Submitted: 26 October, 2023 Accepted: 24 November, 2023 Published: 08 March, 2024 DOI:10.22514/sv.2024.027

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Signa Vitae

ORIGINAL RESEARCH

Quality of inter-facility transfer for Type A aortic dissection patients in a medical center in Taiwan: a retrospective observational study

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Abstract

Inter-facility transfer of patients with type A aortic dissection (AD) requires timely and efficient medical care. However, the quality of care provided during the transfer remains largely unknown. This study aimed to evaluate the quality of care of patients with type A AD who underwent inter-facility transfer at a single medical center in Taiwan. This retrospective cohort study enrolled all patients with type A AD who underwent inter-facility transfer between January 2017 and December 2019. Patients with complete transfer records and electronic medical charts in the emergency department (ED) were included. Patients who experienced a cardiac arrest episode before transfer were excluded due to poor outcomes. Patients were divided into two groups based on their hemodynamic status: the ideal group with values within the desirable range heart rate (HR) <60 bpm and systolic blood pressure (SBP): 100–120 mmHg and the control group with values out of range (HR >60 bpm or SBP <100 or >120 mmHg) before the transfer. We conducted an analysis of variations of hemodynamic status after the transfer. Among the 378 patients transferred with type A AD, 36 (31.9%) in the ideal group and 255 (96.2%) in the control group experienced hemodynamic deterioration after the transfer. In the ideal group and control group, the presence of nurses and emergency physicians assisting in the transfer accounted for only 6.2% and 7.95%, respectively. The ideal group had a significantly better survival outcome (adjusted OR (aOR): 1.25, 95% confidence interval (CI): 1.12–2.45) compared to the control group. The quality of inter-facility transfer in patients with type A AD is inadequate. Hemodynamic deterioration should be managed by ambulance crews during the transfer.

Keywords

Type A aortic dissection; Emergency department; Transfer safety; Inter-facility transfer

1. Introduction

Type A aortic dissection (AD) is among the most formidable and life-threatening conditions encountered in the emergency department (ED), with a high mortality rate if left untreated promptly [1, 2]. A previous study has indicated that the mortality rate of type A AD is 1%–2% per hour following the onset of symptoms [3]. Emergent surgical interventions have been identified as the sole effective treatment for type A AD [4–6]. However, not all hospitals possess the necessary capabilities to perform such emergent surgeries, as this always necessitates the presence of a cardiovascular surgeon on duty and the availability of an intensive care unit following the diagnosis of type A AD [7, 8]. Therefore, in Taiwan, local or regional hospitals inevitably need to transfer critical patients. Before transferring these patients to the operating room, emergency physicians in both the transferring and receiving hospitals must ensure adequate pain control, hemodynamic stability (systolic blood pressure (SBP): 100–120 mmHg and heart rate (HR) <60 bpm), and airway support to minimize the risk of disease progression [9–11].

To date, no established protocol has been developed to guide such critical inter-facility transfers in Taiwan. Given that the transferring staff may encounter numerous uncertainties during the transfer process, such as alterations in consciousness, dyspnea due to aortic valve regurgitation resulting from the progression of type A AD, cardiac tamponade, elevated blood pressure induced by pain, or inadequate hemodynamic management before and during the transfer, the risk of cardiac arrest occurring during the process is even more severe [12, 13]. Consequently, it is imperative to investigate and analyze the quality of current inter-facility transfers, considering variations in hemodynamic status before and after the transfer and the composition of the ambulance staff [14, 15] responsible for the patient's care throughout the transfer process.

While a limited number of studies [12, 16] have explored the safety of inter-facility transfers for patients with type A AD, it is crucial to prioritize these transfers to enhance the quality of care and the chances of survival. Therefore, this study aims to assess the quality of care provided to patients with type A AD who undergo inter-facility transfers at a single medical center in Taiwan.

2. Material and methods

2.1 Study setting and databases

We conducted a retrospective cohort study by reviewing the electronic medical charts and transfer records at a medical center in northern Taiwan. Chang Gung Memorial Hospital (CGMH) Linkou is an urban academic tertiary care hospital with approximately 170,000 ED visits per year [17]. As a medical center, CGMH Linkou is responsible for managing a wide range of diseases that require specialized treatment, such as intra-arterial thrombectomy (IAT) or tissue-type plasminogen activator for ischemic stroke, emergent panendoscopy for active upper gastrointestinal bleeding, major trauma, ST-elevation myocardial infarction (STEMI), and patients who require emergency surgery, including type A AD, ischemic bowel, or hollow organ perforation.

The transfer model works as follows: (1) the transferring hospital contacts the CGMH emergency department (ED) by the cellphone or local telephone system; (2) our ED contacts the relevant department based on the patient's specific needs, such as the cardiovascular surgeon, IAT team or STEMI team; (3) we confirm that the necessary resources, such as an operating room or intensive care unit (ICU) bed, are available; (4) we inform the transferring hospital that our resources are available; and (5) the transferring hospital collaborates with its ambulance system to initiate the transfer process.

