



Management of acute aortic services during the COVID-19 pandemic: a retrospective cohort study from the Middle East

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Background: COVID-19 created a challenging situation for cardiac surgery and associated acute care programs around the world. While non-urgent cases might be postponed, operating on life-threatening conditions, including type A aortic dissection (TAAD), must be sustained despite the ongoing pandemic. Therefore, the authors investigated the impact of the COVID-19 pandemic on their urgent aortic program.

Methods: The authors included consecutive patients presenting with TAAD ($n = 36$) in the years 2019 and 2020 [pre-pandemic period (2019; $n = 16$) and the pandemic era (2020; $n = 20$)] at a tertiary care centre. Patient characteristics, TAAD presenting symptoms, operative techniques, postoperative outcomes, and length of stay were determined retrospectively using chart review and were compared between both years.

Results: An increase occurred in the absolute number of TAAD referrals during the pandemic era. Patients were featured by younger age of presentation (pre-pandemic group: 47.6 ± 18.7 , and the pandemic group: 50.6 ± 16.2 years, $P = 0.6$) in contrast to Western data but showed similar male predominance (4:1) in both groups. There was no statistical difference in baseline comorbidities between the groups. Length of hospital stay [20 (10.8–56) vs. 14.5 (8.5–53.3) days, $P = 0.5$] and intensive care unit stay [5 (2.3–14.5) vs. 5 (3.3–9.3) days, $P = 0.4$] were comparable between both groups. Low rates of postoperative complications were registered in both groups with no significant between-group difference. There was no significant difference in the rates of in-hospital mortality between both groups [12.5% (2) vs. 10% (2), $P = 0.93$].

Conclusions: Compared with the pre-pandemic era (2019), there was no difference in resource utilisation and clinical outcomes of patients presenting with TAAD during the first year of COVID-19 pandemic (2020). Structural departmental re-configuration and optimal personal protective equipment utilisation warrant maintained satisfactory outcomes in critical healthcare scenarios. Future studies are required to further investigate aortic care delivery during such challenging pandemics.

Keywords: outcomes, SARS-CoV-2, surgical performance, TAAD, critical care

Introduction

The SARS-CoV-2 pandemic created several challenges to delivering healthcare services for a prolonged period, including cardiac surgery and associated acute care programs worldwide^[1,2]. Elective procedures have been postponed by overwhelmed healthcare systems, especially during the first wave of the pandemic, and a fear of getting infected in emergency facilities led to delayed or even hindered patient presentation^[3]. A multicentre European study concluded that the pandemic led to a decrease in

HIGHLIGHTS

- The COVID-19 pandemic created several challenges for cardiac surgery programs worldwide.
- Structural re-configuration and optimal personal protective equipment utilisation are key in healthcare crisis.
- Outcomes in patients with type A aortic dissection were maintained despite the ongoing pandemic.

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referrals of acute aortic syndromes. The major driving force in the trend was patient reluctance to seek medical support. The number of elective aortic patients, who have been postponed but suffered from an aortic rupture during the waiting period, was reassuringly low^[4]. Similar trends were observed in US aortic centres; a 76.5% drop in type A aortic dissection (TAAD) surgical case volume was seen in eleven cardiovascular units during the first wave in New York City, and an 8-fold to 10-fold increase in all-cause at-home death rates in comparison with the same period in 2019, raising concerns about the impact of the pandemic on non-COVID related health conditions, including acute coronary syndrome and TAAD^[5].

Emerging evidence brought to light the microvascular target and multiorgan involvement features of the infection, in contrast to the initially assumed only respiratory target^[6,7]. In addition, diagnostic and therapeutic events associated with hypertension were dramatically decreased during the first year of the pandemic, with the most significant cut down during the first lockdown period, shown in a large-scale study from 54 Excellence Centres of the European Society of Hypertension (ESH), with data collected from 21 European countries^[3]. The long-term consequences of inadequate blood pressure control and related cardiovascular events in this era are still an open question^[3].

Additionally, chronic disease follow-up care was also limited by institutional constraints in the same era. Nevertheless, while non-urgent cases might be deferred, providing care to patients presenting with life-threatening conditions, including TAAD, must be sustained despite the ongoing pandemic.

