

Research Article
Open Access

Off-Island Transfer for Type A Aortic Dissection: A Decade Experience from a Hospital in Guam

Claire Liu^{1*}, Chi Chan Lee², Nancy Lentz², Nat Dumrong², Bryan Bansil², Jose Gonzalez², Michael Agustin², Pei-Chang Liu², Christian Eusebio³, Daniel Medina³, Nicholas Bandy³ and Scott Shay⁴

¹St John's School, Tamuning, Guam, USA

²Intensive Care Unit, Department of Medicine, Guam Regional Medical City, Dededo, Guam, USA

³Department of Surgery, Guam Regional Medical City, Dededo, Guam, USA

⁴Department of Radiology, Guam Regional Medical City, Dededo, Guam, USA

*Corresponding author

Claire Liu, St John's School 911 North Marine Corps Dr, Tamuning, 96913, Guam, USA.

Received: January 05, 2026; **Accepted:** January 09, 2026; **Published:** January 20, 2026

Introduction

Guam, a U.S. territory in the Pacific with 200,000 residents, is the first American soil to see the sunrise each day. Yet, despite its economic and purchasing power matching the U.S. mainland (USM), Guam's healthcare system is critically flawed. Its immense distance from the USM (nearly 10,000 km) deters American doctors, and with no local medical school, the island cannot train its own. This leaves patients with serious conditions no option but off-island referral. The referral process itself is a major hurdle. Given Guam's isolation, air travel is mandatory. The closest destinations, either Japan, Taiwan, or the Philippines (PI), are 3-4 hour flights, while Korea is 5 hours away. These long journeys increase the risk of a patient's condition deteriorating en route. Moreover, most Guam health insurance plans don't cover off-island care directly, requiring lengthy, case-by-case financial approvals from local insurers, which can critically delay treatment. Over 70% of Guamanians, many with family ties, prefer referral to PI. However, despite specialist availability, PI's medical infrastructure and care quality don't meet international standards, often leading to worse patient outcomes [1]. For those seeking U.S. specialists or healthcare, the trips are even longer and more perilous: 7-8 hours to Hawaii (HI) or 12-14 hours to the USM. Such travel also demands pre-trip insurance authorization, adding to concerns about delays.

Insurance approval covers facility medical expenses and transportation. For critically ill patients unable to fly commercially, an air ambulance—a mobile ICU staffed by critical care professionals—becomes essential. These services are astronomically expensive, sometimes exceeding the medical bill itself, explaining why insurers frequently delay approval. This strained system has profound implications for emergencies like Type A aortic dissection (TAAD), which demands immediate surgical repair; mortality increases hourly. Alarming, Guam has lacked a cardiothoracic surgeon for 25 years. Thus, TAAD patients must be referred off-island immediately, a process severely

hindered by the obstacles described. To address this, we surveyed all TAAD patients presenting to our 200-bed hospital, the island's largest, since its opening roughly 10 years ago, investigating outcomes based on referral status and destination. Our hope is this survey will guide future TAAD patients in Guam on referral decisions and potential medical consequences.

Methods

Our hospital's comprehensive electronic medical records allowed for thorough documentation of all patient visits from the outset. However, once patients transferred, their medical records were no longer accessible. To gather follow-up data, our investigators contacted the referred facilities. When complete records weren't available, particularly from some overseas hospitals, we directly contacted patients or their families. We ultimately traced the medical profiles of all transferred patients, though some specific details remained unconfirmed at the time of publication. These 93 patients were then categorized based on their referral status and destination (e.g., those who stayed versus those transferred to PI, Japan, Taiwan, Korea, HI, or the USM). The primary outcome was 30-day mortality following a TAAD diagnosis. This timeframe was chosen for two reasons: 1. It's a standard academic measure for short-term TAAD mortality, allowing for comparison with existing literature. 2. It accommodates the nearly two-week waiting period some patients experienced before transfer, providing sufficient time for surgery and postoperative observation. Secondary outcomes included: number of patients alive on departure, number of patients alive on arrival, average waiting time (AWT) before departure, total AWT, pre-departure mortality, in-flight mortality, surgical mortality, and post-operative mortality. Patient demographics were also thoroughly analyzed to identify any statistical baseline differences among the various referral categories. These included gender, race, smoking status, and histories of hypertension, diabetes, dyslipidemia, congestive heart failure, coronary artery disease, atrial fibrillation, stroke, chronic obstructive pulmonary disease, peripheral vascular