In general, all hospitals have a limited capacity to manage emergent illnesses due to the unavailability of medical personnel, regardless of their level (local, regional or medical center). Therefore, transferred patients frequently contacted our ED during the night shift (16:00–08:00). In Taiwan, there are three levels of emergency medical technicians (EMTs): EMT-1 (40 hours of training), EMT-2 (280 hours of training), and EMT-P (1280 hours of training) [17]. EMT-1 provides basic life support (BLS), BLS encompasses fundamental interventions, including oxygen therapy, monitoring, cardiopulmonary resuscitation (CPR), and the use of automated external defibrillators (AEDs). EMT-2 can perform tasks such as setting up peripheral lines to administer fluids, checking blood sugar levels, providing oral glucose, performing lacrimal irrigation, assisting patients with sublingual nitroglycerin, and managing advanced airways laryngeal mask airway (LMA) or I-gel for unconscious patients or those in cardiac arrest. EMT-P offers advanced life support (ALS), including procedures like intubation and administering medications like epinephrine or amiodarone intravenously or intraosseously in cases of cardiac arrest, and the use of transcutaneous pacing (TCP) following established prehospital protocols. In general, ambulance staff handle patient complaints and manage emergency situations like changes in consciousness, difficulty breathing or shock. However, EMTs cannot independently adjust medications based on established protocols when a patient's hemodynamic status deteriorates during transport. Medications adjustment require a nurse to follow a physician's orders, such as titrating or tapering antihypertensive medications based on blood pressure or heart rate variations.

2.2 Study population

Fig. 1 illustrates the conceptual research model. We analyzed all patients with type A AD who experienced inter-facility transfers to a single medical center in northern Taiwan from January 2017 to December 2019. Only adult patients with intact transfer records and electronic medical charts in the ED were included in this study. Patients who experienced a cardiac arrest episode before transfer were excluded due to poor outcomes. Patients were divided into two groups based on their hemodynamic status: the ideal group with values within the desirable range (HR <60 bpm and SBP: 100–120 mmHg), and the control group with values out of range (HR >60 bpm or SBP <100 or >120 mmHg) before transfer. The ambulance staff were directed to evaluate patients' vital signs both before and during the transfer, with an additional check before the patient left the ambulance. Additionally, more intensive monitoring would be initiated if clinical deterioration occurred.

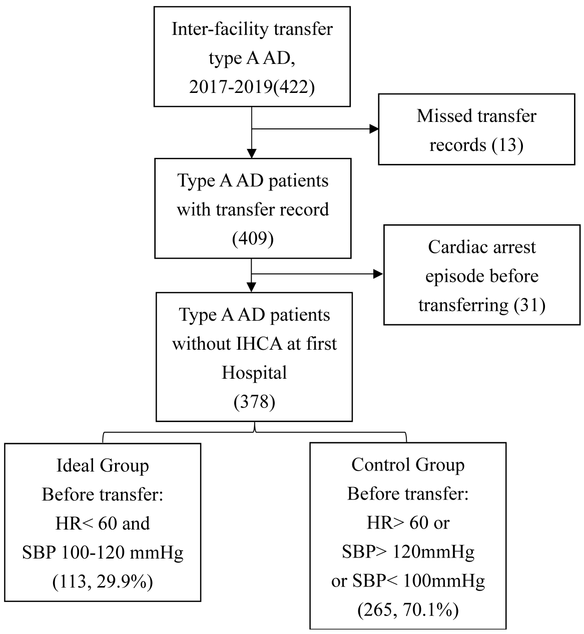

FIGURE 1. Study algorithm. Abbreviations: AD: Aortic dissection; IHCA: in-hospital cardiac arrest; HR: Heart rate; SBP: Systolic blood pressure.

2.3 Data collection

A trained study assistant reviewed the de-identified computer-based registry records and conducted data abstraction by using a standard reporting template with clear definitions and codes. Demographic data and transferring covariates were collected from the transfer of handwritten records and receiving hospital electronic medical records, including the transferring hospital, response time interval, scene time interval, transport time interval, staff composition on the ambulance, age and sex of the patients, final vital signs (including Glasgow Coma Scale, temperature, heart rate, respiratory rate, blood pressure and SpO_2) before transferring at the transferring hospital, in-hospital cardiac arrest at the transferring hospital, whether under hemodynamic control or inotropic agent support, intubation or noninvasive airway support, pericardiocentesis before transfer, and vital signs at triage in the receiving hospital. The final disposition of patients with type A AD in emergency department or upon admission was also recorded.

