# Management strategy of an inpatient requiring urgent coronary artery revascularisation with prolonged SARS-CoV-2 shedding

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**Short running title:** Revascularisation Strategy in Covid-19 Era

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**Abstract**
Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which originated in China, is the cause of the global pandemic Coronavirus Disease 19 (Covid-19). To date, there is no widely available vaccine or treatment, hence containment strategies are currently centred around measures ameliorating human transmission via social distancing and quarantine.

Due to the magnitude of the pandemic, elective operative work had ceased within cardiac surgery at our institution and strategies adapted to facilitate safe management of surgical candidates. Here, we present the case report of an asymptomatic inpatient with prolonged viral shedding on real-time polymerase chain reaction (RT-PCR) on oropharyngeal swabs who required urgent coronary artery revascularisation, and the lessons learnt from the adapted management strategy deployed for revascularisation during the COVID-19 pandemic.

## Introduction

The Coronavirus disease 2019 (Covid-19) pandemic, caused by the novel pathogen named severe respiratory syndrome coronavirus 2 (SARS-CoV-2) originated in China spreading globally, with the first UK reported case in late January 2020. Due to the magnitude of the pandemic, much of the surgical work across the UK had been condensed, including within cardiac surgery.

Currently there is no widely available vaccine, and current strategies are focussed around containment and reduction in transmission via isolation and social distancing. There is currently a paucity of data on patient outcomes undergoing cardiac surgery with concurrent asymptomatic SARS-CoV-2 infection.

Our institution is a tertiary cardiothoracic centre with no attached emergency department, whereby at the height of the pandemic in the UK, only urgent in-patient cardiac surgery was offered, in order to accommodate transfer of ventilated patients with Covid-19 from other local centres where there were bed pressures. Here we present the case of an asymptomatic inpatient requiring urgent coronary artery revascularisation, who had prolonged viral shedding on RT-PCR oropharyngeal swabs, and we discuss the adapted management strategies deployed for revascularisation during the COVID-19 pandemic.

## Case Report

Our patient, a 68-year old male of Asian descent with a background of non-insulin-dependent diabetes (NIDDM), smoker and chronic kidney disease (stage III), was admitted following an out-of-hospital ventricular fibrillation (VF) cardiac arrest. A post-resuscitation angiogram showed severe proximal, mid and distal left anterior descending (LAD) artery disease with a chronic total occlusion (CTO) of the mid-LAD, severely diseased proximal left circumflex with an aneurysmal segment beyond it and middle vessel CTO of his right coronary artery (RCA) **(Figure 1A, 1B)**. As per cardiac multi-disciplinary team (MDT) decision, he was listed for urgent inpatient coronary artery bypass graft (CABG) surgery.

Whilst awaiting surgery, a SARS-CoV-2 RT-PCR swab was conducted on him as there was a patient positively swabbed in his cohort bay. This came back positive and he was transferred to the Covid-19 medical ward. His procedure was postponed until he had two negative swabs as per hospital protocol and a computed tomography (CT) scan of his chest negating evidence of COVID-19 disease. During his in-patient stay, he had non-specific abdominal symptoms including distension and his CT Abdomen showed functional ileus which self-limited; this pre-dated his initial positive swab. Additionally, he was treated successfully for a urinary tract infection with an oral course of ciprofloxacin. A chest CT scan had shown no focal or diffuse abnormality, although there were bilateral pleural effusions, probably due to cardiac dysfunction **(Figure 2)**.

Forty days from his initial swab confirming SARS-CoV-2, he remained positive despite being asymptomatic from a Covid-19 perspective throughout his admission. On day 43 he was re-discussed at the revascularisation MDT due to his positive SARS-CoV-2 status, whereby given the risk of operating whilst being Covid-19 positive likely outweighed the benefit, thus he was listed for complex percutaneous coronary intervention (PCI).

Additionally, our patient's vitamin D level was tested at this time point and he was found to be severely deficient. He was subsequently treated with high-dose oral vitamin D supplementation.

