Changes to management of a non-pandemic illness during the COVID-19 pandemic: case study of invasive management of acute coronary syndrome

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ABSTRACT

The coronavirus 2019 (COVID-19) pandemic requires significant changes to standard operating procedures for non-COVID-19 related illnesses. Balancing the benefit from standard evidence-based treatments with the risks posed by COVID-19 to patients, healthcare workers and to the population at large is difficult due to incomplete and rapidly changing information. In this article, we use management of acute coronary syndromes as a case study to show how these competing risks and benefits can be resolved, albeit incompletely. While the risks due to COVID-19 in patients with acute coronary syndromes is unclear, the benefits of standard management are well established in this condition. As an aid to decision making, we recommend systematic estimation of the risks and benefits for management of any condition where there is likely to be an increase in non-COVID-19 related mortality and morbidity due to changes in routine care.

The coronavirus 2019 (COVID-19) pandemic has altered the risk-benefit ratio for standard management of many non-COVID-19 medical conditions, in some cases quite dramatically. This has required the development of new treatment approaches that deviate from national and international guidelines, and would likely be considered sub-optimal treatment in non-COVID-19 conditions. This is done for a number of reasons: firstly, to protect patients and healthcare staff from COVID-19 related morbidity and mortality; secondly, to reduce population transmission rates of the underlying virus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2); thirdly, in a pandemic setting there are extreme resource constraints, with resource used in one area (e.g., bed days, staff, cleaning, administration, personal protective equipment) being unavailable for use in other, potentially more clinically important, areas. Standard methods of resource allocation require adjustment in pandemic situations. For example, it can be argued that research participants and healthcare workers should receive priority for treatment due to their instrumental value, that is their capacity to benefit others in the pandemic.¹

Therefore treatment approaches need to be adapted in order to deliver “the greatest good to the greatest number” while minimizing resource consumption and risk to patients, staff and the wider population. Furthermore, this adaptation process must be performed in the absence of complete data, which is often rapidly changing. We believe that a case study in this process may be useful for other departments hurrying to produce their own recommendations.
In this example, we present our approach to balancing these competing risks in the management of acute coronary syndrome (ACS) in hospitals without percutaneous coronary intervention (PCI) capabilities. While high-level documents exist providing guidance in these scenarios, local adaptation is needed due to local health capacity in the face of the pandemic, and also for geographical considerations. The Southern District Health Board (SDHB) serves a population of approximately 330,000 over the largest geographic region of any DHB in New Zealand (62,356 square kilometers, over 2.5 times the size of the Lombardy region in Italy). Healthcare provision includes one tertiary hospital with a cardiac catheterisation laboratory, one secondary care hospital and five rural hospitals. Standard operating procedures in the SDHB currently involve primary PCI for patients with ST elevation myocardial infarction (STEMI) within 90 minutes transfer time of Dunedin Hospital, and thrombolysis followed by immediate transfer for patients with STEMI more than 90 minutes from Dunedin Hospital. Early invasive management is considered in most patients with non-ST elevation acute coronary syndrome (NSTEACS), with transfer to the tertiary centre for patients presenting at secondary or rural hospitals.

Dunedin Hospital has in-house COVID-19 molecular diagnostic testing available 16 hours per day, seven days a week, with a turn-around time of 4–5 hours for hospital collected specimens (plus transport time if collected in the community or outside hospital). In this article, we will examine the benefit of invasive management for ACS, the estimated risk of COVID-19 in our specific patient population, and then attempt to balance these competing benefits and risks. We focus on ACS in patients not suspected of having COVID-19, and only mention in passing those with proven or suspected COVID-19. Although currently under investigation, it is clear that COVID-19 itself can lead to myocardial injury, with subsequent very high mortality rates (in one series of patients with an elevated troponin, 37% and 69% mortality without and with underlying cardiovascular disease, respectively), making invasive therapy very unlikely to alter outcomes except in highly selected cases.

Benefit of invasive management in routine circumstances

There is an established benefit of both primary PCI and routine PCI after thrombolysis in STEMI. Primary PCI reduces the short-term (4–6 weeks) risk of death by 2%, the risk of non-fatal myocardial infarction (MI) by 4% and the risk of stroke by 1% (primarily driven by a reduction in intracranial haemorrhage). After thrombolysis, routine invasive management (the pharmacoinvasive approach routinely followed in SDHB) compared to invasive management only if there is ongoing ischaemia after thrombolysis reduces the rate of reinfarction, but makes no difference to the risk of death.

For patients with NSTEACS, invasive management reduces the risk of death at two years by 1.6%, and the risk of nonfatal MI by 1.5%. This benefit is limited to those at higher risk of adverse outcome. In those at low risk (identified as thrombolysis in myocardial infarction (TIMI) risk score 0 to 2, Table 1), there is no difference in outcomes with routine invasive management.

