COVID-19 Pandemic Impact on Percutaneous Coronary Intervention for Acute Coronary Syndromes: An Australian Tertiary Centre Experience

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Background	Countries who suffered large COVID-19 outbreaks reported a decrease in acute coronary syndrome (ACS) presentations and percutaneous coronary intervention (PCI). The impact of the pandemic in countries like Australia, with relatively small outbreaks yet significant social restrictions, is relatively unknown. There is also limited and conflicting data regarding the impact on clinical outcomes, symptom-to-door time (STDT) and door-to-balloon time (DTBT).
Methods	Consecutive ACS patients treated with PCI were prospectively recruited from a tertiary hospital network in Melbourne, Australia. The pre-pandemic period (11 March 2019–10 March 2020) was compared to the pandemic period (11 March 2020–10 May 2020) using an interrupted time series analysis with a primary endpoint of number PCI-treated ACS per day. Secondary endpoints included STDT, DTBT, total mortality and major adverse cardiac events (MACE).
Results	A total 984 ACS patients (14.8% during the pandemic period) received PCI. Mean number of PCI-treated ACS per day did not differ between the two periods (2.3 vs 2.4, p=0.61) with no difference in STDT [+51.3 mins, 95% confidence interval (CI) -52.4 to 154.9, p=0.33], 30-day mortality (5% vs 5.3%, p=0.86) or MACE (5.2% vs 6.1%, p=0.68). DTBT was significantly longer during the pandemic versus the pre-pandemic period (+18.1 mins, 95% CI 1.6–34.5, p=0.03) and improved with time (slope estimate: -0.76, 95% CI -1.62 to 0.10).
Conclusions	Despite significant social restrictions imposed in Melbourne, numbers of ACS treated with PCI and 30-day outcomes were similar to pre-pandemic times. DTBT was significantly longer during the COVID-19 pandemic period, likely reflecting infection control measures, which reassuringly improved with time.
Keywords	COVID-19 • Pandemic • Acute coronary syndrome • Percutaneous coronary intervention

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Introduction

On 11 March 2020 the World Health Organization (WHO) declared coronavirus disease 2019 (COVID-19) a pandemic. On 16 March a state of emergency (SOE) was declared in the state of Victoria, Australia. This was rapidly followed by significant lockdown measures which lasted until the 11 May 2020, at which stage restrictions were eased following the first 'wave' of COVID-19. Countries who suffered large COVID-19 waves of infection have seen decreases in acute coronary syndromes (ACS) and interventional procedures of 26-40% [1–6]. This has been hypothesised to be multifactorial with causes including missed ACS diagnoses in overwhelmed hospitals, higher rates of thrombolysis, competing risk of death from COVID-19 and changes in health care seeking behaviour of the general population. With regards to the latter, concerns have been raised that during periods of social restrictions, patients with ACS may avoid hospitals due to fear of contracting COVID-19, or dismiss their symptoms to avoid being an additional burden on health care services [7–10].

Current guidelines recommend timely reperfusion therapy for ST-elevation myocardial infarction (STEMI) with a door-to-balloon (DTB) time of less than 90 minutes [11,12]. During the pandemic, additional precautions by emergency and hospital staff may impact the provision of timely care due to the need for COVID-19 precautions. However, much of our data regarding management of STEMI during the COVID-19 era has come from locations where health care services were overwhelmed with COVID-19 patients such as New York and Lombardy.

The effect on ACS care of government-mandated social restrictions, social distancing and heightened health care worker infection precautions, in the absence of high COVID-19 numbers, is not known. The state of Victoria in Australia represents a unique environment to study this, with significant and severe lockdown measures enforced, without a large influx of COVID-19 cases into hospitals. While there are reports that Victorian catheterisation laboratories have seen a reduction in percutaneous coronary intervention (PCI) for ACS during the pandemic, there is no data from high volume centres to confirm this. This study reports ACS and PCI numbers and key performance indicators (such as door-to-balloon time), during the first Victorian COVID-19 lockdown.

