis' and 'diagnostic laparoscopy' were searched for. Diagnostic laparoscopy was included with appendicitis. Exclusion criteria were miscoded cases, discharges against medical advice, cases which were managed by other services (emergency department or general medicine), unclear diagnoses, transfers to other hospitals, chronic presentations and representations.

All demographic data and length of stay were automatically populated for each eligible patient from the hospital database. The electronic hospital records programme (CHIP) was then used to access the digital discharge summary and theatre notes. From this information, the duration of symptoms, method of diagnosis (computed tomography scan (CT), ultrasonography scan (US),

clinical), treatment (operative vs non-operative) and re-presentations were extracted. Ethical approval for access to this information was obtained from the Bay of Plenty District Health Board Ethics Committee. Severity of disease was coded as follows:

- for appendicitis: based on operative finding using the American Association for the Surgery of Trauma (AAST) system¹¹ (Appendix 1)
- for diverticulitis using the Hinchey system¹² (Appendix 2).

For both of these, data was extracted and interpreted by the same two investigators (LB, AB). Data was then analysed by diagnosis (appendicitis, cholecystitis and diverticulitis) and by subgroup (pre-lockdown period and lockdown period) using Microsoft Excel.

Results

Review of the coding identified a total of 63 cases of acute appendicitis and diagnostic laparoscopy, 41 cases of acute cholecystitis and 79 cases of acute diverticulitis over the two periods (Figure 1). Following application of the exclusion criteria as above, the following cases were identified:

- Thirty-seven cases of acute appendicitis in the pre-lockdown period with 14 in the lockdown period,
- 17 cases of acute cholecystitis in the pre-lockdown period with 11 in the lockdown period and
- 15 cases of acute diverticulitis in the pre-lockdown period with 17 in the lockdown period.

The patient demographics are displayed in Table 1. The only statistically significant finding was that for acute appendicitis, a younger group presented during lockdown with an average age of 21.5 years compared to 36.6 years in the pre-lockdown group ($p < 0.01$). Otherwise there was no significant differences in age, ethnicity or gender distribution across the groups.

Appendicitis

A total of 51 cases of acute appendicitis were included in the final analysis; 14 (27.5% of total) during the lockdown period and 37 (72.5%) during the pre-lockdown period. This represents a 62.2% reduction between the pre-lockdown and lockdown periods.

Management of acute appendicitis in the two time periods is displayed in Table 2. Of note, patients in the lockdown period

Figure 1: Included and excluded cases for appendicitis, cholecystitis and diverticulitis.