disease, and cancer. Binary or qualitative data were assessed using Fisher's exact test, while age, a continuous variable, was analyzed using Analysis of Variance (ANOVA) [2,3].

Results

Outcomes

As detailed in Table 1, 37 patients could not be transferred off-island for aortic intervention. Of these, 34 were unable to transfer due to lack of insurance, participation in an insurance program that excluded overseas referrals, or financial hardship preventing self-funded travel. The remaining three had adequate resources but opted to stay on-island.

The PI received the largest number of referrals, totaling 29 patients. The waiting time for PI transfers ranged from 6-22 days, with an AWT of 13.7 days. Only 16 of these patients survived to board the flight. The 13 pre-boarding deaths were attributed to: 5 aortic ruptures, 2 myocardial infarctions, 1 ischemic stroke, 2 intracranial hemorrhages, 3 septic shock, 2 pneumonia, and 1 ventricular fibrillation secondary to hyperkalemia (due to acute renal failure, with the patient refusing dialysis). Despite a short three-and-a-half-hour flight from Guam to PI, three patients died mid-flight; specific causes remain unknown as no autopsies were performed.

For Japan, five patients were referred, but only four survived to board the approximately four-hour flight, with one death occurring from an aortic rupture before transfer. All four who boarded arrived alive in Japan for surgery. Patients waited 3-9 days for transfer (AWT: 6.3 days). Both patients referred to Korea (approximately 5-hour flight) arrived in Seoul alive, after waiting 4-8 days (AWT: 6 days). All three patients referred to Taiwan (approximately 4-hour flight) also arrived alive, following a 4-6 day wait (AWT: 5.3 days).

Seven patients were referred to HI. Two died from an aortic rupture before transfer, but the five who boarded the roughly 7.5-hour flight all reached HI alive. Waiting times for HI transfers ranged from 2-10 days (AWT: 7.6 days). All 10 patients referred to the USM, including Los Angeles, San Diego, San Francisco, and Seattle, boarded alive. However, only seven reached their destination alive, with three in-flight deaths: one from aortic rupture, one from pericardial tamponade, and one from tension pneumothorax. Flight distances to these cities vary from 9,100 km (Seattle) to 9,900 km (San Diego), with flight times ranging from 11.5 to 12.8 hours. Patients waited 2-11 days for USM transfer (AWT: 7.8 days).

Regarding surgical outcomes: three patients who underwent surgery in PI died during the operation, and five more died within two weeks post-operation; precise causes were undocumented. Conversely, all patients who underwent surgery in Japan, South Korea, and Taiwan survived. In HI, one patient died during surgery, and two USM patients died from postoperative complications. Given that TAAD is an immediate life-threatening condition, our focus is on short-term outcomes rather than 3-month or 1-year mortality to justify off-island transfers. Among patients who remained in Guam for conservative treatment, 29 died within one month, yielding a 78.4% mortality rate (MR). For PI-referred patients, only 5 were alive after one month, resulting in an 82.8% MR. Japan-referred patients had a 20% MR after one month, while South Korea and Taiwan referrals maintained a 100% survival rate (0% MR). HI-referred patients experienced a 42.9% MR after one month, and USM-referred patients had a 50% MR over the same period.

Overall, of the 56 patients scheduled for transfer, 40 successfully boarded their flights, and 30 arrived at their destinations alive. The total waiting time for transfer ranged from 2 to 22 days, with an AWT of 10.5 days. The overall one-month MR for patients en route for transfer was 58.9%, while the combined total MR for both stayed and referred patients during this period was 66.7%.

