Original Article

Does the weekend effect exist for acute type A aortic dissection?—a retrospective case-control study

Jinlin Wu[1#], Guang Tong[1#], Julia Fayanne Chen[2#], Changjiang Yu[1], Jue Yang[1], Zerui Chen[1], Xin Li[1], Xinjian Yan[1], Donglin Zhuang[1], Yongchao Yang[1], Yaorong Liu[1], Zhichao Liang[1], Jie Liu[1], Zhen Zhang[1], Ruixin Fan[1], Tucheng Sun[1]

[1]Department of Cardiac Surgery, Guangdong Cardiovascular Institute, Guangdong Provincial People's Hospital, Guangdong Academy of Medical Sciences, Guangzhou, China; [2]Division of Vascular and Endovascular Surgery, Department of Surgery, University of Toronto, Toronto, Canada

Contributions: (I) Conception and design: J Wu, G Tong, R Fan, T Sun; (II) Administrative support: C Yu, J Yang; (III) Provision of study materials or patients: Z Chen, X Li, X Yan, D Zhuang; (IV) Collection and assembly of data: Y Yang, Y Liu, Z Liang, J Liu, Z Zhang; (V) Data analysis and interpretation: J Wu, G Tong, JF Chen; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

[#]These authors contributed equally to this work.

Correspondence to: Jinlin Wu, MD. Department of Cardiac Surgery, Guangdong Cardiovascular Institute, Guangdong Provincial People's Hospital, Guangdong Academy of Medical Sciences, Zhongshan 2nd Rd., 106, Guangzhou, China. Email: wujinlin@gdph.org.cn; Zhen Zhang, MD. Department of Cardiac Surgery, Guangdong Cardiovascular Institute, Guangdong Provincial People's Hospital, Guangdong Academy of Medical Sciences, Guangzhou, China. Email: zhangzhen1122@126.com; Tucheng Sun, MD. Department of Cardiac Surgery, Guangdong Cardiovascular Institute, Guangdong Provincial People's Hospital, Guangdong Academy of Medical Sciences, Guangzhou, China. Email: suntucheng@126.com.

Background: The weekend effect refers to the mortality difference for patients admitted/operated on weekends compared to those on weekdays. The study aimed to provide new evidence on the impact of the weekend effect on acute type A aortic dissection (ATAAD).

Methods: Primary endpoints were operative mortality, stroke, paraplegia, and continuous renal replacement therapy (CRRT). A meta-analysis of current evidence on the weekend effect was first conducted. Analyses based on single-center data (retrospective, case-control study) were further performed.

Results: A total of 18,462 individuals were included in the meta-analysis. The pooled results showed that mortality was not significantly higher for ATAAD on weekends compared to that on weekdays [odds ratio (OR): 1.16, 95% CI: 0.94–1.43]. The single-center cohort included 479 patients, which also showed no significant differences in primary and secondary outcomes between the two groups. The unadjusted OR for weekend group over weekday group was 0.90 (95% CI: 0.40–1.86, P=0.777). The adjusted OR for weekend group was 0.94 (95% CI: 0.41–2.02, P=0.880) controlling for significant preoperative factors, and 0.75 (95% CI: 0.30–1.74, P=0.24) controlling for significant preoperative and operative factors altogether. In PSM matched cohort, the operative mortality was still comparable between the weekend group [10 (7.2%)] and weekday group [9 (6.5%)] (P=1.000). No significant survival difference was observed between the two groups (P=0.970).

Conclusions: The weekend effect was not found to be applicable to ATAAD. However, clinicians should be cautious of the weekend effect as it is disease-specific and may vary across healthcare systems.

Keywords: Type A aortic dissection; weekend effect; mortality

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Introduction

The quality of medical and surgical services within a healthcare system ideally should not vary between weekdays and weekends. However, due to limited hospital resources such as support staff and specialty services, cross-coverage is a common practice on weekends. On the other hand, acutely ill patients who require urgent medical attention are admitted to the hospital regardless of the day of the week. The potential for an acutely ill patient experiencing worse outcomes during the weekend is commonly referred as the "weekend effect", and has been shown to be a valid point of concern.