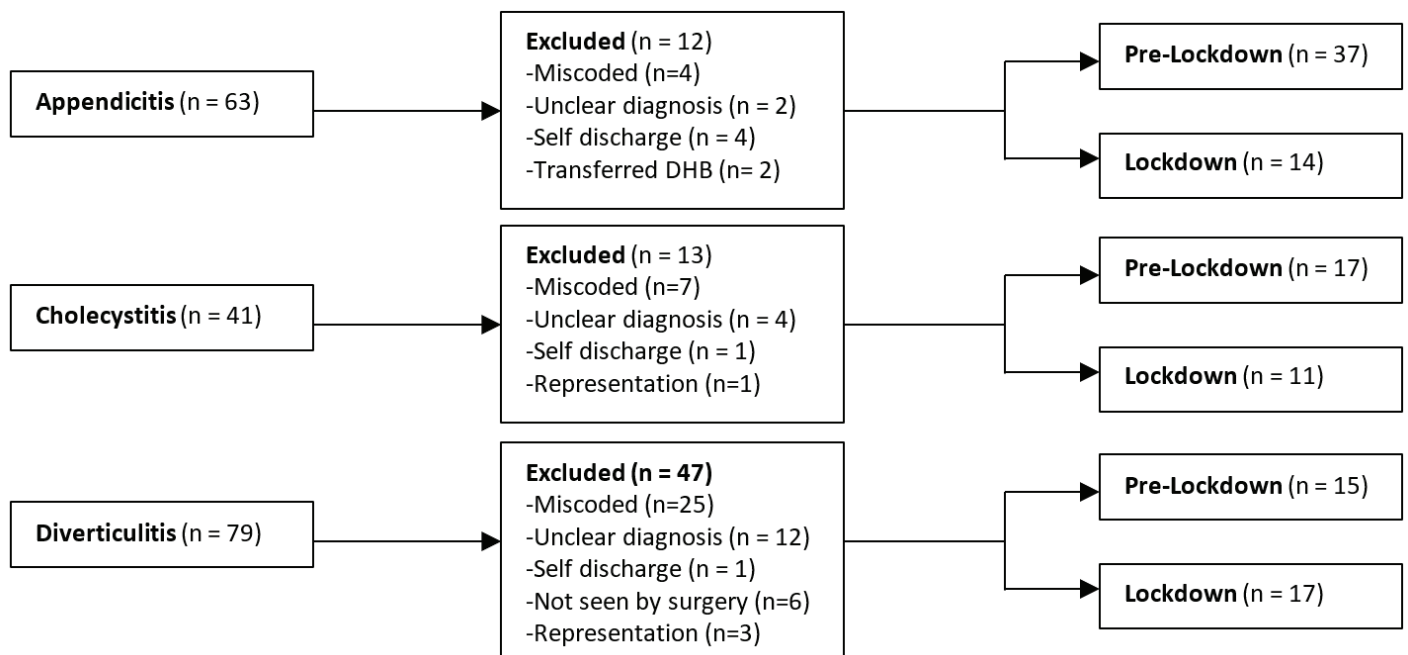
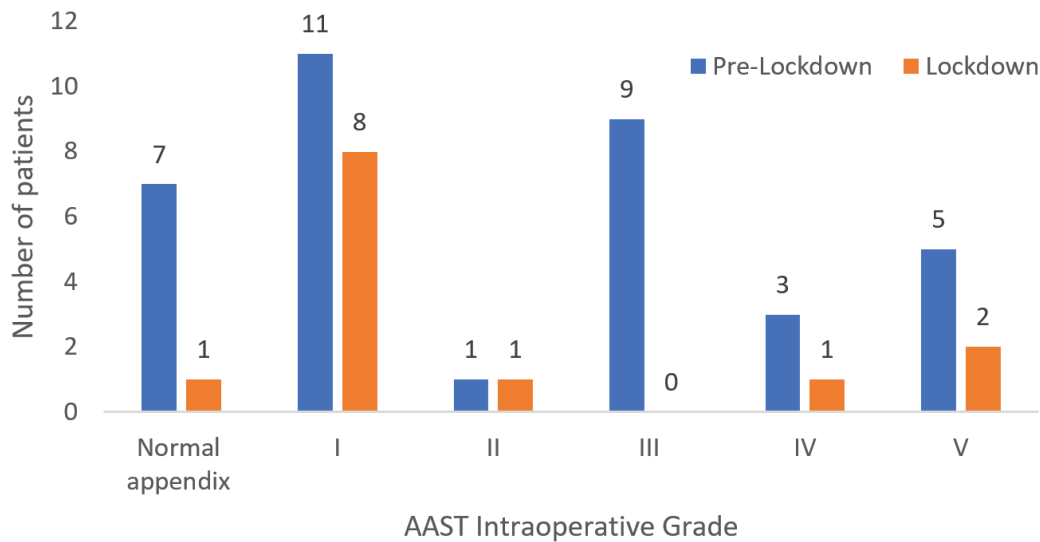


Table 1: Demographics of included patients by diagnosis and time period.