The response time interval was defined as the time from transferring the hospital call to ambulance arrival, the scene time interval was defined as the time from ambulance arrival to departure from the transferring hospital, and the transport time interval was defined as the time from departure from transferring the hospital to arrival at the receiving hospital. The definition of hemodynamic deterioration was (1) HR or BP became out of the desirable range (HR >60 bpm or SBP <100 or SBP >120 mmHg) whether patients had already received medications (anti-hypertensive medications or inotropic agents) or not. (2) Conscious change. (3) Respiratory rate became >29 or <10 per minute. (4) SpO_2 <90% after the transfer.

2.4 Outcome of interest

We recorded significant medical interventions conducted both before and after the transfer to address these critical situations, including procedures like intubation, pericardiocentesis and blood pressure management in Table 1. Besides, we believe that during the transfer of Type A AD patients, the most critical situations for the staff include out-of-hospital cardiac arrest, respiratory failure, altered consciousness and hemodynamic deterioration. Therefore, we gathered data on these factors in Table 2.

The composition of ambulance staff responsible for the transfer of patients with type A AD were also collected to present the ability to provide emergency care in current condition (Table 3). The primary outcome measure was survival to the operating room, and the secondary outcome was survival to discharge after surgery (Table 4).

2.5 Statistical analyses

To analyze the data, we considered several variables, including sex, age, vital signs at transferring and receiving hospital, invasive procedures such as intubation or pericardiocentesis, hemodynamic management or inotropic agent support, inter-facility transfer time interval, disposition of patients, and composition of staff in the ambulance. Categorical variables are presented as numbers and percentages and were compared using the χ^2 test. Continuous variables are presented as mean and standard deviation (SD). The Student's *t*-test was used for normally continuous variables. Multiple logistic regression models were built to show the relationship between patient outcome and the two group. The adjusted OR (aOR) was reported with a 95% confidence interval (CI) and factors including age, gender, vital sign at receiving hospital, inter-facility transfer interval and staff composition. Data were analyzed using the SPSS software (IBM SPSS Statistics for Windows, version 20.0; IBM Corp, NY, USA). Statistical significance was set at $p < 0.05$.

3. Results

3.1 Demographic and clinical characteristics of patients

All patients with type A AD who underwent inter-facility transfer from neighborhood hospitals to the CGMH between 2017–2019 were included in our study. Of the total number of patients, 378 had intact transfer records and did not experience any cardiac arrest episodes before the transfer, as shown in Fig. 1. Among these patients, only 113 (29.89%) had a heart rate and systolic blood pressure (SBP) within the ideal range before transfer. 45.1% and 12% of patients received anti-hypertensive medications before the transfer in the ideal and control group, respectively. And there were 9.7% and 8.3% of patients who received inotropic agents before the transfer in the ideal and control group, respectively (Table 1).

At triage in the receiving hospital, only 23.0% of the patients had vital signs within the ideal range, as shown in Table 1. Hemodynamic management was initiated at the receiving hospital, including intubation (12.4%), pericardiocentesis (10.6%), medication to control SBP >120 mmHg (63.8%), and inotropic agent support (8.2%). Thirteen (3.4%) patients experienced cardiac arrest during transportation. The average transfer distance was 30.2 km, and the average response, scene, and transport time intervals were 21.9, 5.3 and 18.2 min, respectively (Table 1). Among the 378 enrolled patients, 293 (77.5%) survived to the operating room and 247 (65.3%) survived to discharge.

Fig. 2 indicates that, following transfer, 36 patients (31.9%) in the ideal group exhibited hemodynamic status beyond the acceptable range. In the control group, 255 patients (96.2%) remained outside the desired range upon arrival at the receiving hospital's triage. Table 2 illustrates the percentage of deterioration in the ideal group based on various hemodynamic parameters: change in consciousness (20.4%), SBP: 100–120 mmHg to SBP <100 mmHg (6.2%), SBP: 100–120 mmHg to SBP >120 mmHg (25.7%), HR ≤60 to HR >60 (22.1%), respiration rate (RR) 10–29 to RR >29 (15.9%), RR 10–29 to RR <10 (19.5%), and SpO_2 ≥90% to SpO_2 <90% (25.7%).

Table 3 displays the crew composition in an ambulance, excluding drivers. The prevalent crew composition in the ideal group consisted of one nurse in 47 cases (41.6%), while in the control group, this composition was observed in 105 cases (39.6%). Notably, the participation of nurses and emergency physicians in assisting the transfer was only 6.2% in the ideal group and 7.9% in the control group (Table 3).

TABLE 1. Patient characteristic.