On day 45 he underwent PCI; the initial planned strategy was for PCI to the left main stem and LAD with assistance of rotary ablation and shockwave lithotripsy balloon, with pre-emptive left ventricle (LV) support by means of an Impella device. However, due to the heavy calcific burden, it was only possible to treat the proximal LAD and second diagonal proximal to the CTO of the LAD with rotablation, laser and drug eluting stent back to the left main stem with an Impella inserted. Given the complexity of the procedure the patient did suffer contrast induced nephropathy with his post procedure creatinine peaking at 405 umol/L and a haemoglobin drop of 47g/L, though remained stable post-procedure.

Our patient was re-discussed in the MDT (at which point he had acquired two negative swabs on day 46 and day 47) and to treat his residual disease he eventually underwent CABG (Left internal mammary artery-LAD, Saphenous vein graft (SVG)-Obtuse marginal 1, SVG-Posterior Descending Artery) on day 58. Intraoperatively, a significant haemaopericardium (500ml) was observed **(Figure 3)**. Central Venous Pressure at induction was 30mmHg returning to 18mmHg after decompression. There was severe bruising of the anterior wall most likely related to the previous shockwave treatment impairing the identification of target vessels. Post-operatively, the patient was pre-emptively filtered for two days in view of his previous renal impairment, with no significant post-operative sequalae. He is currently awaiting an ICD placement prior to discharge.

Summarised in **Table 1** are our patients' various investigations.

**Discussion**

Data from studies provide evidence that SARS-CoV-2 is primarily spread through respiratory droplets from symptomatic individuals or through direct contact with infected individuals [1, 2]. Through contact tracing of cases, pre-symptomatic transmission has been identified [3] and transmission via contact with contaminated surfaces has also been implicated [4].

Currently, there is no large cohort evidence analysing the duration of viral shedding in the context of asymptomatic Covid-19 infection. Furthermore, there is paucity of evidence on the operative outcomes of asymptomatic patients with positive SARS-Cov-2 swabs.

Given the sanctioned re-swabbing of our patient in order to facilitate an operation (during a time of limited swabbing facilities), we were in a unique position to be able to observe the potential longevity of viral shedding. Given the limited data currently available on the duration of viral shedding in asymptomatic patients it is unclear what the estimated burden on inpatient resource provision will be for future surgical patients alike.

In the absence of an accurate method to measure viral load, a crude measure can be yielded from a throat swab RT-PCR, whereby viral load is inversely proportional to the cycle threshold (CTh) value reported i.e. the lower the value, the higher the viral load. At our institution, a strongly positive swab was reflected by a CTh value of <22; between 22-26 being weakly positive; and >26 cycles deemed negative. All but one swab result for both our cases were strongly positive (**Table 1**), making a false positive swab result unlikely.

The quantitative information obtained via RT-PCR does have its limitations including poor operator technique and appropriate location of swabbing; literature suggests that throat swabs yield a higher viral load than nasal swabs [5]. Importantly, it is unknown at what CTh value the virus is non-viable. Moreover, it is unclear whether testing positive for such prolonged periods will result in individuals being deemed contagious. All this information will have implications on the revascularisation strategies of urgent in-patient operations such as ours, and alternative complex PCI options may need to be explored for future patients. Our patient had had an attempted complex PCI with pre-emptive LV support due to his prolonged viral shedding, however on this occasion it was unsuccessful in achieving the intended revascularisation.

Of note, our patient was severely vitamin D deficient, and on replacement, the negative swabs followed. There is emerging evidence implicating vitamin D status and outcomes of Covid-19 [6]. It has become apparent that there is an association between northern latitude countries (whom have a high prevalence of vitamin D deficiency) and Covid-19 mortality. Furthermore, countries of lower latitude such as Spain and Italy, were also found to have high rates of vitamin D deficiency, despite being sunnier. Furthermore, black and minority ethnic individuals are proportionally more likely to be affected by Covid-19 and are also at higher risk of vitamin D deficiency. A hypothesised mechanism includes the role of vitamin D in supporting antimicrobial peptides in the respiratory epithelium and also via dysregulation of the inflammatory response, whereby vitamin D promotes expression of the angiotensin converting enzyme 2, whilst SARS-CoV 2 downregulates it and exploits it as an entry receptor. Testing and supplementation of Vitamin D in surgical patients who may deficient or have inadequate levels should be considered.