Data on how the COVID-19 pandemic affected aortic emergency programs around the world are limited, especially from the Middle East region. Therefore, we investigated the impact of the COVID-19 pandemic on acute aortic syndrome volumes and outcomes at a tertiary care centre in the United Arab Emirates.

Methods

Consecutive patients ($n=36$) presenting with TAAD at a single tertiary care centre were identified using retrospective review of electronic health records. Patient characteristics, demographics and comorbidities, TAAD presenting symptoms (chest pain, back pain, or abdominal pain, and syncope), operative techniques, postoperative course and complications (sepsis, acute kidney injury, any-organ ischaemia and in-hospital mortality), hospital and intensive care unit length of stay were retrospectively identified. Patients were grouped according to the presentation date as the pre-pandemic era, including those treated during the calendar year 2019 ($n=16$) or the pandemic period for those operated during the identical timeframe in 2020 ($n=20$). This work has been reported in line with the STROCCS criteria^[8]. Categorical variables were reported as absolute numbers (%), and continuous variables were reported as a mean \pm SD or median [interquartile range]. A comparison was made between both eras using appropriate testing methods (t -test or Mann–Whitney U-test for non-normally distributed continuous variables; χ^2 test for categorical variables). P value less than 0.05 was considered statistically significant. All statistical analyses were performed with JMP Data Analysis Software Version 16, SAS Institute Inc. The study was approved by the Institutional Review Board and Research Ethics Committee, and an informed patient consent has been waived due to the study's retrospective nature.

Results

An increase occurred in the absolute number of TAAD referrals during the pandemic era (16 vs. 20 cases, translating into an incidence increase from 5.3 to 6.5 cases per one million inhabitants per year. Patients were featured by younger age of presentation (pre-pandemic group: 47.6 ± 18.7 , and the pandemic group: 50.6 ± 16.2 years, $P=0.6$) in contrast to classical Western TAAD data but showed a similar male predominance of 4:1 in both groups. There was no statistical difference in baseline comorbidities between the groups, hypertension in the medical history was numerically more common in the pandemic period, with 75% compared to 68.8% in 2019 ($P=0.7$). Regarding presenting symptoms, abdominal pain was numerically more common in the pandemic cohort (20% vs 6%, $P=0.3$), and syncope featured the pre-pandemic patients (25% vs 5%, $P=0.1$), respectively (Table 1).

All patients were deemed infected and operated on in a designated negative-pressure emergency theatre. Only the anaesthetist and operative department practitioner were present at the time of induction, when the highest possibility of airborne infection may occur. All team members wore double-layer skin protective apparel, N95 masks, and a face shield. Surgical strategies have not changed as the nature of the disease has not modified as well.

Strict donning and doffing procedures were followed, and all patients were transferred to negative-pressure isolation rooms in the ICU, and on the regular ward as well. The first PCR was obtained on arrival at our institution and did not affect the patient care pathways; all patients were isolated as potentially infected. The second PCR sample was taken on postoperative day one in the ICU, and the third on postoperative day 7, as directed

Table 1

Baseline clinical characteristics and outcomes of TAAD patients comparing the pre (2019)-and COVID-19 pandemic era (2020) at a tertiary cardiosurgical centre in the Middle East.

Variable	Pre-Pandemic group ($n=16$)	Pandemic group ($n=20$)	P
Age (years)	47.6 ± 18.7	50.6 ± 16.2	0.6
Male sex	13 (81.2)	17 (85)	0.7
Body mass index (kg/m^2)	31.6 ± 10.2	30.8 ± 8.7	0.8
Hypertension	11 (68.8)	15 (75)	0.7
Diabetes	1 (6.2)	2 (10)	0.7
Smokers	6 (37.5)	11 (55)	0.3
Presentation			
Chest pain	10 (62.5)	12 (60)	0.9
Syncope	4 (25)	1 (5)	0.1
Back pain	2 (12.5)	3 (15)	0.8
Abdominal pain	1 (6.2)	4 (20)	0.3
Complications and outcomes			
Hospital length of stay (days)	20 [10.8–56]	14.5 [8.5–53.3]	0.5
ICU length of stay (days)	5 [2.3–14.5]	5 [3.3–9.3]	0.4
Acute kidney injury	6 (37.5)	7 (35)	0.9
Ischaemia	3 (18.7)	4 (20)	0.9
Sepsis	3 (18.7)	2 (10)	0.6
In-hospital mortality	2 (12.5)	2 (10)	0.9