In patients with acute coronary syndrome without troponin elevation (ie, unstable angina), routine invasive management leads to an increase in procedure-related myocardial infarction and bleeding, without any improvement in long-term MI or death.

Risk of COVID-19 in patients with acute coronary syndromes

While the authors acknowledge the difficulties, biases and limitations of case fatality rates calculated early in an epidemic, cardiovascular disease and cardiac risk factors seem to be a significant risk factor for COVID-19 related complications. In the general patient population, the case fatality rate in Italy was 1.0% for those aged 50–59 years, 3.5% in those aged 60–69 years, 13% in those aged 70–79 years, and 20% in those aged 80 years and older, with these risks being approximately 50% higher than those reported in China. In China, those with any cardiovascular disease had the highest case fatality rate of 10.5% (non-age adjusted), compared to 7.3% with diabetes, 6.3% with COPD, 6.0% with hypertension and 0.9% for those with no comorbidities. As such, nosocomial or community transmission of COVID-19 to...
patients with a recent ACS can be expected to result in significant excess mortality.

How these numbers will change in New Zealand with likely reduced transmission due to Prime Minister Jacinda Ardern’s declaration of a state of emergency and move to the highest level of public response on 23 March 2020 and, on the other hand, a lower number of Intensive Care Unit beds (approximately one half to one third of the capacity in Lombardy) is not yet known. For example, a very low community prevalence or even elimination of COVID-19 may allow earlier resumption of usual care.

Risk to healthcare workers

In Wuhan, 3.8% of confirmed cases were healthcare workers, of which 15% of cases were classified as severe or critical. It is clear that some patients are potentially infectious despite minimal or absent symptoms, especially early in the disease time-course. It is arguable whether these patients contribute substantially to community transmission or not, however they may pose a potential infection risk during invasive healthcare procedures. Although other countries are moving to high-level personal protective equipment (PPE) use in patients with STEMI (ie, treating every case as potentially COVID-19 positive), it is unlikely that our current PPE supplies will allow such an approach. While it is tempting to simply suggest all patients undergoing invasive procedures receive a COVID-19 diagnostic test, this approach is not feasible within the confines of current laboratory resources (exhaustible and limited supply of diagnostic swabs and reagents) and would likely have suboptimal sensitivity to exclude early infection. Risk of transmission to cardiology staff or transferring teams (ie, aeromedical or road ambulance crews) is also unknown.

Another consideration is that, in New Zealand, staffing levels are, in general, lower than international centres—for example, Lombardy, with a population of approximately 10 million people, has 55 hospitals with cardiac catheterisation laboratories, allowing the health system to restructure to 13 “Hub” hospitals in the face of coronavirus. By comparison, there are only nine hospitals with catheterisation laboratories in New Zealand suitable for interventional treatment of acute coronary syndrome, serving a population approximately half that of Lombardy. Loss of even a single catheterisation laboratory team due to COVID-19 positivity would likely severely reduce interventional cardiology capacity in any of the tertiary centres in New Zealand—this is certainly the case in SDHB.

Approach to invasive management of STEMI

With these considerations in mind, we have taken the following approach to management of STEMI:

1. Patients within 90 minutes transfer time from Dunedin Hospital should be transferred immediately for primary PCI (the current standard of care).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Score</th>
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<tbody>
<tr>
<td>Pre-existing risk</td>
<td></td>
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<tr>
<td>Age 65 years or older</td>
<td>+1</td>
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<tr>
<td>Three or more traditional coronary artery disease risk factors (hypertension, hypercholesterolaemia, diabetes, family history of CAD, current smoker)</td>
<td>+1</td>
</tr>
<tr>
<td>Use of aspirin in last 7 days</td>
<td>+1</td>
</tr>
<tr>
<td>Known coronary stenosis &gt;50%</td>
<td>+1</td>
</tr>
<tr>
<td>Markers of severity of ischaemia</td>
<td></td>
</tr>
<tr>
<td>Presence of &gt;0.5mm ST deviation on admission ECG</td>
<td>+1</td>
</tr>
<tr>
<td>Severe anginal symptoms (two or more episodes of angina in last 24 hours)</td>
<td>+1</td>
</tr>
<tr>
<td>Positive biomarker</td>
<td>+1</td>
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</tbody>
</table>

Table 1: Thrombolysis in myocardial infarction (TIMI) score.12
2. For those outside this time frame, thrombolysis should be performed, following standard protocols (ie, ideally field thrombolysis where available). Patients should be taken to their local hospital for assessment, and the cardiologist on-call contacted.