	Appendicitis		Cholecystitis		Diverticulitis	
	Pre-lock-down (n= 37)	Lockdown (n=14)	Pre-lock-down (n=17)	Lockdown (n=11)	Pre-lock-down (n=15)	Lockdown (n=17)
Age (years, mean)	36.6	21.5	57	67	58.4	60.7
Gender (n, %)						
Female	14 (37.8)	8 (57.1)	7 (41.2)	6 (54.5)	6 (40.0)	12 (70.6)
Male	23 (62.2)	6 (42.9)	10 (58.8)	5 (45.5)	9 (60.0)	5 (29.4)
Ethnicity (n, %)						
NZ European/Pākehā	15 (40.5)	9 (64.2)	11 (64.7)	9 (81.8)	10 (66.7)	13 (76.5)
Māori	12 (32.4)	1 (7.1)	6 (35.3)	-	2 (13.3)	1 (5.9)
Other European	7 (18.9)	2 (14.3)	-	2 (18.2)	2 (13.3)	3 (17.6)
South East Asian	-	1 (7.1)	-	-	-	-
Indian	1 (2.7)	1 (7.1)	-	-	-	-
Pacific Islander	2 (5.4)	-	-	-	1 (6.6)	-

Table 2: Acute appendicitis during the pre-lockdown and lockdown periods.

	Pre-lockdown period (n=37)	Lockdown period (n=14)
Presentation (days)		
Duration of symptoms	1.8	2.8
Length of stay	2.7	2.1
Diagnosis (n, %)		
Clinical	13 (35.1)	7 (50.0)
USS – diagnostic	1 (2.7)	2 (14.3)
USS – inconclusive	4 (10.8)	2 (14.3)
CT – uncomplicated	13 (35.1)	3 (21.4)
CT – complicated	6 (16.2)	0
Management (n, %)		
Laparoscopic appendicectomy	28 (75.7)	12 (85.7)
Diagnostic laparoscopy with appendicectomy	8 (21.6)	1 (7.1)
Diagnostic laparoscopy without appendicectomy	1 (2.7)	0
Conservative	0	1 (7.1)
Representation or complication (n, %)		
Ileus	1 (2.7)	2 (14.2)
Pain	1 (2.7)	2 (14.2)
Collection	0	2 (14.2)

Figure 2: Intraoperative grade* of acute appendicitis during the lockdown and pre-lockdown periods.

*AAST grade of appendicitis: Grade I: acutely inflamed appendix, intact, Grade II: gangrenous appendix, intact, Grade III: above, with evidence of local contamination, Grade IV: above, with abscess or phlegmon in region of appendix, Grade V: above with addition of generalised purulent contamination away from appendix (Appendix 1).

presented with a greater average duration of symptoms (2.8 days), compared to 2.1 days in the pre-lockdown period, ($p=0.25$). Patients in the lockdown period had a lower average grade of appendicitis (1.84) compared to the pre-lockdown period (2.04). Figure 2 displays the intraoperative findings by each grade. Despite this, a higher rate of complications and/or representation (6/14, 42.8%) was noted during the lockdown period compared to the period prior to lockdown (2/37, 5.4%).

Cholecystitis

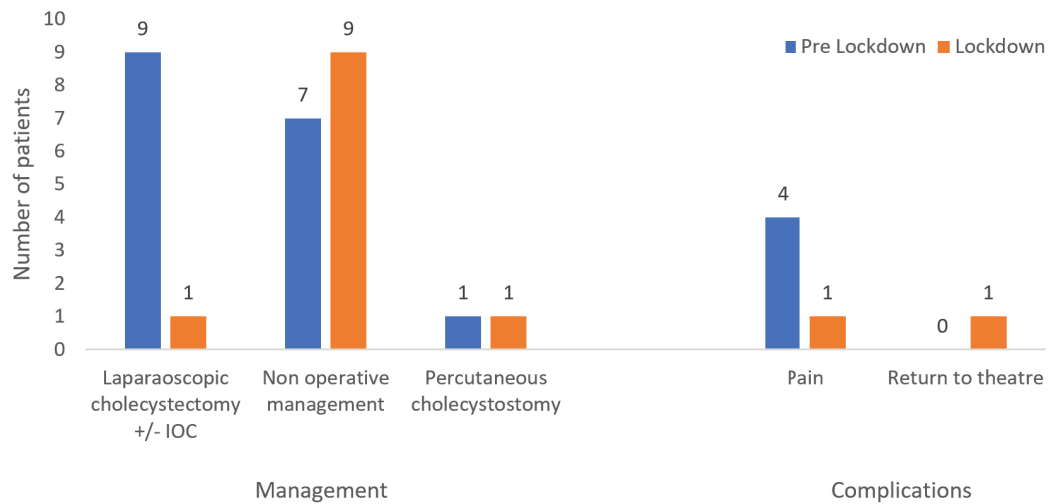
A total of 28 cases of acute cholecystitis were included, with 17 in the pre-lockdown period and 11 during lockdown. This represents a 39.2% reduction in volume. Of note, the length of stay was longer during lockdown compared to the month prior to lockdown (6.9 versus 4 days) ($p=0.13$). The management of acute cholecystitis is displayed in Table 3 and Figure 3.