Methods

Consecutive patients who underwent percutaneous coronary intervention (PCI) for ACS were prospectively recruited and followed for 30 days as part of the Victorian Cardiac Outcomes Registry (VCOR) (2013-current). Patients who received PCI at MonashHeart, a tertiary referral hospital, treating ACS patients from four hospitals (Monash Medical Centre, Dandenong Hospital, Casey Hospital and Jessie McPherson Private Hospital) in Melbourne, Victoria, Australia, were included. The patient population served by this hospital group is between 913,000 and 1,294,000 people.

Results were analysed according to time periods. The 'pre-pandemic' period was determined as the time from 11March 2019 to 10 March 2020 while the 'pandemic' period was defined as 11 March 2020 to 10 May 2020 (the day the WHO declared COVID-19 a pandemic to the day the stage 3 COVID-19 restrictions in Victoria ended). Daily ACS and PCI numbers, patient clinical characteristics, medication use, in-hospital and 30-day adverse outcomes were compared between the pre-pandemic and pandemic group. For the door-to-balloon time (DTBT) analysis only STEMI patients who presented directly to a PCI capable facility within 12 hours of symptom onset were included, while those with symptom onset while in hospital or who received PCI after thrombolytics were excluded. Identical data collection methods were used for the pre-pandemic and COVID-19 periods. The study was approved by the Monash Human Research Ethics Committee with an opt-out consent. De-identified VCOR data is available upon request to the VCOR Data Access, Research and Publications Committee by emailing vcor@monash.edu.

Primary and Secondary Outcomes

The primary endpoint was the number of PCI performed each day for ACS. Secondary endpoints included symptom-to door time (STDT) and DTBT time in STEMI patients, in-hospital and 30-day major adverse cardiac events, major adverse cardiac and cerebrovascular events, and major bleeding for all ACS patients. The relevant times were defined as follows: STDT as time from symptom onset to arrival at a PCI-capable centre, DTBT as time from arrival at a PCI-capable hospital to time of establishing flow in the culprit vessel (independent of which device was used for revascularisation). Major adverse cardiac events (MACE) were defined as death, new or recurrent MI, stent thrombosis, and target vessel revascularisation. Major adverse cardiac and cerebrovascular events (MACCE) were defined as for MACE with the addition of stroke. The international Bleeding Academic Research Consortium standardised bleeding definitions were used to report on major bleeding events (identified by Bleeding Academic Research Consortium categories 3 and 5), including bleeding that required blood transfusion, cardiac tamponade, intracranial haemorrhage, and/or any fatal bleeding.

Statistical Analysis

Interrupted time series analysis was chosen as the most appropriate method of statistical analysis to assess the impact of the COVID-19 pandemic on the volume of PCI for ACS as well as STDT and DTBT in STEMI. The study periods were initially collapsed by month, producing a time series of number of PCIs per month to determine if seasonality was present. For analysis of STDT and DTBT the data was collapsed by day. In exploratory analyses stationarity of the time series was assessed using the Dickey-Fuller unit root test. Determination of any autocorrelation and an appropriate lag to model the autocorrelation was assessed by

visualising the autocorrelation function (ACF), the partial autocorrelation function (PCF) and by Stata's actest. Time series was modelled using generalised linear modelling (glm) [13]. For count or binary outcomes glm with a negative binomial probability distribution and a log link function was used. A heteroskedastic and autocorrelation consistent variance estimator was used, with Newey-West standard errors. Seasonality was tested by including indicator variables for winter in the model. The adequacy of the models was investigated by examining the plot of observed model-estimated monthly event count against the observed event count and using the estimated error variance. The ratio of estimated regression slopes was tested with a slope ratio of 1 showing no difference in slopes (no difference in the rate of change over time). The ratio of the midpoints of estimated regression slopes was tested, with a midpoint ratio of 1 showing no difference in midpoint estimates. Statistical significance was defined as a two-sided p-value ≤ 0.05. Stata Statistical Software: Release 15 (StataCorp LP, College Station, TX, USA) was used for all analyses.

Results

A total of 984 ACS patients were treated with PCI over the study period, 839 during the defined pre-pandemic period and 145 during the pandemic period. A time series analysis of the number of PCI procedures performed for ACS each month from 1 January 2016 to 10 May 2019 showed that there was no seasonal component (Supplemental Figure 1). The addition of a variable for winter demonstrated to not be significant in a model of monthly PCI count. We therefore performed an interrupted time series analysis comparing the 8-week pandemic period (11 March 2020–10 May 2020) to a 12-month pre-pandemic period (11 March 2019–10 March 2020).

