Transfer Metrics in Patients With Suspected Acute Aortic Syndrome

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National guidelines by the American College of Cardiology, American Heart Association, and European Society of Cardiology have established benchmarks for patient transfer times (door-in-door-out time and door-to-balloon time) that serve as clinical performance measures for ST-segment–elevation myocardial infarction (STEMI) networks. Campaigns, such as D2B Alliance and Mission Lifeline, were also launched in an effort to reduce system delays in transfer and improve outcomes for subjects presenting with STEMI. This scrutiny on pre- and interhospital care has led to marked reductions in door-to-balloon times across the United States.

Unlike STEMI, acute aortic syndrome (AAS) defined as acute aortic dissection, intramural hematoma, or penetrating aortic ulcer is a less frequent clinical event that lacks an effective diagnostic biomarker and requires definitive imaging for confirmation. The time-sensitive nature of AAS, complexity of surgery, and endovascular intervention and the relative paucity of institutions that deliver 24/7 state-of-the-art care strongly advocates for regional systems of care across the United States. Successful transfer of patients with AAS has previously been described through such efficient regional care models. Our aim was to evaluate safety and timeliness of transfer provided by our regional aortic network. The transfer metrics served by this analysis will help us improve as a network and more importantly serve as a benchmark to be replicated and improved on by others.

Methods and Results

Our AAS network shares a common hotline with our STEMI and stroke networks. On activation, a transfer team is dispatched immediately to the referring center. The transfer system is operated by critical care trained nurse practitioners and paramedics, who are equipped in handling all cardiovascular emergencies under direct consultation with cardiac intensive care unit (CCU) physicians. The transfer team’s goal is to expedite safe transfer and optimize medical care during transfer for these patients. Transfer times were abstracted on consecutive patients transported with suspected AAS between March 2010 and May 2013. We defined total transfer time (TTT) and hospital-to-transfer delay (HT) as time from arrival of our transfer team at referring hospital to dispatch toward the tertiary center.

A total of 359 patients were transferred from 84 different regional medical centers in the given time frame. Mean age was 65 years and 58% were men. Transfers were accomplished by the institutional critical care transfer system using ground ambulance (n=83), helicopter (n=248), or fixed-wing jet (n=28) from referring centers directly to our CCU bypassing the emergency department. Comprehensive TTT and HT data were available for 307 patients. Median transfer distance was 66 km (interquartile range, 23–117), and median TTT was 88 minutes (interquartile range, 67–117). More than 3 quarters (76%; n=234/307) of the patients were successfully transferred to the CCU within 2 hours of network activation (Figure 1A). Median HT was 35 minutes (interquartile range, 25–47) and 39% patients (n=119/307) had HT <30 minutes (Figure 1B). The transfer mortality was 0% (n=0/359 patients), whereas in-hospital mortality of patients with type A dissection managed surgically was 4% (n=4/114) and for those managed medically alone was 30% (n=10/33). The survival curve (Figure 2) underestimates the true mortality for patients with type A dissection who did not receive surgery (primarily because of advanced age, comorbidities, and death before surgery) because a significant proportion of these patients (39%, n=9/23) were discharged in critical condition to hospice/palliative care facilities. Mortality of patients with confirmed type B dissection treated medically was 7% (n=8/120). Surgical intervention was performed in 32% of patients with type B dissection and mortality in this group was 5% (n=3/57). The remaining patients (n=35) were confirmed to have no aortic pathology after arrival to CCU and were labeled as false-positive network activations.

Comment

The low incidence of AAS, its heterogeneous clinical presentation, the lack of a diagnostic biomarker, and the emergent need for the performance and definitive interpretation of imaging studies all contribute to make timely diagnosis a challenge. Centers with therapeutic expertise in the management of acute aortic syndrome are relatively scarce and as a result transfer to these facilities is often warranted after diagnosis. It is likely that these diagnostic and transfer delays contribute to adverse outcomes, especially in the subset of patients with acute type A dissection. In this article, we report transfer times and outcomes for consecutive patients referred to our aortic network. We think that measuring and improving on these transfer metrics will serve as a benchmark to improve our performance over time. We acknowledge that although TTT and HT reflect the performance of the transfer team of the receiving hospital,
the ultimate system metric for a condition, such as type A dissection, will be time from symptom onset to definitive surgical intervention. However, we think that our approach with these current measures is an important first step, analogous to our experience with the transfer of patients with acute STEMI. Although the cardiology community realized the importance of total ischemic time from the onset, the initial focus was on optimal door-to-balloon and door-to-needle time because these performance metrics reflected system operations that could be modified at the hospital level. Once refined the focus then shifted to timely activation, transportation, and the development of regional systems of care with which we are now familiar. Similarly, we think that our current article will enable aortic centers to focus and refine their transfer times with an ultimate goal being to decrease time from initial clinical presentation to definitive therapy.

TTT in the setting of an AAS is clearly influenced by distance and mode of transport. Unlike STEMI, where increasing door-to-balloon is associated with worsened outcomes, similar data are unavailable in AAS. Although expeditious transfer to a center with surgical expertise is clearly warranted, especially in type A dissection, safety of transport seems to be the dominant concern. We have demonstrated safe and successful transfer of critical patients with AAS within a relatively short time frame (median TTT of 88 minutes). We also noted that HT constituted over a third of the TTT for patients transferred with AAS in our network. Unlike TTT, HT is independent of distance and mode of eventual transfer and is, therefore, a direct marker of system efficiency. This critical time is used in stabilizing patients, collection of patient clinical information, and recovery of diagnostic imaging studies performed before transfer. Standardized protocols for patient preparation and improved systems of care between referring center and transport teams can potentially decrease this important time interval.

A previous survey of 86 successive patients admitted to our CCU with aortic dissection before the establishment of our organized network reported an overall mortality of 18.6% (n=16/86) with a surgical mortality of 10%. In our current series

**Figure 1.** Frequency histogram demonstrating total transfer time (A) and handover time (B) for patients with suspected acute aortic syndrome.
after the creation of our network, we observed an overall mortality of 10% and a 4% surgical mortality. Our in-hospital mortality outcomes also compare favorably to the multicenter data published as part of the landmark aortic dissection registry (in-hospital mortality with type A dissection 34.9%). Although improved surgical techniques, surgical experience, transfer bias, sampling error, and early recognition are likely to be major determinants contributing to this difference, the contribution of an efficient network and timely transfer cannot be understated.

It is time that integrated, regional aortic networks are established and compared for quality of care, transfer times, and clinical outcomes. We have previously demonstrated that an efficient aortic network can use this transfer interval to optimize care in patients transferred with suspected AAS.4 Furthermore, times achieved by our transfer network provide foundation for further research on recognition of system delays in diagnosis and transfer in patients with aortic emergencies. We recognize that ultimately availability of total dissection time (ie, time from symptom onset to eventual transfer and door-in-door-out times) will have important prognostic implications for patients with suspected AAS. Our network transferred patients from 84 different regional centers many of which did not routinely acquire this important time interval. However, we have now started acquiring this data in our network protocol and will be analyzing this data going forward. Nevertheless, our preliminary attempt provides evidence of safety and timely transfer after system activation in patients with AAS. In conclusion, a robust and efficient aortic network is critical for improving clinical outcomes in patients with acute aortic emergencies. In the absence of standard clinical guidelines, the timings achieved by our regional network can serve as a yardstick for other similar aortic systems of care to emulate.

Disclosures
None.

References
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