The departmental policy and gold-standard is to perform laparoscopic

Table 3: Presentations with acute cholecystitis in the pre-lockdown and lockdown periods.

	Pre-lockdown period (n=17)	Lockdown period (n=11)
Presentation (days)		
Duration of symptoms	2.5	1.7
Length of stay	4	6.9
Diagnosis (n, %)		
USS	10 (58.8)	4 (36.4)
CT – Complicated	1 (5.9)	1 (9.1)
CT – Uncomplicated	5 (29.4)	3 (27.3)
Clinical	1 (5.9)	3 (27.3)

Figure 3: Management and complications of acute cholecystitis in the pre-lockdown and lockdown periods.



cholecystectomy during the index admission, if considered safe and feasible. However, during the lockdown period only one (9.1%) was managed this way, which resulted in the non-operative management of 90.1% (n=10/11) of cases. The rationale for non-operative management in this period was not documented in two cases, due to patient comorbidities in three cases and due to consideration of the pandemic and lockdown in five cases.

Diverticulitis

A total of 33 cases of acute diverticulitis were identified; 18 of these presented during the lockdown period and 15 during the pre-lockdown period. Patients during the lockdown period tended to present earlier (average 3.8 days) compared to the pre-lockdown month (12.2 days), p<0.05 (Table 4). The majority of cases during both periods were uncomplicated (53.3% and

64.7%, respectively) with a trend to less severe disease in lockdown. This is reflected by 20% of pre-lockdown patients having Hinchey Ib/II disease, compared to only 12% during lockdown. Severity of disease by Hinchey grade is shown in Figure 4. All cases during lockdown were managed with antibiotics alone and three of these represented with pain (Figure 5).

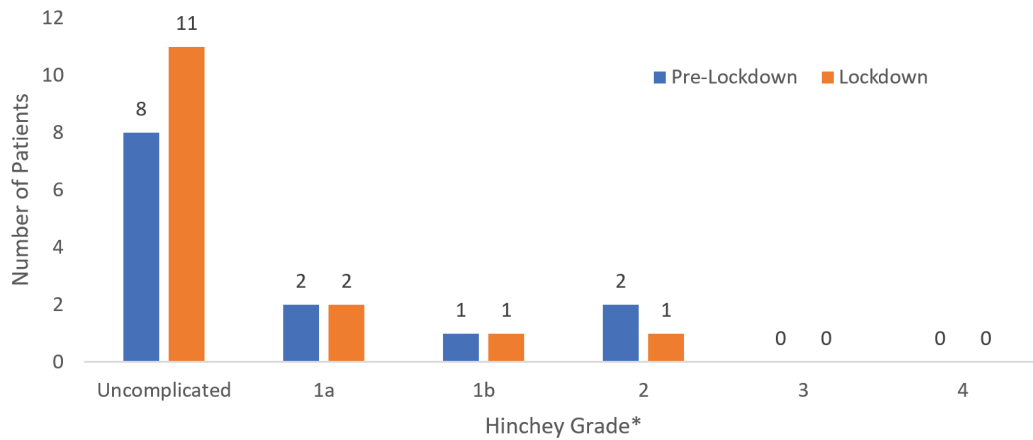
Discussion

This study explored the effect of the COVID-19 pandemic and national lockdown on the frequency and severity of presentations to BOPDHB general surgical services. Because COVID-19 is a predominantly respiratory illness, the expectation was that there should be no significant reduction in volume of acute surgical presentations. When it became apparent that this assumption was incorrect, further assumptions followed:

Table 4: Management of acute diverticulitis in the pre-lockdown and lockdown periods.