**Conclusion**

Our case highlights a revascularisation strategy of a patient with triple vessel disease, adapted for the Covid-19 era, due to prolonged asymptomatic viral shedding. Further research is needed to establish the viability of SARS-CoV-2 at different viral loads, and ascertain infectivity in asymptomatic individuals with prolonged positive SARS-CoV-2 results as well as the role of low vitamin D levels. This will have implications on the decision of whether to and when to operate as well as the impact on in-patient surgical provision. In the interim, complex PCI techniques may be considered with appropriate rescue strategies if amenable.

**Authors' contributions:**
DN – Patient care, data collection, writing the manuscript
SK - Patient care
AH - Patient care
PUD - Interpreting the radiology images
TK – Patient care and interpreting angiogram images.
US – Operating surgeon and writing the manuscript
JBM - Patient care, data collection, writing the manuscript.
*All authors reviewed and finalised the manuscript.

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**Figure Legends**

**Figure 1A.** Anterior-posterior (AP) caudal 30 degree view: Angiogram showing severe proximal, mid and distal left anterior descending (LAD) artery disease with chronic total occlusion (CTO_ of the mid-LAD, severely diseased proximal left circumflex with an aneurysmal segment beyond it.

**Figure 1B.** Right anterior oblique (RAO) view: CTO of the right coronary artery (RCA).

**Figure 2.** Coronal computed tomography (CT) reconstruction reveals no evidence of ground glass opacity or consolidation to suggest Covid-19 infection. Black arrow points to a small right pleural collection secondary to the patient's congestive cardiac failure.

**Figure 3.** Intraoperative haemopericardium with fibrin tissue overlying myocardium

**Tables**

| Investigations (Normal range where applicable) | Case 1: 68M, Asymptomatic | |
|---|---|---|
| **SARS-CoV-2 Swabs** | **Day of swabbing – result of swab** | **CTh value** |
| | Day 0 – Positive | 10.53 |
| | Day 7 – positive | 3.57 |
| | Day 10 – positive | 6.36 |
| | Day 14 – positive | 12.18 |
| | Day 18 – positive | 18.74 |
| | Day 21 – positive | 16.86 |
| | Day 24 – positive | 8.74 |
| | Day 29 – negative | - |
| | Day 30 – positive | 9.69 |
| | Day 33 – positive | 19.64 |
| | Day 37 - positive | 20.11 |
| | Day 40 – positive | 15.73 |
| | Day 46 – negative | - |
| | Day 47 - negative | - |
| **Peak D-Dimer** (0-240 ng/ml) | 964 ng/ml | |
| **Peak Ferritin** (32-284 ug/L) | 371 ug/L | |
| **Peak LDH** (266-500 IU/L) | 402 IU/L | |
| **Peak Troponin I** (0-19.8 ng/L) | 6597 ng/L* | |
| **Vitamin D** (<25 nmol/L – deficient 25-50 nmol/L – insufficient 50-75 nmol/L – adequate >75nmol/L – optimal) | 8 nmol/L | |
| **Echocardiography** | Normal LV with mild LVH. LVEF 50-55% with no significant valvular abnormalities. RV appears non-dilated with mildly reduced function* | |

**Table 1.** Patient investigations conducted over the course of the admission

*Abbreviations: RT-PCR = Real-time polymerase chain reaction, CTh= cycles threshold, LV= Left Ventricle, LVH= Left Ventricular Hypertrophy, LVEF= Left Ventricular ejection fraction, RV= Right ventricle*
**investigation done during same index admission prior to first positive SARS-CoV-2 RT-PCR swab*