In October 2015, the weekend effect was cited by UK Health Minister Jeremy Hunt when he claimed that "there are 11,000 excess deaths as a result of inadequate cover at weekends" (available at https://publications.parliament.uk/pa/cm201516/cmhansrd/cm151013/debtext/151013-0001.htm). He used the phenomenon to support the government's drive to improve hospital services on weekends and to justify the imposition of new contracts on junior doctors, eventually triggering a mass strike in November 2015 (1). As a result, the weekend effect has started to gain more exposure and become the focus of attention for journalists, health bloggers, and clinicians, etc.

If the weekend effect indeed exists for acute type A aortic dissection (ATAAD) patients, then healthcare systems may need to deploy more resources to address the issue. The aim of this study is to provide new evidence on the impact of the weekend effect on ATAAD and to assess whether the current weekend practice protocol requires modification. We present this article in accordance with the STROCSS reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-22-1639/rc) (2).

Highlight box

Key findings

- Weekend effect was not found to be applicable to acute type A aortic dissection.

What is known and what is new?

- The potential for an acutely ill patient experiencing worse outcomes with the admission or treatments at weekends is commonly referred as the "weekend effect".
- The weekend effect is disease-specific and may vary across healthcare systems.

What is the implication, and what should change now?

- The outcomes of patients with acute type A aortic dissection can be guaranteed at specialized centers, both on weekends and weekdays.

Methods

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institutional Review Board of Guangdong Provincial People's Hospital on July 6th, 2021 (No. 2019-842H-1). Written informed consent was not required due to the retrospective nature of the study.

Data collection

All consecutive ATAAD patients operated at the Guangdong Provincial People's Hospital (Guangdong, China) from September 2017 to June 2021 were enrolled. No patients were excluded. No monetary incentivization of patients for recruitment was applied. Anthropometric, radiologic, laboratory, and operative data were manually accrued from individual electronic medical records and hospital charts. A total of 479 ATAAD patients were entered into the final analysis, which were divided into weekday group (n=336) and weekend group (n=143) according to the day of the week of the operation. Patients were followed up with clinical visits and phone calls. One hundred and thirty-four patients (27.9%) were lost to follow-up.

Variables definition

Primary endpoints were operative mortality, stroke, paraplegia, and continuous renal replacement therapy (CRRT). Operative mortality included in-hospital mortality and 30-day postoperative mortality. Secondary endpoints were re-exploration for bleeding, delayed chest closure, acute lung injury, hospital stay (days), intensive care unit (ICU) stay (days), and mechanical ventilation time (hours). Acute lung injury was defined as oxygenation index ≤100. A pulmonary artery systolic pressure above 30 mmHg indicated pulmonary hypertension. Malperfusion syndrome was defined using the Penn classification (3).

Meta-analysis

To pool the currently available studies on the weekend effect of ATAAD, a meta-analysis was first conducted. Firstly, PubMed was searched from its commencement to February 8th, 2022, with the search strategy as "(weekend

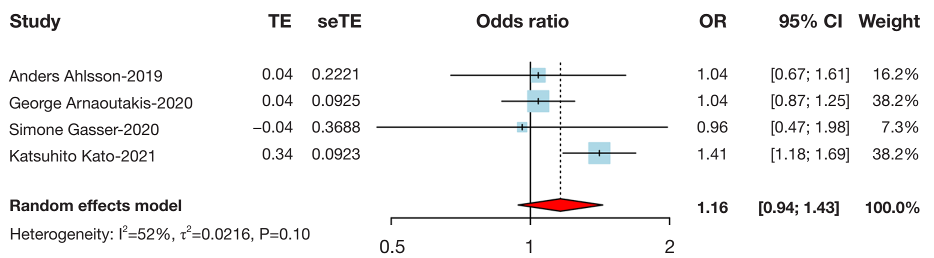

Figure 1 Forest plot showing the meta-analysis of the current researches on the weekend effect on acute type A aortic dissection. TE, estimate of treatment effect; seTE, standard error of treatment estimate; OR, odds ratio; CI, confidence interval.