Volume of PCI for ACS

The mean number of PCI for ACS per day did not differ between the pre-pandemic and pandemic periods (2.3 vs 2.4, p=0.61). The proportion of PCI performed for each sub-type of ACS was also similar between both time periods (Table 1). On interrupted time series analysis, comparison of the slopes of the number of PCIs per day during the two periods (slope ratio=1.002 [95% Confidence Interval (CI): 0.998–1.006], p=0.45) demonstrated that the rate of PCI per day was similar across the time periods (Figure 1).

Baseline Clinical Characteristics

There were no significant differences in the baseline clinical characteristics of the ACS patients in the pre-pandemic and

Table 1 Baseline and procedural characteristics of all ACS presentations by period.

	Pre-Pandemic Period (11 March 2019–10 Mar 2020)	COVID-19 Period (11 March 2020–10 May 2020)	P-value
N	839	145	
Age, mean (SD)	63.3 (12.1)	62.6 (11.1)	0.53
Male sex	641 (76.4%)	111 (76.6%)	0.97
BMI (kg/m^2), median (IQR)	28.0 (25.0, 31.8)	26.8 (24.0, 30.0)	0.005
Diabetes mellitus requiring medication or insulin	230 (27.4%)	38 (26.2%)	0.76
Peripheral vascular disease	28 (3.3%)	8 (5.5%)	0.20
Cerebrovascular disease	26 (3.1%)	3 (2.1%)	0.50
Previous CABG or PCI	187 (22.3%)	33 (22.8%)	0.90
Unstable angina	78 (9.3%)	9 (6.2%)	0.23
NSTEMI	303 (36.1%)	48 (33.1%)	0.48
STEMI	458 (54.6%)	88 (60.7%)	0.17
LVEF <45%	159 (21.4%)	48 (35%)	<0.001
Out of hospital cardiac arrest	38 (4.5%)	8 (5.5%)	0.61
Cardiogenic shock on arrival	37 (4.4%)	6 (4.1%)	0.88
Glycoprotein IIb/IIIa inhibitors	68 (8.1%)	11 (7.6%)	0.83
Heparin	836 (99.6%)	145 (100.0%)	0.47
Thrombolytics ≤24 hr prior to PCI	60 (7.2%)	15 (10.3%)	0.18
IHT	112 (24.5%)	28 (31.8%)	0.18
Lesion successfully treated[a]	706 (94.6%)	125 (95.4%)	0.71

Abbreviations: SD, standard deviation; BMI, body mass index; IQR, interquartile range; CABG, coronary artery bypass grafting; NSTEMI, non ST-elevation myocardial infarction; STEMI, ST-elevation myocardial infarction; LVEF, left ventricular ejection fraction; IHT, inter-hospital transfer; PCI, percutaneous coronary intervention; ACS, acute coronary syndrome.
[a]Includes NSTEMI and STEMI patients only and excludes inpatient events (pre-pandemic period n=746, pandemic period n=131).
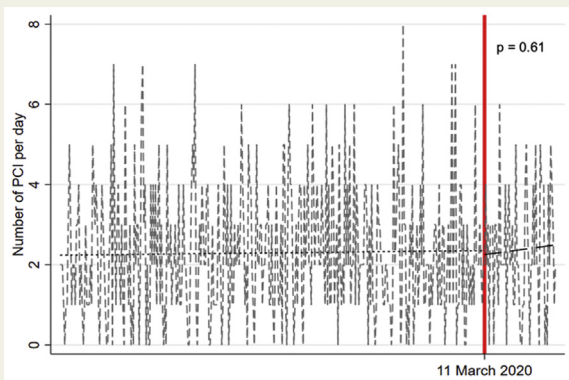
Figure 1 Time series of PCI number per day pre- and post-pandemic period with estimated slopes for the pre-pandemic period and pandemic period.
Legend: There was no difference in number of PCI per day between the pre-pandemic and pandemic periods (2.3 vs 2.4, p=0.61) on interrupted time series analysis. The rate of change of PCI per day within each period was also similar (slope ratio=1.002, [CI]: 0.998–1.006, p=0.45). 11 March corresponds to when COVID-19 was declared a pandemic by the World Health Organization (WHO).
Abbreviation: PCI, percutaneous coronary intervention.