In low-risk STEMs (eg, inferior STEMs) or patients at high risk of COVID-19 complications, medical therapy will likely be the management strategy. In high-risk STEMs (eg, anterior STEMs) or low-risk STEMs in patients at low risk of COVID-19 related complications, patients will be considered for transfer on a case-by-case basis.

Any patients with cardiogenic shock or heart failure due to acute ischaemia (whether due to STEMI or NSTEMI) are at high risk of cardiac death and will likely need to be transferred for immediate angiography.

Approach to invasive management of NSTEMI

While the TIMI risk score identifies those most at risk of adverse events, the likelihood of benefitting from invasive management is mostly related to the three components identifying active ischaemia (ECG changes, positive troponin, and most likely more frequent chest pain). In addition, the four components of the TIMI score related to pre-existing risk are also markers of significant additional risk of COVID-19 related morbidity and mortality. As such, in those receiving points on the TIMI score primarily due to pre-existing risk, it is likely that the benefit of invasive management is not outweighed by the risk associated with potential COVID-19.

For this reason, patients with an overall low TIMI score (0–2) will in general be managed medically. As a general rule, only patients with NSTEMI and any of the following features will be considered for transfer for invasive management:

- Presence of >0.5mm ST deviation on admission ECG
- Two or more episodes of angina in last 24 hours
- Positive biomarker

Patients meeting these criteria, but who may not necessarily be transferred for invasive management. Note that “positive biomarker” was defined in an era before high-sensitivity troponin assays, primarily using creatinine kinase. As such, borderline or small changes in high-sensitivity troponin are unlikely to meet this criterion.

Due to the likely lack of benefit to the patient, and high risk to the staff, the following patients will not, in general, be offered routine invasive management:

- Likely type 2 myocardial infarction (ie, not primarily due to coronary plaque rupture)
- COVID-19 positive or suspected patients

Referring physicians are encouraged to contact the on-call cardiologist for discussion of patients on a case-by-case basis.

Medical management and follow-up

For patients being managed medically, we recommend earlier discharge than normal to reduce risk of nosocomial COVID-19 acquisition. In stable patients without recurrence of chest pain, discharge can be considered on the day of admission, as the marginal potential benefit, for example from more rapid up-titration of medication, is likely to be outweighed by the risk of COVID-19 complications. As access to echocardiography is extremely limited due to COVID-19, beta-blockers should, if possible, be started in all patients.

We expect major issues with lack of clinical capacity once current restrictions are lifted. On discharge, patients are advised to attend their GP in approximately three to six months for re-assessment and referral to the cardiology clinic. Brief assessment by the GP for symptoms will allow us to better triage the likely large numbers of patients at that time that will require assessment in an outpatient setting.

Conclusions

In this article, we have described the thought processes behind significant changes to a non-COVID-19 related standard operating procedure, summarised in Table 2. We have attempted to balance the likely consequent increase in cardiovascular complications of ACS against the risk of COVID-19 to patients and staff, bearing in
mind that patients with cardiovascular disease are likely among the highest risk groups for COVID-19 related complications. In the case of the health system being overwhelmed during the pandemic, we would have to move to an even more conservative approach, as was seen in China.17

We believe that systematic estimation of the estimated risks and benefits may be helpful for decision making. Most interventions in medicine, whether pharmacological or invasive, have limited short-term efficacy in an individual patient, and by focusing only on those that do, we are likely to reduce risk to patients and staff, and reduce the rate of transmission in the population at large, while maximising scare resources.

Table 2: Summary of key changes to management of ACS in non-PCI capable hospitals due to pandemic.

<table>
<thead>
<tr>
<th>Routine standard of care</th>
<th>Pandemic standard of care</th>
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<tbody>
<tr>
<td>STEMI</td>
<td></td>
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<tr>
<td>Pre-hospital or in-hospital thrombolysis with immediate transfer to PCI capable centre</td>
<td>Pre-hospital or in-hospital thrombolysis with local hospital medical management for low-risk STEMI</td>
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<tr>
<td>NSTEACS</td>
<td></td>
</tr>
<tr>
<td>Routine transfer to PCI capable centre in majority of cases</td>
<td>Transfer to PCI capable centre only for patients with:</td>
</tr>
<tr>
<td></td>
<td>• Presence of &gt;0.5mm ST deviation on admission ECG</td>
</tr>
<tr>
<td></td>
<td>• Two or more episodes of angina in last 24 hours</td>
</tr>
<tr>
<td></td>
<td>• Positive biomarker</td>
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</tbody>
</table>

Abbreviations: ACS, acute coronary syndrome; ECG, electrocardiogram; PCI, percutaneous coronary intervention; NSTEACS, non-ST elevation acute coronary syndrome; STEMI, ST-elevation myocardial infarction.

Competing interests:
Nil.

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