[Title/Abstract]) AND (aortic dissection [Title/Abstract])". Next, relevant studies were recognized through manual examination of secondary sources covering references of formerly identified articles and a search of reviews and commentaries. All relevant publications were downloaded for confirmation and further analysis. A total of 12 studies were searched, and 4 studies were ultimately included after a full-text review (4-7) (*Figure 1*).

Surgical techniques

The surgical strategies have been reported in detail previously (8,9). Briefly, the standard procedure in our center for ATAAD included total arch replacement with a tetrafurcate graft and frozen elephant trunk (FET). The preferred cardiopulmonary bypass (CPB) protocol involved the right axillary artery cannulation, anterior selective cerebral perfusion, and moderate hypothermic circulatory arrest.

Statistical analysis

For the meta-analysis, heterogeneity between studies was analyzed utilizing the Q test and I^2 index. The extent of variation among the effects observed in different studies (inter-study variance) is referred to as τ^2. Events and total numbers were extracted to generate odds ratio (OR) and 95% confidence intervals (CI) using the random-effects model ("DerSimonian-Laird" model).

Continuous variables were tested for normality distribution with the Kolmogorov-Smirnov test and were expressed as a mean with standard deviation (SD) or median with an interquartile range (IQR). Independent *t*-tests were performed for normally distributed variables, or Mann-Whitney U tests otherwise. Categorical variables were presented as frequencies with percentages, and analyzed by Chi-square test or Fisher's exact test, as appropriate. The survival rate was calculated using the Kaplan-Meier analytical method combined with the log-rank test. Propensity score matching (PSM) was used to balance differences in baseline status. PSM of 1:1 ratio by the "nearest neighbor" method was performed with the "Matching" package. Logistic regression was performed to calculate the odds ratio (OR) and 95% confidence interval (CI). A sensitivity analysis was further performed by grouping patients by day of the week of admission (Table S1). R software (version 3.5.1) was used for data analysis. A two-tailed P<0.05 indicated statistical significance.

Results

A total of 18,462 individuals were included in the meta-analysis. The relevant literature for the meta-analysis is summarized in *Figure 1* and Table S1. One study supports the existence of the weekend effect, while three studies present opposite results, suggesting that the current evidence is controversial and further research is warranted. The pooled results showed that mortality was not significantly higher for ATAAD on weekends compared to that on weekdays (OR: 1.16, 95% CI: 0.94–1.43).

Our single-center data included 479 ATAAD patients, of which 336 underwent surgery on weekdays and 143 on weekends. Baseline characteristics are shown in *Table 1*. Males accounted for 404 (84.3%), and the median age was 52.0 (IQR: 45.0–60.0) years. Compared to the weekday group, the weekend group had a higher percentage of Penn Aa class [62 (43.4%) *vs.* 103 (30.7%), P=0.010], and a lower percentage of Penn Ab [77 (53.8%) *vs.* 224 (66.7%), P=0.011]. All other variables were comparable between the two groups, confirming the 'randomly distributed' effect.

The surgical management of ATAAD is shown in *Table 2*. There were no significant differences in root strategy, arch