	Patient number	Alive on departure	Alive on arrival	Waiting time (days)	Average waiting time (days)	Survival rate at one month
Stayed	37	—	—	—	—	21.6%
Philippines	29	16	13	6-22	13.7	17.2%
Japan	5	4	4	3-9	6.3	80%
Korea	2	2	2	4-8	6	100%
Taiwan	3	3	3	4-6	5.3	100%
Hawaii	7	5	5	2-10	7.6	57.1%
U.S. mainland	10	10	7	2-11	7.8	50%
Total	93	40	30	2-22	10.5	33.3%

Demographics

As detailed in Table 2, demographic discussions excluded patients transferred to Japan, Korea, and Taiwan due to their small sample sizes. Instead, our primary comparisons focused on patients who stayed in Guam, and those transferred to the PI, HI, and the USM. Across these four groups, we found no statistically significant differences in gender, age, smoking status, or history of hypertension, diabetes, congestive heart failure, atrial fibrillation, stroke, peripheral vascular disease, or cancer. However, patients referred to HI showed a significantly higher prevalence of dyslipidemia ($p = 0.0351$) and chronic obstructive pulmonary disease ($p = 0.027$), alongside a remarkably lower prevalence of coronary artery disease ($p < 0.01$), compared to the other three groups. We also observed heterogeneity in racial composition: the Guam-stayed and PI-referred patient groups had lower White and Black populations than those referred to HI and USM.

	Stayed	Philippines	Japan	Korea	Taiwan	Hawaii	U.S. mainland
Gender (M)	62%	62%	80%	50%	67%	71%	70%
Race (A/W/B)	33/4/0	24/5/0	5/0/0	2/0/0	3/0/0	1/4/2	2/7/1
Age (years old)	23-89	28-77	37-65	53-62	42-70	31-74	19-72
Smoking	72%	70%	80%	100%	67%	86%	70%
Hypertension	91%	93%	80%	100%	100%	100%	90%
Diabetes	65%	76%	40%	50%	33%	71%	50%
Dyslipidemia	54%	62%	40%	100%	67%	86%	60%
Congestive heart failure	32%	38%	20%	0%	33%	43%	30%
Coronary artery disease	16%	14%	0%	0%	33%	0%	20%
Atrial fibrillation	35%	34%	0%	50%	0%	29%	30%
Stroke	19%	18%	0%	0%	0%	14%	20%
Chronic obstructive pulmonary disease	8%	7%	20%	50%	0%	29%	10%
Peripheral vascular disease	35%	34%	40%	50%	33%	29%	30%
Cancer	5%	10%	0%	0%	0%	14%	10%

Discussion

Overall Mortality

Our cohort of 93 patients exhibited a remarkably high overall 30-day MR, significantly exceeding the national average of 22% [4]. This disparity is unsurprising given that TAAD typically necessitates immediate surgical repair, as mortality increases by 1-2% per hour within the first 48 hours without intervention [5]. In contrast, only 36.6% of our patients ultimately underwent surgery. Patients who do not receive surgical intervention for TAAD can face an MR as high as 70% [6]. For our patients who did not receive surgery, including those who stayed and those who died before surgery, the overall MR was 86.4%. While higher than most published reports, we lack a validated explanation for this, though contributing factors may include: insufficient medical resources,

sicker baseline patient populations with more comorbidities in Guam, and the unavailability of titratable vasoactive medications like esmolol in our hospital to achieve the North American standard of care heart rate below 60 bpm [7-9].