Variables	Total numbers (N = 378)	Ideal group (N = 113)	Control group (N = 265)	*p* value
Age, mean (SD)	56.2 (22.1)	58.9 (17.2)	55.1 (24.2)	0.377
Gender				
Female, n (%)	116 (30.7)	32 (28.3)	84 (37.5)	0.094
Male, n (%)	262 (69.3)	81 (71.7)	181 (62.5)	
Vital sign at receiving hospital				
Within range, n (%)	87 (23.0)	77 (68.1)	10 (3.8)	<0.001
Out of range, n (%)	291 (77.0)	36 (31.9)	255 (96.2)	
Before transferring				
ER Intubation, n (%)	53 (14.0)	22 (19.5)	31 (11.7)	0.007
ER Pericardiocentesis, n (%)	17 (4.5)	5 (4.4)	12 (4.5)	
Hemodynamic management*, n (%)	83 (22.0)	51 (45.1)	32 (12.0)	
Shock with inotropic agents, n (%)	33 (8.7)	11 (9.7)	22 (8.3)	
After receiving				
ER Intubation, n (%)	47 (12.4)	20 (17.7)	27 (10.2)	0.008
ER Pericardiocentesis, n (%)	40 (10.6)	12 (10.6)	28 (10.6)	
Start hemodynamic management, n (%)	241 (63.8)	50 (44.2)	191 (72.1)	
Start inotropic agents, n (%)	31 (8.2)	11 (9.7)	20 (7.5)	
Transfer distance, km (SD)	30.2 (6.8)	31.1 (6.5)	28.8 (7.4)	0.188
Inter-facility transfer interval				
Response time, mins (SD)	21.9 (4.8)	23.3 (4.7)	20.0 (5.2)	0.125
Scene time, mins (SD)	5.3 (3.9)	6.1 (4.2)	5.0 (3.7)	0.439
Transport time, mins (SD)	18.2 (7.0)	19.2 (7.4)	17.5 (6.2)	0.216
OHCA during transfer, n (%)	13 (3.4)	4 (3.5)	9 (3.3)	0.812
Outcome				
Survival to OR, n (%)	293 (77.5)	102 (90.3)	191 (72.1)	<0.001
Survival to discharge, n (%)	247 (65.3)	83 (73.5)	164 (61.9)	0.031

**Use of medication for systolic blood pressure control <120 mmHg. Abbreviations: ER: Emergency room; OR: operating room; SD: Standard deviation; OHCA: out-of-hospital cardiac arrest.*

TABLE 2. Ideal group Type A AD patients who deteriorate during transport.

Variables	Total N = 113	Survival to OR N = 102	Survival to discharge N = 83
Conscious change, n (%)	23 (20.4)	20 (19.6)	17 (20.5)
SBP 100–120 to SBP <100, n (%)	7 (6.2)	4 (3.9)	2 (2.4)
SBP 100–120 to SBP >120, n (%)	29 (25.7)	25 (24.5)	19 (22.9)
HR ≤60 to HR >60, n (%)	25 (22.1)	24 (23.5)	20 (24.1)
RR 10–29 to RR >29, n (%)	18 (15.9)	15 (14.7)	12 (14.5)
RR 10–29 to RR <10, n (%)	22 (19.5)	10 (9.8)	5 (6.0)
SpO_2 ≥90% to SpO_2 <90%, n (%)	29 (25.7)	25 (24.5)	19 (22.9)

Abbreviations: SBP: systolic blood pressure; HR: heart rate; RR: respiratory rate; SpO_2: peripheral oxygen saturation; OR: operating room.

TABLE 3. Staff composition during inter-facility transfer on the ambulance.

Variables	Ideal group (N = 113)	Control group (N = 265)
EMT1, n (%)	18 (15.9)	40 (15.1)
EMT2, n (%)	34 (30.1)	86 (32.5)
Nurse, n (%)	47 (41.6)	105 (39.6)
EMT1 + nurse, n (%)	4 (3.5)	5 (1.9)
EMT2 + nurse, n (%)	3 (2.7)	8 (3.0)
Nurse + physician, n (%)	7 (6.2)	21 (7.9)

Abbreviations: EMT: emergency medical technician.

TABLE 4. Result of logistic regression analysis of survival to operation room and survival to discharge.

Variables	Survival to OR		Survival to discharge	
	aOR (95% CI)	*p* value	aOR (95% CI)	*p* value
Ideal Group	1.252 (1.121–2.453)	0.014	1.131 (1.084–3.021)	0.031
Control Group	Reference group		Reference group	
Vital sign in ideal Group				
Within range at receiving hospital	1.476 (0.834–2.416)	0.197	1.385 (1.109–3.781)	0.021
Out of range at receiving hospital	1.024 (0.219–2.111)	0.764	0.918 (0.351–1.767)	0.662
Vital sign in control Group				
Within range at receiving hospital	1.112 (0.603–1.940)	0.792	0.967 (0.948–1.015)	0.872
Out of range at receiving hospital	Reference group		Reference group	

Abbreviations: aOR: adjusted OR by age, gender, vital sign at receiving hospital, inter-facility transfer interval and staff composition; 95% CI: 95% Confidence interval.