Table 1 Baseline characteristics

Variables	Overall (n=479)	Weekday (n=336)	Weekend (n=143)	P value
Male	404 (84.3)	281 (83.6)	123 (86.0)	0.584
Age (year)	52.0 [45.0, 60.0]	52.0 [45.0, 60.0]	52.0 [46.0, 61.0]	0.497
Height (m)	1.7 [1.6, 1.7]	1.7 [1.6, 1.7]	1.7 [1.6, 1.7]	0.597
Weight (kg)	70.0 [63.0, 79.0]	70.0 [62.0, 77.2]	73.0 [64.0, 80.0]	0.106
BMI (kg/m^2)	24.5 [22.2, 27.1]	24.2 [22.2, 27.0]	25.3 [22.5, 27.8]	0.123
DeBakey II	49 (10.2)	37 (11.0)	12 (8.4)	0.416
Penn Aa	165 (34.4)	103 (30.7)	62 (43.4)	0.010
Penn Ab	301 (62.8)	224 (66.7)	77 (53.8)	0.011
Penn Ab&c	11 (2.3)	9 (2.7)	2 (1.4)	0.601
Penn Ac	2 (0.4)	0 (0.0)	2 (1.4)	0.162
Aortic regurgitation	157 (32.8)	114 (33.9)	43 (30.1)	0.457
Smoking	163 (34.0)	110 (32.7)	53 (37.1)	0.399
Pulmonary artery hypertension	34 (7.1)	23 (6.8)	11 (7.7)	0.703
Hypertension	326 (68.1)	220 (65.5)	106 (74.1)	0.069
Coronary artery disease	46 (9.6)	34 (10.1)	12 (8.4)	0.615
Marfan syndrome	25 (5.2)	21 (6.2)	4 (2.8)	0.176
Hx of cardiovascular surgery	38 (7.9)	30 (8.9)	8 (5.6)	0.269
Diabetes	8 (1.7)	4 (1.2)	4 (2.8)	0.247
COPD	45 (9.4)	32 (9.5)	13 (9.1)	1.000
White blood cell count (×10^9/L)	12.5 [10.2, 15.2]	12.6 [10.2, 15.2]	12.1 [10.2, 15.2]	0.478
Hemoglobin (g/L)	133.0 [123.0, 145.5]	133.0 [122.8, 146.0]	132.0 [124.0, 145.0]	0.833
Platelet count (×10^9/L)	184.0 [151.5, 228.0]	181.0 [148.8, 225.0]	185.0 [153.5, 235.0]	0.536
D-dimer (ng/mL)	10,130.0 [3,540.0, 20,000.0]	10,530.0 [3,407.5, 20,000.0]	9,870.0 [3,730.0, 20,000.0]	0.726

Data are shown as n (%) or median [IQR]. BMI, body mass index; IQR, interquartile range; Hx, history; COPD, chronic obstructive pulmonary disease.

strategy, cannulation, coronary artery graft bypass (CABG), or FET implantation. There were also no differences in operative time, cardiopulmonary bypass (CPB) time, aortic cross-clamp (ACC) time, and proportion and duration of moderate hyperthermic cardiac arrest (MHCA).

Surgical outcomes are shown in *Table 3*. There were no significant differences in primary outcomes between the two groups. Operative mortality was 7.5% (n=36) [weekend *vs.* weekday group: 7.0% (n=10) *vs.* 7.7% (n=26), P=0.852]. Stroke rate was 5.6% (n=27) [weekend *vs.* weekday group: 7.0% (n=10) *vs.* 5.1% (n=17), P=0.394]. Paraplegia rate was 4.4% (n=21) [weekend *vs.* weekday group: 2.1% (n=3) *vs.* 5.4% (n=18), P=0.144]. CRRT rate was 26.7% (n=128) [weekend *vs.* weekday group: 24.5% (n=35) *vs.* 27.7% (n=93), P=0.500]. No significant differences were found concerning secondary endpoints including re-exploration for bleeding, delayed chest closure, acute lung injury, hospital stay (days), ICU stay (days), and mechanical ventilation time (hours).

Univariate analysis of the risk factors for operative mortality suggested that the following factors were significant: age (per year) (OR: 1.05, 95% CI: 1.01–1.09, P=0.009), Penn classification (OR for Penn Ab with Penn Aa being the dummy variable: 3.54, 95% CI: 1.47–10.56, P=0.010), hypertension (OR: 2.48, 95% CI: 1.08–6.73, P=0.047), D-dimer (per 1,000 unit) (OR: 1.10,