	Pre-lockdown period (n=15)	Lockdown period (n=17)
Presentation (days)		
Duration of symptoms	12.2	3.8
Length of stay	3.1	2.2
Diagnosis (n, %)		
CT scan	13 (86.6)	11 (64.7)
Clinical	1 (6.7)	2 (11.8)
Sigmoidoscopy	1 (6.7)	0

Figure 4: Severity of diverticulitis by Hinchey* grade during the pre-lockdown and lockdown periods.



*Hinchey Grade- I – pericolic abscess, IIa – distant abscess amendable to percutaneous drainage, IIb – complex abscess associated with fistula not amendable to percutaneous drainage, III – generalised purulent peritonitis, IV – fecal peritonitis.

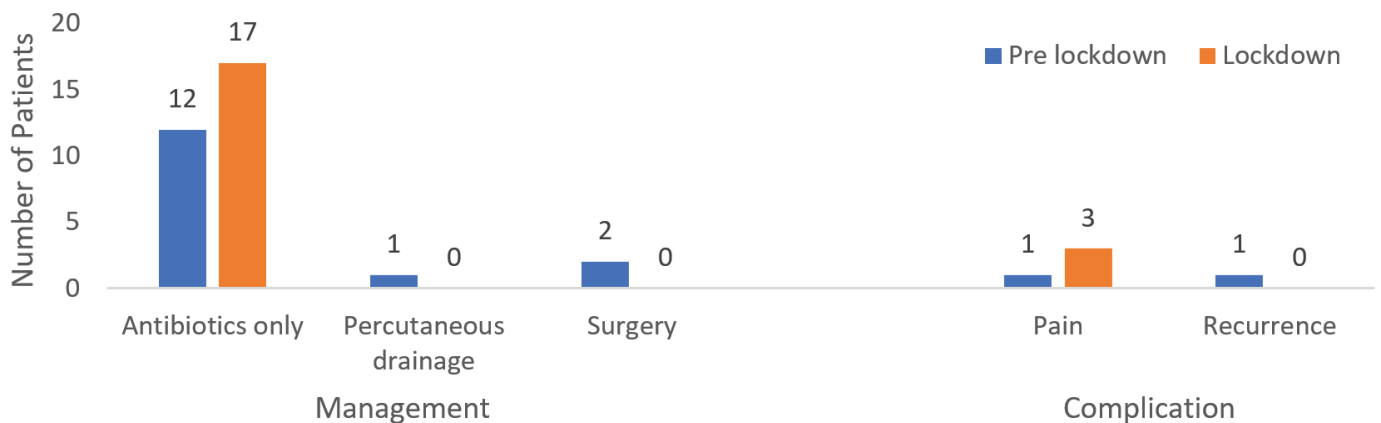
1. That a reluctance of patients to present to healthcare facilities due to a population-wide fear of contracting COVID- 19 in healthcare facilities, would lead to a *delay in presentations* of surgical diseases;
2. This delay would lead to *increased rates of complicated disease*;
3. A subsequent *increase in complication rates* would be seen; and
4. Average *length of stay* would be increased.

Appendicitis showed the most significant reduction in volume, with a 62% drop across the two periods. As postulated above, patients indeed presented later during the lockdown period; 2.82 days compared to 1.77 days, but disease severity was unchanged.

Length of stay in the lockdown group was shorter, which may reflect an urgency to discharge patients from healthcare facilities sooner during the lockdown period and may partly explain the significant difference in complication rates between the two groups (5% vs 42%).

Cholecystitis showed a similar, but less significant reduction (39%) in volume compared to the pre-lockdown period. Despite this decrease in volume, there existed no statistical difference in disease duration on presentation, yet the length of stay was increased over lockdown (4 days vs 6.9 days). Despite the surgical department agreeing early on that it would carry on performing acute cholecystectomies, only one case (9.1%) was managed in this manner. This is compared to 52.9% of cases

Figure 5: Management and complications of diverticulitis during the pre-lockdown and lockdown periods.



in the pre-lockdown period. For 50% (5/10) of the lockdown cases managed non-operatively, the only documented reason in the clinical notes for this was 'due to COVID'. It is possible that fewer laparoscopic cholecystectomies were performed due to the initial RACS guidelines¹³ having raised concerns about the risks of aerosolisation of virus particles during laparoscopy.