As expected, patients who remained in Guam for conservative treatment experienced a higher MR than any other referral group, reinforcing that surgical intervention is the only proven effective treatment for TAAD. Among transferred patients, those referred to the PI had the highest MR, likely due to the longest AWT for surgery at 13.7 days. Patients referred to HI and the USM had similar AWTs of 7.6 and 7.8 days, respectively, suggesting potentially similar mortality rates. However, the MR for HI-referred patients was lower than for USM-referred patients (42.9% versus 50%), which aligns with the slightly shorter transfer waiting time for HI. Conversely, patients referred to Japan, Korea, and Taiwan had MRs ranging from 0-20%, falling between PI and HI/USM, consistent with their intermediate AWTs. Notably, Japan-referred patients had a higher MR than those sent to Korea or Taiwan, possibly attributable to a slightly longer transfer delay (AWT of 6.3 days for Japan versus 6 days for Korea and 5.3 days for Taiwan). In summary, a longer AWT for transfer was consistently associated with higher overall 30-day mortality.

Pre-Transfer Mortality

Patients Referred to the PI Experienced the Longest Delays Due to Several Factors:

- Seven patients required U.S. passport applications, a process that typically takes two weeks in Guam and caused the most significant delay.
- Thirteen patients awaited health insurer approval for transfer expenses, a moderate delay given the astronomical cost of air ambulances.
- Twenty-five patients needed health insurer approval for reimbursement of medical fees incurred in PI, leading to mild delays.
- Four self-pay patients took longer to secure sufficient funds.
- In contrast, referrals to Japan, Korea, and Taiwan experienced minimal delays. These patients were all citizens of their respective countries, benefiting from national health insurance for free medical treatments and possessing immediate legal entry. Consequently, their only waiting time was for national health insurers to approve transfer fees.

Patients traveling to the USM or HI were all U.S. nationals, eliminating the need for passport applications and thus speeding up the initial transfer process. However, most Guam insurance plans do not automatically cover off-island medical treatment fees, requiring these patients to wait for insurer authorization before departure. It's worth noting that while commercial flights from Guam were periodically suspended during the COVID-19 pandemic, air ambulances remained operational, ensuring this did not cause transfer delays.

Among all referral groups, the PI bracket had the highest pre-boarding mortality, consistent with its longest AWT. However, a contradiction emerged when comparing the next two longest AWTs: the USM bracket (second longest AWT) had a lower pre-boarding mortality rate (0%) than the HI bracket (third longest AWT), which recorded a 28.6% pre-boarding mortality. Possible explanations for this discrepancy include: 1. The AWTs for HI (7.6 days) and USM (7.8 days) were very similar, potentially not significantly impacting pre-boarding mortality. 2. Crucially, the two pre-boarding deaths for HI-referred patients were Black individuals. It is well-documented that non-Hispanic Black

patients with TAAD exhibit a higher mortality rate than other racial groups, regardless of surgical intervention [10].

For patient groups with shorter transfer AWTs (Taiwan/Korea/Japan), pre-boarding mortality was accordingly lower, with the exception of one patient to Japan who expired while waiting. However, given the small sample sizes for these three groups, this single death did not reach statistical significance. In summary, longer transfer AWTs generally correlated with higher pre-boarding mortality, though racial factors also played a role.

Mortality During Transfer

Only three patients died during in-flight transfer, all of whom were en route to the PI; patients flying to other destinations survived. While we can attribute these deaths to longer pre-transfer waiting times, we can't rule out the possibility of substandard in-flight care from the air ambulance company exclusively serving PI transfers, especially since their exact causes of death remain unknown.

Mortality During Surgery

Our TAAD patients who underwent surgery experienced a one-month MR of 36.7%, notably higher than the 15-19% reported in literature [11]. This elevated mortality likely stems from the average 10.5-day delay these patients faced before transfer and surgery. Among those who had surgery, PI-referred patients had the highest surgical MR at 23.1%, followed by HI-referred patients at 20%. Patients transferred to other countries experienced zero surgical mortality. While it's hard to definitively attribute these MR differences to variations in surgeon skill or care quality across locations, a trend emerged: longer pre-surgical waiting times generally correlated with higher mortality. The exception was the USM, where patients likely benefited from treatment by highly experienced cardiothoracic surgeons, leading to better survival during the repair procedure despite comparable delays.