Table 2 Operative data

Variables	Overall (n=479)	Weekday (n=336)	Weekend (n=143)	P value
Root				0.098
Bentall	110 (23.0)	79 (23.5)	31 (21.7)	
Cabrol	7 (1.5)	7 (2.1)	0 (0.0)	
David	2 (0.4)	2 (0.6)	0 (0.0)	
Root sparing	322 (67.2)	227 (67.6)	95 (66.4)	
Wheat	38 (7.9)	21 (6.2)	17 (11.9)	
Arch				0.558
Arch sparing	5 (1.0)	5 (1.5)	0 (0.0)	
Hemiarch	11 (2.3)	8 (2.4)	3 (2.1)	
Hybrid TAR	2 (0.4)	2 (0.6)	0 (0.0)	
TAR	461 (96.2)	321 (95.5)	140 (97.9)	
Cannulation				0.201
Arch	47 (9.8)	31 (9.2)	16 (11.2)	
FA	32 (6.7)	26 (7.7)	6 (4.2)	
IA + FA	62 (12.9)	39 (11.6)	23 (16.1)	
RSA	236 (49.3)	173 (51.5)	63 (44.1)	
RSA + FA	102 (21.3)	67 (19.9)	35 (24.5)	
CABG	33 (6.9)	19 (5.7)	14 (9.8)	0.116
FET	463 (96.7)	323 (96.1)	140 (97.9)	0.414
Operation time (min)	470.0 [420.0, 540.0]	468.5 [420.0, 545.0]	470.0 [414.0, 535.0]	0.746
CPB time (min)	241.0 [210.5, 280.0]	242.0 [211.0, 278.2]	239.0 [208.5, 280.0]	0.936
ACC time (min)	132.0 [103.0, 160.0]	129.0 [103.0, 160.0]	135.0 [108.5, 161.5]	0.307
MHCA time (min)	20.0 [16.0, 24.0]	20.0 [16.0, 24.0]	20.0 [16.0, 25.0]	0.780
MHCA	314 (65.6)	227 (67.6)	87 (60.8)	0.172

Data are shown as n (%) or median [IQR]. TAR, total arch replacement; IQR, interquartile range; FA, femoral artery; IA, innominate artery; RSA, right subclavian artery; CABG, coronary artery bypass graft; FET, frozen elephant trunk; CPB, cardiopulmonary bypass; ACC, aortic cross-clamp; MHCA, moderate hyperthermic cardiac arrest.

95% CI: 1.04–1.16, P=0.001), CABG (OR: 14.20, 95% CI: 6.26–32.13, P<0.001), operation time (per 30 min) (OR: 1.24, 95% CI: 1.14–1.34, P<0.001), CPB time (per 30 min) (OR: 1.50, 95% CI: 1.31–1.73, P<0.001), ACC time (per 30 min) (OR: 1.83, 95% CI: 1.46–2.5, P<0.001). The unadjusted OR for mortality in the weekend group over the weekday group was 0.90 (95% CI: 0.40–1.86, P=0.777). Two multivariable logistic models were then performed respectively. In model 1, the adjusted OR for mortality in the weekend group was 0.94 (95% CI: 0.41–2.02, P=0.880), controlling for significant preoperative factors (age, Penn classification, hypertension, and D-dimer). In model 2, the adjusted OR for the weekend group was 0.75 (95% CI: 0.30–1.74, P=0.24), controlling for significant preoperative and operative factors altogether (age, Penn classification, hypertension, D-dimer, CABG, operation time, CPB time, and ACC time).

A PSM was carried out to balance differences in baseline status with a total of 138 pairs being matched. The love plot demonstrated an improved balance between weekend and weekday groups (*Figure 2*). In the matched cohort, operative mortality was still comparable between the weekend group

Table 3 Operative outcomes

Variables	Overall (n=479)	Weekday (n=336)	Weekend (n=143)	P value
Mortality	36 (7.5)	26 (7.7)	10 (7.0)	0.852
Stroke	27 (5.6)	17 (5.1)	10 (7.0)	0.394
Paraplegia	21 (4.4)	18 (5.4)	3 (2.1)	0.144
CRRT	128 (26.7)	93 (27.7)	35 (24.5)	0.500
Re-exploration	7 (1.5)	5 (1.5)	2 (1.4)	1.000
Delayed chest closure	37 (7.7)	26 (7.7)	11 (7.7)	1.000
Acute lung injury	132 (27.6)	98 (29.2)	34 (23.8)	0.264
Hospital stay (day)	23.0 [18.0, 31.0]	23.0 [18.0, 32.0]	23.0 [18.0, 30.0]	0.234
ICU stay (day)	7.7 [4.8, 12.3]	7.6 [4.8, 12.6]	8.3 [4.7, 11.6]	0.691
Mechanical ventilation time (hour)	97.0 [47.0, 169.0]	107.0 [46.8, 180.2]	96.0 [56.0, 161.5]	0.970