pandemic periods (Table 1). The mean age of the patients was 62.7 years with 76% male. The proportion of patients with comorbidities including diabetes, peripheral vascular disease and cerebrovascular disease was similar across the two time periods. There was no significant difference in the proportion of patients who received thrombolysis prior to PCI (10.3% vs 7.2%, p=0.18). There was no difference in the

proportion of patients presenting with an ACS following an out-of-hospital cardiac arrest, and no rise in pre-procedural intubation during the pandemic period. Similarly, the baseline characteristics of the patients presenting with STEMI did not differ between the two periods (Table 2).

## Symptom-to-Door Time and Door-to-Balloon Time in STEMI Patients

Following exclusion of patients with in-hospital STEMI there were a total of 531 STEMI PCI procedures available for STD time analysis. Baseline and procedural characteristics did not differ between the 446 STEMI patients in the pre-pandemic period and 85 patients in the pandemic period (Table 2). Interrupted time series analysis showed that there was a trend towards longer STDT during the pandemic period although this was not statistically significant (difference in midpoint estimates: +51.3 mins, 95% CI -52.4 to 154.9, p=0.33). There was also no significant change in STDT throughout the course of each period as demonstrated by the slope estimates (Figure 2).

There were 246 STEMI patients in the pre-pandemic period and 44 in the pandemic period who presented within 12 hours to a PCI-capable hospital and were included in the DTBT analyses. Baseline characteristics did not differ between these two groups (Appendix Table 1). There was a significant increase in the DTBT during the pandemic period with a difference in the mid-point estimate of 18.1 minutes (95% CI 1.6–34.5, p=0.03) (Table 3). Interrupted time series analysis also demonstrated that the prolongation in DTBT during the pandemic period was greatest at the beginning of this period and improved throughout the course of the pandemic (Figure 3). Amongst the STEMI patients who met the criteria for DTBT analysis, there were no significant differences in in-hospital outcomes

Table 2 Characteristics of STEMI patients only, according to pandemic or control period.

	Pre-Pandemic Period (11 March 2019–10 Mar 2020)	COVID-19 Period (11 March 2020–10 May 2020)	P-value
N	446	85	
Age, mean (SD)	63.3 (12.3)	62.1 (11.3)	0.42
Male	342 (76.7%)	69 (81.2%)	0.36
BMI (kg/m2), median (IQR)	27.7 (24.8, 31.5)	26.5 (23.7, 29.4)	0.013
Diabetes mellitus requiring medication or insulin	117 (26.2%)	16 (18.8%)	0.15
Peripheral vascular disease	12 (2.7%)	7 (8.2%)	0.012
Cerebrovascular disease	15 (3.4%)	1 (1.2%)	0.28
Previous CABG or PCI	74 (16.6%)	17 (20.0%)	0.44
LVEF <45%	120 (29.7%)	35 (42.2%)	<0.001
Out of hospital cardiac arrest	36 (8.1%)	7 (8.2%)	0.96
Cardiogenic shock on arrival	37 (8.3%)	5 (5.9%)	0.45
Pre-hospital ECG notification	334 (74.9%)	57 (67.1%)	0.13

Abbreviations: SD, standard deviation; BMI, body mass index; IQR, interquartile range; CABG, coronary artery bypass grafting; LVEF, left ventricular ejection fraction; ECG, electrocardiograph; STEMI, ST-elevation myocardial infarction.
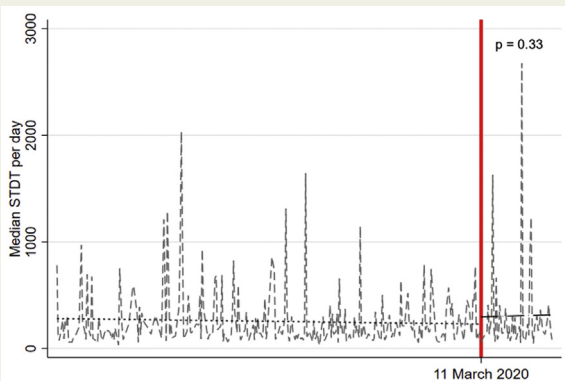
Figure 2 Interrupted time series analysis of median STDT per day pre- and post-pandemic period with estimated slopes.
Legend: 446 and 85 STEMI patients met the inclusion criteria for symptom to door time analysis in the in the pre-pandemic and pandemic periods respectively. There was no statistically significant difference in STDT on interrupted time series analysis between the two periods (difference in midpoint estimates: +51.3 min, 95% CI -52.4 to 154.9, p=0.33). There was also no significant difference in the rate of change in STDT throughout the course of each period (slope ratio=0.44, [CI]: -4.24 to 5.11, p=0.85).
Abbreviations: STEMI, ST elevation myocardial infarction; STDT, symptom-to-door time.

