

# Use of Arterial Catheters in the Management of Acute Aortic Dissection

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## Abstract

**Purpose:** The aim of this study was to investigate the relationship between the use of invasive arterial blood pressure (IBP) monitoring and reaching established aggressive medical management goals in acute aortic dissection.

**Methods:** Data were collected through a retrospective chart review of patients diagnosed with acute aortic syndromes of the thoracic cavity who required transport to tertiary care over a 28-month period. The 2010 American Heart Association medical management goals of thoracic aortic disease were used as hemodynamic end points.

**Results:** A total of 208 patients were included, with 113 (54%) diagnosed at least in part with acute Stanford Type A aortic dissections and the remaining 95 (46%) having isolated Stanford Type B dissections. Emergency departments made up 158 (76%) of transfer departments; 129 (62%) patients had IBP catheters placed. The highest mean systolic blood pressures (SBPs) recorded were 165 mm Hg in the IBP group versus 151 mm Hg when noninvasive blood pressure (NIBP) cuffs were used ( $P < .01$ ). The mean decrease in SBP during transport was 51 mm Hg in the IBP group versus 34 mm Hg in the NIBP group ( $P < .001$ ). The difference between the last reported NIBP and the first IBP was noted as 19 mm Hg higher. The IBP group met the SBP goal more frequently than the NIBP group ( $P < .05$ ) when the SBP was noted as greater than 140 mm Hg during transport. Bedside time increased only 6 minutes with IBP placement ( $P < .007$ ).

**Conclusion:** Patients with IBP catheters were noted to be more aggressively managed with antihypertensive medications, met

hemodynamic goals more frequently, and had only 6 minutes longer bedside times. These findings support the placement of IBP catheters by emergency departments and critical care transport (CCT) teams in patients with acute aortic syndromes requiring interfacility transport to definitive care.

## Introduction

Acute aortic dissections (AoDs) are life-threatening emergencies associated with high mortality. There are 6,000 to 10,000 new cases of recognized AoDs every year in the United States; approximately 40% of patients die immediately with rupture of the aorta, 1% die every hour after the start of the dissection, and between 5% and 20% die perioperatively.<sup>1</sup> Advances in surgical treatment methods over the last decade have decreased patient mortality; however, ensuring that these patients reach appropriate definitive care remains an ongoing challenge. Even after a prompt diagnosis in the emergency department, patients may still require transport to larger tertiary centers for surgical intervention or endovascular repair.

Aggressive medical management through anti-impulse and blood pressure control strategies has long been used since first proposed by Wheat et al<sup>2</sup> in contention with the landmark DeBakey et al<sup>3</sup> study 4 years earlier recommending surgical intervention in all acute AoDs. Aggressive medical management of heart rate and blood pressure has been shown to help decrease extension of the AoD and maximize the patient's likelihood of reaching the operating room. In 2010, the American Heart Association (AHA), in collaboration with multiple other nationally recognized organizations, developed practice guidelines to assist clinicians in the diagnosis, management, and prevention of acute AoD of the thoracic aorta. These guidelines establish a stepwise approach to meeting specific hemodynamic goals of a heart rate (HR) less than 60 beats per minute (bpm), pain control, and systolic blood pressure (SBP) less than 120 mm Hg<sup>1</sup> (Fig. 1).

The relationship between methods of blood pressure monitoring (invasive arterial blood pressure [IBP] catheter vs. non-invasive blood pressure [NIBP] cuff) and how quickly AoD patients meet the established SBP goal has not previously been observed. Currently, the majority of blood pressure measurements in AoD patients are obtained through NIBP measurements, which have been shown to underestimate the true SBP, overestimate diastolic blood pressure, and provide only intermittent data.<sup>4-7</sup> Given these limitations, early institution of IBP monitoring may be a preferable alternative to

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NIBP measurements in the acute AoD population. Several studies have recognized that arterial catheters provide the most accurate method of continuous monitoring of blood pressure. One review also noted that nonphysician providers with proper training and education could safely place IBP catheters.<sup>8</sup> However, no studies currently exist addressing IBP placement within the context of medical transport, specifically comparing time as the key factor in reaching specific hemodynamic goals and controlling hypertension. Therefore, the aim of this study was to investigate the relationship between the use of IBP monitoring and reaching established aggressive medical management goals in acute AoD for patients undergoing medical transport.