Data are shown as n (%) or median [IQR]. CRRT, continuous renal replacement therapy; IQR, interquartile range; ICU, intensive care unit.

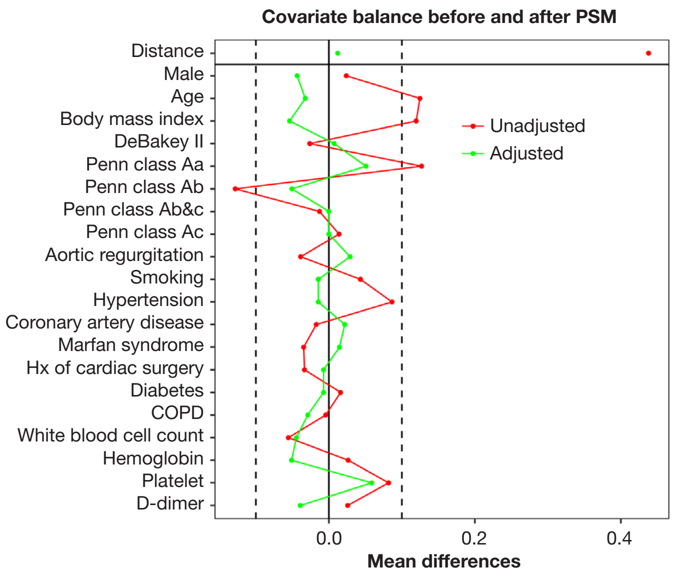

Figure 2 Love plot demonstrating the propensity score matching by weekend group *vs.* weekday group. PSM, propensity score matching; COPD, chronic obstructive pulmonary disease.

[10 (7.2%)] and weekday group [9 (6.5%)] (P=1.000).

This cohort was followed for an average of 21.2 months (IQR: 7.98–57.12), with 36 early deaths and 8 late deaths. The survival rates at 1-, 2- and 3-year follow-up were 91.6%, 91.2% and 89.7% respectively for the weekday group, and 91.4%, 90.4% and 90.4% respectively for the weekend group (P=0.970) (*Figure 3*).

Next, a sensitivity analysis was performed by grouping patients based on the day of the week of admission rather than the operation. The results were unchanged; there remained no significant differences in primary and secondary outcomes between the weekday and weekend groups (Table S2).

Discussion

Currently, there are few reports on the weekend effect on surgical outcomes in ATAAD; amongst the reports that

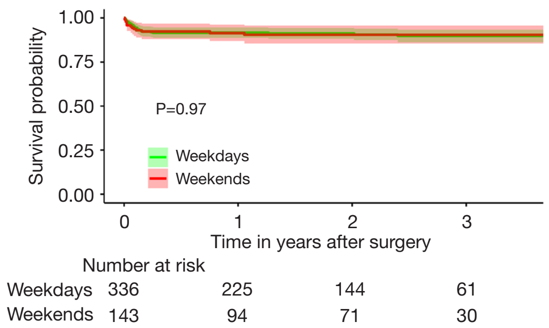

Figure 3 Kaplan-Meier survival curve displaying the survival rate by weekend group *vs.* weekday group.

do exist, results are conflicting. A meta-analysis including a total of 18,462 patients was conducted, demonstrating that the mortality rate does not increase significantly on weekends (OR: 1.16, 95% CI: 0.94–1.43). The weekend effect was further evaluated based on single-center data using logistic regression, PSM, and Kaplan-Meier analysis; all analyses confirmed that the effect does not exist in ATAAD, with mortality rates of 7% (n=10) *vs.* 7.7% (n=26) for the weekend and weekday groups, respectively (P=0.852).