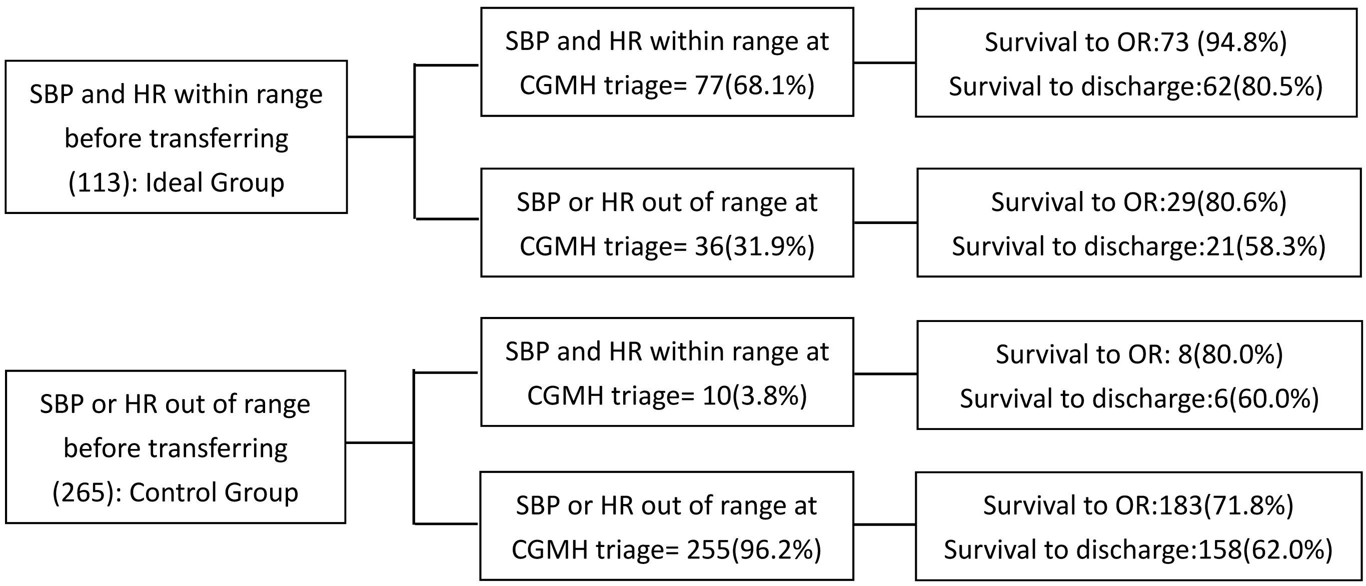

FIGURE 2. Variation of hemodynamic status of Type A aortic dissection patients before and after transferring. CGMH: Chang Gung Memorial Hospital; OR: operating room; HR: Heart rate; SBP: Systolic blood pressure.

3.2 Multivariable logistic regression analysis for primary outcomes

The outcome analyses, based on survival-to-OR and survival-to-discharge, for both the ideal and control groups are presented in Table 4. The adjusted odds ratios (aOR) were 1.25 (1.12–2.45) and 1.13 (1.08–3.02), respectively. When compared to the reference group (vital signs out of range at the receiving hospital in the control group), the ideal group, with vital signs within the desirable range at the receiving hospital, exhibited a favorable survival-to-discharge outcome (aOR: 1.39 (1.11–3.78)) (Table 4).

4. Discussion

This study aimed to assess the quality of care of patients with type A AD who underwent inter-facility transfer [12, 13, 18]. The control group had significantly higher percentages of vital signs out of the target range after the transfer, with 96.2% at the receiving hospital's triage and 72.1% starting hemodynamic management promptly upon arrival. Despite well-controlled vital signs in the ideal group of patients with type A aortic dissection, 36 patients (31.9%) experienced hemodynamic deterioration during the transfer. In patients with type A aortic dissection, well-controlled vital signs were associated with better survival outcomes in ideal group (aOR, 1.13 (1.08–3.02); and no deterioration after the transfer in ideal group (aOR, 1.39 (1.11–3.78)).

Greg Winsor *et al.* [10] reported that among patients undergoing inter-facility transport for suspected acute aortic dissection, antihypertensive medications were administered in only 23 out of 42 cases (54.8%) at the transferring hospital. In 20 out of 62 cases (32.3%), the air EMS agency initiated antihypertensive therapy, which was successful. Our analysis yielded similar findings. Among 378 patients with type A aortic dissection undergoing inter-facility transfer, hemodynamic therapy was frequently omitted and often inadequate, occurring in 70.1% of cases, highlighting the potential for intervention by EMS. Improving the quality of care should be a focus for both referring hospitals and transport services [8, 19, 20].