## Methods

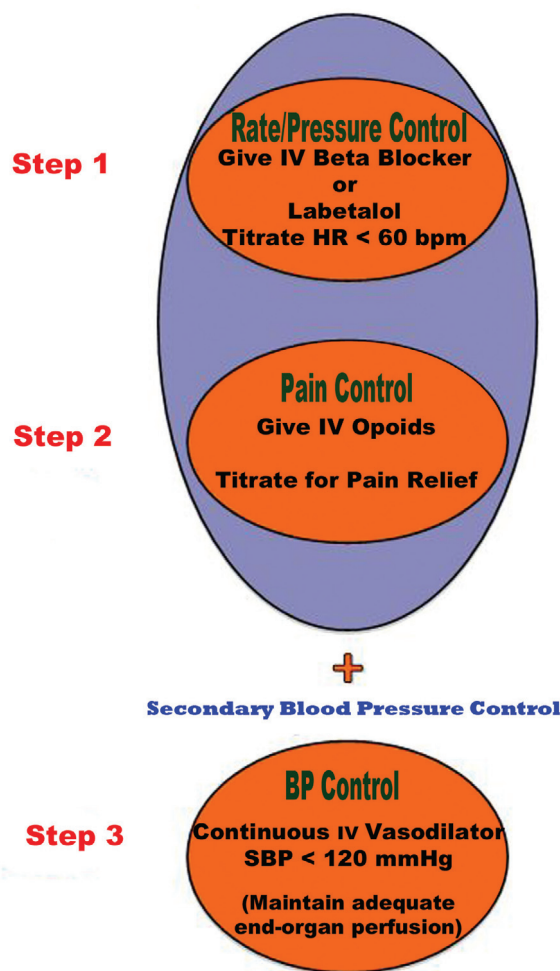
### Design

This was a retrospective cohort study of all nontraumatic thoracic AoDs transported by a critical care transport (CCT) team from a 1,300-bed tertiary care center in the Midwest United States between January 2010 and April 2012. The study was part of a quality improvement program targeted toward the development of best practices regarding CCT in this population. Patients were divided into 1 of 2 cohorts based on the method of blood pressure monitoring during transport (IBP vs. NIBP). The CCT team is unique in that it involves a crew configuration not traditionally used in the field. The team includes a critical care nurse and a paramedic led by an acute care nurse practitioner (ACNP) and uses ground, rotor, and fixed wing modes of transport that are staffed 24 hours a day, 7 days a week. The ACNP has prescriptive authority and hospital privileges that allow for individualized care to be provided instead of a universal standard protocol for every patient. Each ACNP decided independently whether or not to place an IBP catheter for hemodynamic monitoring and what specific medications to administer to reach AHA goals based on the preferred methods of the receiving hospital. The specific extremity chosen for IBP placement was a critical decision that incorporated knowledge of patient anatomy, location of dissection, and assessment of perfusion to that artery.

### Study Sample

All patients transferred by the CCT team by air (rotor or fixed wing) to the 1,300-bed tertiary care center with a confirmed diagnosis of acute AoD were eligible for inclusion. AoD was defined as any aortic dissection with a component above the diaphragm as well as intramural hematomas confirmed by either a board-certified radiologist (via computed tomographic imaging, magnetic resonance imaging, or ultrasound) or direct visualization in the cardiac catheterization laboratory. Because electronic medical record documentation was only available for patients transported by air, those transported by ground were excluded from this analysis. Patients whose SBP never exceeded 140 mm Hg were also excluded from the HR and SBP analysis because IBP catheters may not have an effect on SBP management in patients who are not

**Figure 1. Initial Medical Management Aortic Wall Stress<sup>1</sup>**



hypertensive. The AHA defines stage 1 hypertensive as having an SBP from 140 to 159 mm Hg, and, therefore, 140 mm Hg was chosen as the cutoff. There were no cases identified in which patients refused IBP placement during transport.

### Data Sources

Eligible patients were identified using the CCT program's quality monitoring database. Clinical coordinators from the CCT program enter patient information into this database at the end of each transport using a standardized electronic form including, but not limited to, patient identifiers, referring diagnosis, and mode of transport. This database was designed by a single trained analyst who is responsible for database quality monitoring. Patient identifiers were then used to access the electronic medical records (EMRs), including the tertiary care hospital's Epic System (Verona, Wisconsin), and the transport team's Golden Hour (San Diego, California) charting program. These EMRs are used in air medical transport nationally as reliable programs for both interhospital documentation and billing. A single data collection nurse with expertise in data management and familiar with the CCT database identified and collected all data points using a standardized data collection form.

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