Mortality after Surgery

Following surgery, 50% of patients in PI and 20% in the USM died within two weeks, while all other patients who survived surgery remained alive during this period. We can once again attribute these mortalities to the AWTs for these two groups compared to the others. However, an exception exists: despite HI having an AWT similar to the USM, it experienced zero post-surgical mortality. Although factors like comorbidities, quality of care, and medical resource availability likely influence post-surgical outcomes, our small sample sizes prevented meaningful inferences regarding these variables.

Transfer Work Flow for the TAAD Patients in Guam

Based on the mortality data, TAAD patients should be transferred off-island for surgical repair whenever possible. For those who must remain in Guam, medical management is the only option. This involves aggressively controlling blood pressure (targeting systolic blood pressure at 120 mmHg) and heart rate at 60 bpm, along with pain relief and treatment of end-organ manifestations such as pericardial effusion, congestive heart failure, acute renal failure, and peripheral arterial occlusive disease [12,13]. It's crucial to inform patients and their families that TAAD is a life-threatening condition with a MR up to 70% without surgery. Furthermore, if a patient goes into cardiac arrest, survival chances are near zero, as chest compressions can predispose to aortic rupture. If aortic rupture occurs from TAAD, immediate cardiovascular collapse usually follows, and resuscitation is often futile [14].

If a patient is financially and logistically eligible for referral, immediate transfer to a facility with an available cardiothoracic

surgeon is paramount. The transfer process must be expedited, as TAAD mortality increases linearly with time. While insurance policies often dictate transfer locations, if the patient has ample financial resources or their insurance offers choice, Taiwan should be the first consideration due to its shortest AWT. Korea follows as a secondary choice with the second shortest AWT, comparable to Japan; however, Japan offers a one-hour shorter flight, potentially reducing the risk of patient decompensation during travel. HI or the USM serve as the next options if transfer to Taiwan, Korea, or Japan isn't feasible. HI's AWT of 7.6 days is slightly less than the USM's 7.8 days, and flights to HI are generally 4-6 hours shorter. Although HI had a higher surgical MR, its overall MR was lower than the USM (42.9% versus 50%), making either a viable alternative. Finally, the PI should only be considered if no other locations are accessible, given its longest AWT and highest overall mortality rate.

The Role of Demographics in Mortality

Most demographic factors in our survey didn't show statistically significant differences in TAAD mortality across patient groups. However, dyslipidemia, chronic obstructive pulmonary disease (COPD), and coronary artery disease (CAD) were statistically significant, specifically differing between the HI bracket and the other three adequately sized patient groups. Interestingly, despite the HI bracket having the highest prevalence of dyslipidemia and COPD, it exhibited the lowest overall MR among all groups. This might suggest that these comorbidities could act as relieving factors for TAAD patients in our study. Conversely, CAD might increase TAAD mortality, given that the HI bracket had the lowest prevalence of CAD among these four groups.

Furthermore, we observed discrepancies in racial composition across these patient groups. As previously noted, non-Hispanic Blacks generally experience a higher MR in TAAD, which aligns with the difference in mortality between the HI and USM patient brackets that had similar AWTs. The presence of a White population might also be a protective factor against TAAD mortality, as the two brackets in our survey with White patients showed lower MRs. Given that longer AWT is a consistently identified and strong risk factor for TAAD mortality across the literature— a factor that explains the MR differences in our stayed and PI-referred patient groups— further research is needed to specifically compare mortality differences between White and Asian patients in this context [15].

Conclusion

Despite its U.S. territory status, Guam has been a medically underserved area for decades. This critical deficit, particularly the absence of cardiothoracic surgeons, has tragically condemned many patients with conditions like TAAD, a disease with an exceptionally high mortality rate if not surgically treated in time. These patients urgently require off-island referral to facilities where cardiothoracic surgeons are available. Our 10-year survey, encompassing TAAD patients admitted to our Guam hospital since its inception, aimed to analyze the outcomes of transfers to different destinations. We also investigated the referral waiting times, comparing them across all patient groups and against those who remained on the island. Leveraging these findings, we subsequently propose a structured referral workflow for TAAD patients, providing a sequential guide for optimal destination choice for both patients and local clinicians.