Before transfer, only 29.8% of the patients with type A AD had a HR (<60 bpm) and SBP of (100–120 mmHg) (Table 1). This result implied that most patients with type A AD received inadequate hemodynamic management at the transferring hospital. From the perspective of transfer safety [16, 18, 21], inadequate hemodynamic management before transfer could have adverse effects on inter-facility safety, such as accelerating the progression of type A AD due to persistently uncontrolled SBP and HR [12]. The transfer staff should request the transferring hospital to provide better hemodynamic management before transfer [16].

Patients who experience a decline in consciousness and respiratory distress may require appropriate airway support. Invasive airway support options such as LMA, I-gel, or intubation may be considered for patients exhibiting agonal breathing or experiencing cardiac arrest. Consequently, the ability of the ambulance staff responsible for patient care to provide Advanced Life Support (ALS) is crucial [17, 22]. However, in accordance with the training courses for EMT and Emergency Medical System (EMS) protocols in Taiwan, only EMT-2 and EMT-P can perform intubation on unconscious patients (Glasgow Coma Scale: 3) or those in cardiac arrest [17]. In the ideal group, 18 patients (15.9%) encountered respiratory deterioration, characterized by respiratory rates surpassing 29 (RR >29), while 22 patients (19.5%) demonstrated respiratory deterioration, dropping below 10 (RR <10). The occurrence of respiratory failure in these cases may be linked to the advancement of Type A aortic dissection, involving acute heart failure associated with aortic valve complications or shock resulting from cardiac tamponade [2, 4, 14]. We present instances of respiratory deterioration observed during patient transfers in ambulances. Our recommendation is that ambulance staff should possess the capability to manage critical conditions beyond simply titrating oxygen supply (*e.g.*, transitioning from nasal cannula to mask use). Performing routine intubation before transferring to target hospital is not always necessary [13, 23], but for the sake of patient safety, when there is a possibility of respiratory failure, ambulance staff should be equipped with the ability to manage it immediately [12]. In other words, the level of staff in the ambulance participated in the transfer should have protocol to be followed to ensure patients' transfer safety [16]. We recommend one physician, and one nurse should participate the transfer of type A AD [24]. Furthermore, the integration of telemedicine into the current inter-facility transfer system can be considered to ensure continuity of care [25, 26].

Considering hemodynamic management during transfer, an established protocol is needed to enable staff to regulate medication (antihypertensive or inotropic agents) according to the patients' hemodynamic variation [27]. In Taiwan, nurses can adjust the dose of medication under the guidance of a set-up protocol or order, but EMTs are not allowed to do so. We suggest medical directors in the transfer network should establish protocols of transfer safety, especially in critical illness [12, 16]. (type A AD, active upper gastrointestinal bleeding, intracranial hemorrhage, acute coronary disease...*etc*.) Besides, we should pay more attention to transfer safety through establishing ambulance regulations by relevant department (fire department or health authority) and promoting education course about transfer safety in staff (EMT, nurse and physician) might participate in the transfer [16, 20, 27].

Furthermore, emergent pericardiocentesis should be performed immediately to sustain hemodynamic stability if cardiac tamponade is caused by type A AD itself [4, 7]. However, this invasive procedure can only be performed by an emergency physician during transfer. By analyzing the deterioration ratio of type A AD, we attempted to emphasize the importance of inter-facility safety by determining whether the current staff composition during the transfer could provide appropriate management once the situation deteriorated [28, 29].

In Taiwan, no standard inter-facility transfer protocol has been established for our emergency medical service system. In general, local or regional hospitals transfer patients to medical centers through collaborative private ambulance. However, in the past, little attention was paid to the relevant departments (fire department or Department of Public Health) or each-level hospitals on the issue of inter-facility transfer. We propose that medical directors (MDs) in the emergency departments of all hospitals in the regional network of inter-facility transfers [30] should be responsible for this issue [13, 16]. Based on the medical oversight of the EMS system, the design of the delivery system and EMS provider levels are both related to safety and quality of care during the transfer [12, 28]. Clear guidelines exist for defining and regulating the current official EMS system, including pre-arrival instructions, dispatch, transport vehicles, EMS provider levels, service delivery models, equipment designs, and transportation protocols. However, private ambulances have received limited attention.

In critical transfers such as Type A AD, STEMI, epidural hemorrhage, or major trauma, official emergency medical services (EMS) should be integrated into the inter-facility transfer to ensure that the response time interval is sufficiently short [31]. Moreover, established protocols are needed to guide each inter-facility transfer, whether official or private EMS, including staff composition, whether ALS could be provided, and advanced directives by medical directors [12, 27]. Furthermore, improvement in the quality of inter-facility transfers can only be achieved by following established transfer protocols. By analyzing the transfer and medical records of the receiving hospital, accumulating experience, and revising the protocol, we could provide better quality and safety of inter-facility transfer. Finally, education designed for inter-facility transfers is crucial for both official and private EMS systems [13, 16]. Likewise, medical directors are responsible for promoting education courses on inter-facility transfer safety. Overall, we found that rapid deterioration of vital signs often occurs during inter-facility transfers. Effective control of vital signs of patients with type A AD within the appropriate range can contribute to their survival and prognosis.