between the two periods, although event rates were low (Appendix Table 2).

In-Hospital and 30-Day Outcomes for Overall ACS Cohort

Procedural success was high in both the pandemic and pre-pandemic ACS groups (94.6% vs 95.4%, p=0.71) and there were no significant differences in in-hospital outcomes such as length of stay (LOS), bleeding and stroke (Table 4). MACE and MACCE were also similar between the two groups (5.2% vs 6.1%, p=0.68 and 5.4% vs 6.1%, p=0.73

respectively). Similarly, 30-day mortality did not differ between the pre-pandemic and pandemic periods (5% vs 5.3%, p=0.86).

Discussion

This is the first study from a high-volume Australian tertiary-referral centre to evaluate the impact of the COVID-19 pandemic on volume, service delivery and outcome of PCI for ACS. It had three major findings. Firstly, using interrupted time series analyses, no change was observed for total ACS numbers, ACS type, or number of PCI, between the pre-pandemic and pandemic period. Secondly, a significant increase in door-to-balloon time for STEMIs was observed during the pandemic period that was most marked at the start of the COVID-19 pandemic and improved over time. Lastly, despite delays to STEMI treatment, no difference in short-term ACS outcomes were apparent during the pandemic compared to the pre-pandemic period. The Australian experience provides valuable insight into the effects of COVID-19 social restrictions and heightened health care worker infection precautions in the absence of high COVID-19 numbers. When the state of emergency was declared in Victoria on the 16 March there had been a total of 78 cases of COVID-19 in the state since the start of the pandemic and no deaths [14]. Over the course of the pandemic period studied there were 1,473 cases in the state and 18 deaths [14]. In contrast, there were 208,950 cases and 33,012 deaths in the UK over the same period [15].

In contrast to our findings, reports from around the world have described a marked decrease in ACS presentations and interventional procedures during the pandemic [1–6]. Data from Italy showed a 32% decrease in PCI for ACS [5], and a 26% relative decline in ACS admissions at the start of the pandemic [1]. Similarly, a survey of 73 centres in Spain found a 40–56% reduction in PCI procedures during the pandemic [4]. An Austrian study showed there were 275 fewer ACS presentations than expected at 17 centres in March 2020 [3]. An observed decrease in STEMI presentations has been of particular concern. A 38% reduction in cathlab activations for STEMI was demonstrated among nine high volume centres

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Table 3 Interrupted time series analysis for STDT and DTBT.

	Pre-Pandemic Period		COVID-19 Pandemic Period		COVID Period Compared to Pre-Pandemic Period	
	Slope Estimate (95% CI)	Midpoint Estimate (95% CI)	Slope Estimate (95% CI)	Midpoint Estimate (95% CI)	Δ Slope (95% CI), p-value	Δ Midpoints (95% CI), p-value
STDT	-0.14 (-0.45, 0.16)	254.61 (220.02, 289.20)	0.30 (-4.37, 4.96)	305.88 (208.02, 403.75)	0.44 (-4.24, 5.11) 0.85	51.27 (-52.40, 154.94) 0.33
DTBT	-0.01 (-0.06, 0.04)	68.49 (63.74, 73.24)	-0.76 (-1.62, 0.10)	86.56 (70.81, 102.31)	-0.75 (-1.62, 0.11) 0.09	18.07 (1.63, 34.51) 0.03