Values were reported as mean \pm SD or n (%) of patients, or median [IQR]. IQR, interquartile range; TAAD, type A aortic dissection.

by the health regulatory authority. Patient isolation was de-escalated after three negative PCRs. Of 20 patients, there were two de facto SARS-CoV-2 positives during their treatment in our institution, and their postoperative recovery was not significantly distinct from other cohort members.

Low rates of postoperative complications were registered in both groups, with no significant between-group difference in the rates of ischaemia or acute kidney injury. The pre-pandemic era showed numerically higher rates of septic complications (18.7% vs. 10%, $P=0.6$) and in-hospital mortality (12.5% vs. 10%, $P=0.9$). Length of hospital stay [20 (10.8–56) vs. 14.5 (8.5–53.3) days, $P=0.5$] and intensive care unit stay [5 (2.3–14.5) vs. 5 (3.3–9.3) days, $P=0.4$] were comparable between both groups. However, the small sample size in both groups precluded arriving at decisive conclusions supported by statistical significance for all the above-mentioned clinical outcomes (Table 1).

Discussion

In COVID-19 curfew periods, especially during the first pandemic wave, a lower number of cardiac emergencies were reported in several countries^[9,10]. Fear of infection with the novel coronavirus might have also contributed to a reduced number of patients seeking medical attention with sudden cardiac complaints^[9]. Nevertheless, patients suffering from acute coronary syndrome in the early pandemic faced longer total ischaemic time, leading to often critical pathophysiological status upon hospital admission and an increased rate of in-hospital adverse events^[9,11,12].

On the other hand, excessive activation of the renin-angiotensin system (RAS) leading to an uncontrolled surge of the phagocyte system is the main driver of adverse outcomes, including cardiovascular short-and long-term complications^[6,13,14]. Chronic processes, such as aortic aneurysm formation, involve the same pathomechanism^[15]; a potential RAS burst may lead to an acute transformation of the disease. Furthermore, RAS overactivation by the angiotensin-converting enzyme 2 blockade leads to hypertensive tendencies^[6], which may also provoke aortic dissections. In addition, limited outpatient follow-ups have negatively impacted the adequacy of management for chronic diseases, including hypertension^[3]. This might in part explain the reported increase in TAAD referrals during the first year of the pandemic, in this study. Additionally, since we are the only centre treating this devastating disease in the Emirate, a relatively constant number of about 15 patients per year were managed from 2015, the start of the operative activity, and such increase in the absolute number of cases cannot be ignored.

Despite that baseline comorbidities (including hypertension) were comparable between both groups, the presence of the disease in the history does not discriminate between the well- and uncontrolled individuals.

Emerging evidence suggested postponing cardiosurgical interventions by 7 weeks following an initial SARS-CoV-2 infection hence an increased risk of postoperative morbidity and mortality in patients with active COVID disease at the time of surgery^[16]. However, this decision must be based on the urgency of the condition requiring surgical intervention; in case of TAAD, no significant delay can be considered due to the nature of the disease. In terms of presentation of our cohort, symptoms were similar in both eras, and for triaging and perioperative surgical

patient management, our institution followed the guidelines issued by the American Heart Association and American College of Surgeons^[17]. Non-contrast chest computed tomography was performed in all preoperative surgical patients to search for early signs of SARS-CoV-2 parenchymal lung changes. However, TAAD patients underwent chest computed tomography angiography as part of the standard guideline-directed diagnostic procedure of the pathology.

Nevertheless, clinical features of post-acute COVID-19 infection may manifest even after 60 days of an initial infection, affecting the exacerbation of several chronic diseases, including hypertension and diabetes^[18]. Although we diagnosed only two acute PCR-positive patients in the cohort, it is unclear how many preoperative patients were affected by the hypertensive effect of post-acute COVID-19 syndrome, which may have eventually contributed to the incidence increase of TAAD in the pandemic period. The other, not a negligible confounder in the incidence increase was probably the reduced availability of chronic healthcare during the first curfew period.