References

1. Cordero D A Jr (2022) An evaluation of the Philippine healthcare system: Preparing for a robust public health in the future. *Journal of Preventive Medicine and Public Health* 55: 310-311.
2. Wong KF, Wong WK, Lin MS (2014) Forward selection two sample binomial test. *Journal of Data Science* 12: 279-294.
3. Muhammad LN (2023) Guidelines for repeated measures statistical analysis approaches with basic science research considerations. *Journal of Clinical Investigation* 133: e171058.
4. Obel LM, Lindholt JS, Lasota AN, Henrik K Jensen, Leila L Benhassen, et al. (2022) Clinical characteristics, incidences, and MRs for type A and B aortic dissections: A nationwide Danish population-based cohort study from 1996 to 2016. *Circulation* 146: 1903-1917.
5. Harris KM, Nienaber CA, Peterson MD, Woznicki EM, Braverman AC, et al. (2022) Early mortality in Type A acute aortic dissection: Insights from the International Registry of Acute Aortic Dissection. *JAMA Cardiology* 7: 1009-1015.
6. Ahmad RA, Orelaru F, Titsworth M, Wu X, Kim KM, et al. (2024) Contemporary nonsurgical management of acute type A aortic dissection: Better outcomes?. *Journal of Thoracic and Cardiovascular Surgery* 167: 2027-2036.
7. Schwartz A (2021) Subcommittee on Health hearing on "Averting a Crisis: Protecting Access to Health Care in the U.S. Territories". Attachment-Additional Questions for the Record <https://docs.house.gov/meetings/IF/IF14/20210317/111335/HHRG-117-IF14-Wstate-SchwartzA-20210317-SD001.pdf>.
8. Hagiwara MK, Miyamura J, Yamada S, Sentell T (2016) Younger and sicker: Comparing Micronesians to other ethnicities in Hawaii. *American Journal of Public Health* 106: 485-491.
9. Kodama K, Nishigami K, Sakamoto T, Sawamura T, Hirayama T, et al. (2008) Tight heart rate control reduces secondary adverse events in patients with type B acute aortic dissection. *Circulation* 118: S167-S170.
10. Nazir S, Ariss RW, Minhas AMK, Issa R, Michos ED, et al. (2022) Demographic and regional trends of mortality in patients with aortic dissection in the United States, 1999 to 2019. *Journal of the American Heart Association* 11: e024533.
11. Şulea CM, Kiss AB, Ágg B, Benke K, Bartha E, et al. (2025) Pregnancy-related chronic type A aortic dissection highlights the importance of thorough prenatal maternal examination. *Journal of Cardiothoracic Surgery* 20: 105.
12. Levy D, Sharma S, Grigorova Y, Jacqueline K Le (2025) Aortic dissection. StatPearls Publishing <https://www.ncbi.nlm.nih.gov/sites/books/NBK441963/>.
13. Harris C, Croce B, Cao C (2016) Type A aortic dissection. *Annals of Cardiothoracic Surgery* 5: 256.
14. Park YK, Lee JH, Kim KM, Jung JC, Chang HW, et al. (2024) Acute type A aortic dissection features and outcomes in octogenarians: A propensity score analysis. *Interdisciplinary Cardiovascular and Thoracic Surgery* 38: 1-9.
15. Koba A, Yamagishi K, Sairenchi T, Noda H, Irie F, et al. (2023) Risk factors for mortality from aortic aneurysm and dissection: Results from a 26-year follow-up of a community-based population. *Journal of the American Heart Association* 12: e027045.

Copyright: ©2026 Claire Liu, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.