Acute diverticulitis presentations showed no significant differences between the pre-lockdown and lockdown periods in terms of duration of symptoms, severity of disease or length of stay. Although the absolute number of acute diverticulitis presentations were low during both pre-lockdown and lockdown periods (15 and 17, respectively), there was a trend to less severe disease in the pre-lockdown period. This is reflected by the fact that 20% of pre-lockdown patients had Hinchey Ib/II disease, compared to only 12% during lockdown. Furthermore, three of 15 patients (20%) during the pre-lockdown period required intervention (surgery two and percutaneous drain one), while none during the lockdown period required intervention. This would be in keeping with the earlier presentations of patients during the lockdown period and a consequent reduction in disease severity and the need for intervention.

Proposing explanations for our findings has been challenging. As is evident from the three diseases above, acute diverticulitis was the only condition that did not show a reduction in volume over lockdown. As there is no known trigger for an attack of diverticulitis, one would expect the rates to be consistent over time, as demonstrated. However, the other two conditions showed significant reductions in volume, which cannot be explained based on patient anxiety alone and a reluctance to present to healthcare facilities. The primary care services (family medicine and general practitioners) were conducting their practices almost exclusively through virtual platforms, so it is unlikely that a higher proportion of these patients were being managed in the community.

When one considers appendicitis, the following factors may explain the reduction in volume:

1. it is classically triggered by occlusion of the lumen; one cause for said occlusion is lymphoid hyperplasia and it is conceivable that a reduction in the burden of viral infections in the community may explain this reduction. From a primary care perspective, it was noted anecdotally that the viral infection burden in the community also appeared to decrease during the lockdown period.
2. It is possible that a cohort of patients presented with right iliac fossa pain during lockdown but were discharged without undergoing investigations or intervention.
3. It is plausible that individuals with right iliac fossa pain in the absence of true appendicitis were less likely to present during this time.
4. And finally, it is known that appendicitis does, on occasion, resolve spontaneously¹⁶ and as such, these patients may also not have presented to healthcare facilities over the lockdown period.

Biliary colic and cholecystitis have long been known to be associated with and triggered by fatty meals. During the lockdown period in New Zealand, fast food restaurants were not allowed to operate, which may have decreased individuals' access to fatty meals.

Conclusion

To our knowledge, this observational study is the first of its kind to evaluate the effects of a global pandemic and a national lockdown on specific general surgical presentations. Results should be interpreted with consideration of its limitations. Given only two months of data from one district health board was collected, our sample size was limited. Our method of collection relies on accurate computer coding from the discharge summary and while we excluded incorrectly coded cases, it is possible that some eligible cases were missed. This study does not address the period after lockdown, where we may see the late implications of delayed presentations and increased burden on elective operations, especially cholecystectomies. This is an area which will

be explored in future studies, both in our region and nationally.

We have demonstrated how the COVID-19 global pandemic and national lockdown influenced the frequency and severity of common surgical presentations to two regional centres in New Zealand. These

results may help in preparing for future pandemics or other national crises which impact on healthcare facilities and require a review of resource allocation. Further research is needed in this regard and we look forward to the global sharing of knowledge gained during these unprecedented times.

Appendix 1

American Association for the Surgery of Trauma (AAST) grade of acute appendicitis—operative criteria¹¹

Grade I: acutely inflamed appendix, intact

Grade II: gangrenous appendix, intact

Grade III: above, with evidence of local contamination

Grade IV: above, with abscess or phlegmon in region of appendix

Grade V: above with addition of generalised purulent contamination away from appendix

Appendix 2

Hinchey grade for diverticulitis¹²

I – pericolic abscess

IIa – distant abscess amenable to percutaneous drainage

IIb – complex abscess associated with fistula not amenable to percutaneous drainage

III – generalised purulent peritonitis

IV – fecal peritonitis

Competing interests:

Nil.

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