As our institution is a member of a worldwide present healthcare organisation, temporary volunteer workforce reallocation from a less affected part of the globe assisted our emergency and ICU staff. Additionally, the number of ICU beds was more than doubled by upgrading high dependency wards, and the re-assignment of staff sufficiently covered the amended profile. Our institutional emergency medical services covered all necessary urgent patient transport requirements, even when other ambulance services might have been impacted by the pandemic healthcare crisis. Furthermore, postoperative digital visits via our organisational mobile application enabled outpatient care with no compromise, and medication home delivery services ensured well-tailored post-discharge aftercare.

Hospital resource utilisation and clinical outcomes of patients presenting with TAAD to our centre during the pandemic were comparable to the pre-pandemic phase outcomes, highlighting how the above-mentioned technical, structural departmental re-configuration, optimal personal protective equipment utilisation, and transformation of logistics facilitated patient care.

At the zenith of the first wave, disaster medicine triaging was close to being applied in operative medicine, including cardiac surgery in the most hit geographic areas^[19]. This was less of a concern regarding coronary bypass surgery; hence interventional cardiology treated most culprit lesions; operative heart failure therapies were often delayed with intensifying the medical management^[18]. A leading UK institution maintained a considerable volume of aortic valve surgical activity over the first wave COVID-19 outbreak for higher-risk patients without compromising postoperative outcomes. However, they expect a backlog of elective cases to develop, and sufficient planning of surgical activity normalisation is crucial^[20]. Nevertheless, two fields were in serious consideration regarding resource and treatment triaging; extracorporeal membrane oxygenation and acute aortic syndrome procedures. The former was influenced by limited number of devices at rapidly increasing demand in COVID-19-related severe cardiorespiratory failure, and the latter was due to intensive resource requirements and potential futile outcomes in malperfusion syndromes. Risk models existed because of limited resources, and discussions might have been held about futility of advanced individual pathologies, but fortunately, only a few

centres had to deal with ethical dilemmas of restricting care provided for high-risk patients^[19].

Limitations

The paper reflects a single-centre experience with a relatively low analysed patient number in a comparison period of 2 years. Our centre is the only medical facility providing acute TAAD care in the 67 340 km² geographical area. Therefore, pain-to-table time was not analysed due to the transport time variances; the in-hospital admission-related procedural times are standardised and constantly monitored. Nevertheless, conducting a multicentre study on institutional response to the early pandemic challenges in TAAD surgery would show only the average healthcare answers since both positive and negative outliers in outcomes would be masked by the mass effect. On the other hand, systematic reviews on the topic and assessing a mid-term timeframe could highlight practical approaches in acute patient care that may facilitate the improvement of institutional responses in future healthcare crises.

Conclusion

In this retrospective emergency aortic service assessment, we have demonstrated that with sufficient adaptation and optimisation of perioperative duties, the high-quality patient care in this critically endangered patient population was maintained on the pre-pandemic level, with comparable hospital length of stay and clinical outcomes despite the increased number of TAAD cases and constraints posed by the ongoing SARS-CoV-2 pandemic. Future studies are required to further investigate aortic care delivery during such challenging pandemics

Ethical approval

This study was approved by the Institutional Review Board and Research Ethics Committee.

Patient consent statement

Informed consent has been waived due to the study's retrospective nature.

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NA.

Author contribution

Y.M.: conceptualization, formal analysis, methodology, writing—original draft. G.B.: data curation, methodology, writing—original draft. N.K.: data curation, validation, writing—review and editing. T.A., Y.B., W.A., Y.A.J., A.B.: data collection, reviewing end editing. F.A.: methodology, writing—review and editing. V.K., S.S.: data curation, writing—review and editing. L.G.: conceptualization, data curation, investigation, methodology, supervision, validation, writing—original draft, writing—review and editing.

Conflicts of interest disclosure

The authors have nothing to declare.

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Guarantor

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Data availability statement

Data will be made available on request. Deidentified patient data will be available upon reasonable request.

Provenance and peer review

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Clinical trial registration

NA.

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NA.

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