5. Limitations

This study has the following limitations. Firstly, the absence of a dedicated column for pain scale analysis in the standard handwritten transfer record precluded an examination of pain levels. Generally, suboptimal pain control is associated with elevated heart rate and systolic blood pressure (SBP). Second, there is no recorded medication history or dosage information for intubated patients during the inter-hospital transfer process. However, it is important to note that sedative medications may impact the hemodynamic status during the transfer process. Finally, there is no documentation indicating whether an adequate dosage of medications was administered for hemodynamic management based on each patient's characteristics, such as body weight. The patient's physiological characteristics may also influence the prognosis.

6. Conclusions

This study revealed Type A AD patients within the desirable range of vital signs have better survival chances. Moreover, the quality of inter-hospital transfers for patients with type A aortic dissection is inadequate. When patients with type A aortic dissection undergo hemodynamic deterioration during transfer, the existing staff composition limits providing additional hemodynamic management. Consequently, we recommend that medical directors prioritize the safety of inter-facility transfers within the EMS system to uphold the standard of care.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of this study are available from the first author upon reasonable request (e-mail: rainccy217@gmail.com).

AUTHOR CONTRIBUTIONS

SLT—conceived and designed the study. SLT, CJN and CCL—collected the data. CJN, MFW and CHH—managed the data, including quality control. LHT and CYC—analyzed the data; contributed substantially to its revision; takes responsibility for the paper as a whole. SLT and CBC—drafted the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Hospital Ethics Committee on Human Research of Chang Gung Medical Foundation (IRB202201895B0). The study protocol was reviewed and the need for informed consent was waived.

ACKNOWLEDGMENT

Thanks to Wallace Academic Editing for editing this manuscript.

FUNDING

This study did not receive any specific grants from funding agencies in the public, commercial, or not-for-profit sectors.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Carrel T, Sundt TM, von Kodolitsch Y, Czerny M. Acute aortic dissection. The Lancet. 2023; 401: 773–788.

[2] Zhu Y, Lingala B, Baiocchi M, Tao JJ, Toro Arana V, Khoo JW, *et al*. Type a aortic dissection—experience over 5 decades. Journal of the American College of Cardiology. 2020; 76: 1703–1713.

[3] Daily PO, Trueblood HW, Stinson EB, Wuerflein RD, Shumway NE. Management of acute aortic dissections. The Annals of Thoracic Surgery. 1970; 10: 237–247.

[4] Hackett A, Stuart J, Robinson DL. Thoracic aortic syndromes in the emergency department: recognition and management. Emergency Medicine Practice. 2021; 23: 1–28.

[5] Mehta CK, Son AY, Chia MC, Budd AN, Allen BD, Vassallo P, *et al*. Management of acute aortic syndromes from initial presentation to definitive treatment. The American Journal of Emergency Medicine. 2022; 51: 108–113.

[6] Erbel R, Aboyans V, Boileau C, Bossone E, Bartolomeo RD, Eggebrecht H, *et al*. 2014 ESC guidelines on the diagnosis and treatment of aortic diseases: document covering acute and chronic aortic diseases of the thoracic and abdominal aorta of the adult. The task force for the diagnosis and treatment of aortic diseases of the European society of cardiology (ESC). European Heart Journal. 2014; 35: 2873–2926.

[7] Goldstone AB, Chiu P, Baiocchi M, Lingala B, Lee J, Rigdon J, *et al*. Interfacility transfer of medicare beneficiaries with acute type a aortic dissection and regionalization of care in the United States. Circulation. 2019; 140: 1239–1250.

[8] Ingraham A, Reinke CE. Optimizing safety for surgical patients undergoing interhospital transfer. Surgical Clinics of North America. 2021; 101: 57–69.

[9] Kulshrestha A, Singh J. Inter-hospital and intra-hospital patient transfer: recent concepts. Indian Journal of Anaesthesia. 2016; 60: 451.

[10] Winsor G, Thomas SH, Biddinger PD, Wedel SK. Inadequate hemodynamic management in patients undergoing interfacility transfer for suspected aortic dissection. The American Journal of Emergency Medicine. 2005; 23: 24–29.

[11] Mueller SK, Shannon E, Dalal A, Schnipper JL, Dykes P. Patient and physician experience with interhospital transfer: a qualitative study. Journal of Patient Safety. 2021; 17: e752–e757.

[12] Wagle R, Baumgartner B, Chen A, Chilukuri D, Helton N. Improving the hospital transfer process for acute type a aortic dissections. Cureus. 2023; 15: e33451.