Abbreviations: STDT, symptom-to-door-time; DTBT, door-to-balloon-time.
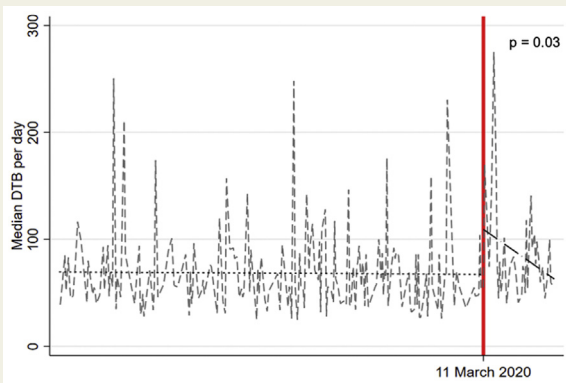
Figure 3 Time series of median DTBT per day pre- and post-pandemic period with estimated slopes.
Legend: There were 246 STEMI patients in the pre-pandemic period and 44 in the pandemic period who met the criteria for inclusion in the DTBT analysis. DTBT was significantly increased during the pandemic period (difference in the mid-point estimate: 18.1 min [95% CI 1.6–34.5, p=0.03]). The prolongation in DTBT during the pandemic period was greatest at the beginning of this period and improved with time (slope estimate: -0.76, 95% CI -1.62 to 0.10).
Abbreviations: DTBT, door-to-balloon time; STEMI, ST elevation myocardial infarction.

in the United States (US) [2]. While the United Kingdom (UK) found a 43% reduction in STEMI [6]. However, our findings are consistent with those of the only other Australian study to examine PCI volumes for ACS prior to and post the pandemic and found no difference (20 vs 18 cases/month, p=0.2) [16]. The unchanged PCI volumes at our institution may be due to the much smaller scale of the initial COVID-19 outbreak in Australia. A prevailing theory for the reduction in ACS presentations worldwide, is concern regarding nosocomial COVID-19 infection deterring patients from presenting. This was illustrated in a survey of British cardiologists, 71% of whom believed this was the cause and 46% of whom believed patients were hesitant to place an additional burden on overwhelmed health services [17]. These apprehensions may be amplified by stay-at-home orders and alerting news media coverage [18]. Our results suggest that, in an environment where COVID-19 case numbers, hospitalisations and deaths are low, these concerns are either less prevalent or do not lead to a significant change in the behaviour of patients. Similarly, it is possible that stay-at-home orders and alarming news media coverage, both of which were present in Victoria, may not exert the same influence on patients when case numbers are low.

Our study represents the second largest examination of the impact of the pandemic on STDT and DTBT in STEMI performed to date. While there was no significant change in STDT, there was a statistically significant increase in DTBT. Our STDT findings differ to those from a retrospective but larger cohort study by Kwok et al. of over 34,000 STEMI patients in the UK which found a small increase in the median STDT after the lockdown (150 [99–270] vs 135 [89–250] min, p=0.004) [6]. Two (2) smaller studies have also examined STDT, including one from another tertiary centre in Victoria and one from Hong Kong [9,16]. Although both found an increase in STDT during the pandemic, they included only three and seven STEMI patients in the pandemic period respectively. Analyses of DTBT during the pandemic have produced mixed results. Kwok et al. reported

Table 4   **In hospital outcomes and 30-day mortality for STEMI and NSTEMI, only exclusion is inpatient event.**

	Pre-Pandemic Period (11 March 2019–10 March 2020)	COVID-19 Period (11 Mar 2020–10 May 2020)	P-value
N	746	131	
Length of stay (d), median (IQR)	3.0 (2.0, 5.0)	3.0 (2.0, 4.0)	0.056
In-Hospital Outcomes			
Stent thrombosis (definite/probable)	5 (0.7%)	0 (-)	0.35
Major bleeding	5 (0.7%)	2 (1.5%)	0.31
Stroke all types	2 (0.3%)	1 (0.8%)	0.37
Mortality	29 (3.9%)	6 (4.6%)	0.71
MACE	39 (5.2%)	8 (6.1%)	0.68
MACCE	40 (5.4%)	8 (6.1%)	0.73
30-Day Outcomes			
Total mortality	37 (5.0%)	7 (5.3%)	0.86

Abbreviations: IQR, interquartile range; MACE, major adverse cardiovascular events; MACCE, major adverse cardiovascular and cerebrovascular events; STEMI, ST-elevation myocardial infarction; non STEMI, non ST-elevation myocardial infarction.

a statistically significant 11-minute increase in median door to balloon time after the UK lockdown [6]. Smaller studies from the US and Austria found no significant difference in DTBT for STEMI during the pandemic [19,20]. Unlike in the UK where large influxes of COVID-19 patients may have impacted service delivery and DTBT, the DTBT delay observed in our study is likely a direct reflection of the introduction of stringent personal protective equipment (PPE) protocols, screening questions and mandatory COVID-19 testing in the emergency department prior to proceeding to the cathlab. A unique feature of our analysis is the use of an interrupted time series analysis which revealed that delays in DTBT improved with time during the pandemic period. This finding likely reflects the health care service adapting over time with streamlining of processes.

Our study found no significant change in the proportion of PCI performed for each subtype of ACS during the pandemic. This is in contrast to several reports from Europe that found larger decreases in NSTEACS than STEMI [18]. Importantly this occurred in settings where overall ACS presentations declined, which was not the case in our study. An explanation for this may be offered by the findings of an analysis of ED presentations in the neighbouring state of New South Wales between 29 March and 30 May 2020 [21]. While there was a significant 12% decrease in presentations with 'chest pain not resulting in another diagnosis' compared to the same period in 2019, there was no change in the number of ACS presentations [21]. Along with our findings, this suggests that, while there was hesitancy amongst patients to present to ED during the pandemic in Australia, this primarily affected patients with non-specific chest pain not those who were found to have an ACS.

Our study found no increase in short-term adverse outcomes among both our overall ACS population and our STEMI cohort during the pandemic, despite longer DTBT. This is in keeping with studies from the UK and Austria that showed no change in short-term outcomes among STEMI patients despite longer ischaemic times [6,20]. Conversely a prospective single centre study from France found a two-fold higher in-hospital mortality among 83 patients with STEMI during the pandemic, however this was in the setting of a very large (3.6-hr) increase in the mean symptom-to-balloon time during the outbreak [8]. The present study is the largest to examine outcomes in an overall ACS cohort during the pandemic. The only other study to examine this included 64 ACS patients presenting during the pandemic who found a significantly higher rate of the composite endpoint of in-hospital death, cardiogenic shock, sustained ventricular tachycardia/ventricular fibrillation (VT/VF) and use of mechanical circulatory support compared to 85 patients presenting prior (14.1% vs 29.7%, p=0.02). While our findings are reassuring that ACS and STEMI patients have not been negatively impacted in the short term by the pandemic and consequent longer DTBT, studies examining the longer term effects of the pandemic are needed.

Limitations

This study has several limitations. We studied ACS patients from across four hospitals within a tertiary health service and our findings may not be representative of the impact of the pandemic more widely in Victoria or Australia. Additionally, the study was limited only to ACS patients who were treated with PCI as these patients were prospectively captured in the VCOR Registry. We therefore cannot comment on numbers of ACS that were not deemed suitable for PCI. Finally, while we corrected for seasonality with use of the interrupted time series analysis, we cannot exclude other factors that may have influenced ACS numbers such as pollution and patient-level lifestyle changes due to stay-at-home orders. Study size may also have limited power to demonstrate difference in ACS presentations over this period and larger studies are also warranted, these studies may also benefit from data collection beyond that of the current study to evaluate any late impact on presentations due to Victoria's much larger "second wave" of COVID-19 cases from June to September 2020.

Conclusions

Unlike the decline in ACS presentations and PCI reported broadly overseas, our study found that in the largest cardiac interventional health care service in Victoria, Australia there was no change in the volume of PCI for ACS during the COVID-19 pandemic. Using an interrupted time series analysis, we found that ACS and PCI numbers as well as time from symptom onset to hospital presentation were similar between the pre-pandemic and pandemic period. While a significant increase in DTBT was seen during the COVID-19 pandemic reassuringly, this delay improved with time, and we did not appear to impact short-term outcomes after PCI for ACS.

Conflicts of Interest and Acknowledgements

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Appendices. Supplementary Data

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