[13] Heaton J, Kohn MD. EMS inter-facility transport. 1 edn. StatPearls Publishing: Treasure Island (FL). 2023.

[14] Privitera D, Capsoni N, Vailati P, Terranova G, Aseni P. Standardized nursing approach to acute aortic dissection patient: a practice update. SAGE Open Nursing. 2022; 8: 237796082211451.

[15] Wilcox G. Nursing patients with acute aortic dissection in emergency departments. Emergency Nurse. 2019; 27: 32–41.

[16] Huang S, Lin Y, Kuo Y, Huang Y, Wu S, Huang K, *et al*. Adequacy of care during interfacility transfer in Taiwan: a pilot study. Journal of the Formosan Medical Association. 2022; 121: 1864–1871.

[17] Ng C, Chien C, Seak JC, Tsai S, Weng Y, Chaou C, *et al*. Validation of the five-tier Taiwan triage and acuity scale for prehospital use by emergency medical technicians. Emergency Medicine Journal. 2019; 36: 472–478.

[18] Catalán-Ibars RM, Martín-Delgado MC, Puigoriol-Juvanteny E, Zapater-Casanova E, Lopez-Alabern M, Lopera-Caballero JL, *et al*. Incidents related to critical patient safety during in-hospital transfer. Medicina Intensiva. 2022; 46: 14–22.

[19] Evangelista A, Barrabés JA, Lidón R, Rodríguez-Lecoq R, Maeso J, Bellmunt S, *et al*. Changes in the diagnosis and management of acute aortic syndrome and associated mortality in the last 20 years. Revista EspañOla De Cardiología. 2021; 74: 257–262.

[20] Glick Y, Avital B, Oppenheimer J, Nahman D, Wagnert-Avraham L, Eisenkraft A, *et al*. Augmenting prehospital care. BMJ Military Health. 2021; 167: 158–162.

[21] Young E, Kopunic HS, Trochsler MI, Maddern GJ. Predictors of interhospital transfer delays in acute surgical patient deaths in Australia: a retrospective study. ANZ Journal of Surgery. 2022; 92: 1322–1331.

[22] Alabdali A, Fisher JD, Trivedy C, Lilford RJ. A systematic review of the prevalence and types of adverse events in interfacility critical care transfers by paramedics. Air Medical Journal. 2017; 36: 116–121.

[23] Ishikawa N, Narita M, Shirasaka T, Ushioda R, Tsutsui M, Azuma N, *et al*. Role of helicopter transfer and cloud-type imaging for acute type A aortic dissection. To be published in The Journal of Thoracic and Cardiovascular Surgery. 2023. [Preprint].

[24] Wonnacott D, Frymire E, Khan S, Green M. Physician attendance during interhospital patient transfer in Ontario: 2005–2015. Canadian Journal of Rural Medicine. 2019; 24: 37.

[25] Jobé C, Carron P, Métrailler P, Bellagamba J, Briguet A, Zurcher L, *et al*. Introduction of telemedicine in a prehospital emergency care setting: a pilot study. International Journal of Telemedicine and Applications. 2023; 2023: 1–8.

[26] Janerka C, Leslie GD, Mellan M, Arendts G. Review article: prehospital telehealth for emergency care: a scoping review. Emergency Medicine Australasia. 2023; 35: 540–552.

[27] K. Tran Q, O'Connell F, Hakopian A, SH Abrahim M, Beisenova K, Pourmand A. Patient care during interfacility transport: a narrative review of managing diverse disease states. World Journal of Emergency Medicine. 2023; 14: 3.

[28] Mueller SK, Fiskio J, Schnipper J. Interhospital transfer: transfer processes and patient outcomes. Journal of Hospital Medicine. 2019; 14: 486–491.

[29] Kiss T, Bölke A, Spieth PM. Interhospital transfer of critically ill patients. Minerva Anestesiologica. 2017; 83: 1101–1108.

[30] Shelton SL, Swor RA, Domeier RM, Lucas R. Medical direction of interfacility transports: national association of EMS physicians standards and clinical practice committee. Prehospital Emergency Care. 2000; 4: 361–364.

[31] Varughese R, Cater-Cyker M, Sabbineni R, Sigler S, Champoux S, Gamber M, *et al*. Transport rates and prehospital intervals for an ems telemedicine intervention. To be published in Prehospital Emergency Care. 2023. [Preprint].

How to cite this article: Shang-Li Tsai, Chip-Jin Ng, Ming-Fang Wang, Chi-Chun Lin, Chen-Bin Chen, Chien-Hsiung Huang, *et al*. Quality of inter-facility transfer for Type A aortic dissection patients in a medical center in Taiwan: a retrospective observational study. Signa Vitae. 2024; 20(3): 46-53. doi: 10.22514/sv.2024.027.