The circadian rhythm has previously been established to have an impact on both surgeons and patients (10). Although some studies group the "night-time effect", which is based on circadian rhythms, and the weekend effect together (7), these are in fact completely different processes. The circadian rhythm is an inherent biological phenomenon, while the weekend is a social phenomenon.

Existing studies on the weekend effect are heterogeneous and inconsistent. Aylin *et al.* examined in-hospital deaths for all emergency inpatient admissions to all public acute hospitals in England for 2005/2006 and found that the overall adjusted odds of death for all emergency admissions were 10% higher in patients admitted on a weekend compared with those admitted on a weekday (P<0.001) (11). Ruiz *et al.* also found higher mortality among patients admitted on weekends in most hospitals studied in the UK, Australia, the US and the Netherlands (12). Freemantle *et al.* indicated that emergency and elective patients admitted to NHS hospitals on weekends were 10% more comorbid and had a 15% increased relative risk of death within 30 days compared with patients admitted on weekdays (13). However, not all studies support the weekend effect. Bray *et al.* concluded that there was no difference in 30-day survival rates between weekend and weekday admissions in stroke patients (14). A separate systematic review evaluated 45 studies related to the weekend effect and found that 53% of studies demonstrated worse outcomes for patients either undergoing surgery or admitted on a weekend (15). That means that the remaining 47% were not able to demonstrate the phenomenon of the weekend effect. Importantly, Zhou *et al.* (16) and Ruiz *et al.* (12) found that the weekend effect appears to be influenced by disease or characteristics inherent to the healthcare system. Acute illnesses are more likely to be affected by the weekend effect. Currently, there are two popular explanations for the weekend effect, each of which is discussed below. The lack of applicability of the following explanations to our center may explain why this study did not find the weekend effect in ATAAD.

First, it is necessary to consider whether there is a difference in hospital staffing and resources between weekdays and weekends. Theoretically, under-resourced staffing and less manpower could contribute to increased mortality. Cross-covering weekend on-call teams may have less experience in the management of disease processes outside of their expertise. In addition, physicians covering on weekends may be overloaded, which in turn may have an impact on patient mortality. Physician fatigue has previously been associated with poorer patient prognosis (17). Furthermore, Kostis *et al.* (18) found that higher weekend mortality is partially mediated by lower rates of invasive procedures and speculated that better access to care on weekends could improve outcomes for patients with acute myocardial infarction. However, in less common conditions such as ATAAD, Ahlsson *et al.* (5) did not find the weekend effect to be relevant. Using the Nordic Consortium for Acute Type A Aortic Dissection Database (NORCAAD) registry, which included data from eight hospitals and 1,159 patients over a 10-year period from 2005 to 2014, the authors found that 30-day mortality was not affected by the timing of operation. Of note, there were an average of 15 procedures per year per center in the NORCAAD report, a relatively small volume. Despite the high demand on resource and staffing for each ATAAD surgery, it may be that the infrequency of such surgeries does not result in a net negative impact on overall resource utilization, thus offsetting the weekend effect in low-volume centers. In contrast, the center in this study performs approximately 200 type A aortic dissection procedures per year, of which around 120 are ATAAD. Despite that this is a much larger number than that reported in the NORCAAD registry, no weekend effect was observed. A potential explanation for this finding is that, as the largest cardiovascular center in southern China, multiple aortic specialty groups are on call on a rotating basis, whether it is a holiday or weekend, always ensuring stable and adequate medical resources. Furthermore, because there is a tendency for aortic disease to be centralized, most patients are referred from other hospitals. By the time they arrive, a diagnosis has already been established, imaging has already been reviewed, a surgical plan is already in place, and the operating room has already been notified. There are minimal delays upon patient arrival, and there is no reliance on other departments such as emergency medicine and radiology, which may experience decreased staffing on weekends. The pre-referral communication with other hospitals allows adequate preparation time ahead of patient arrival. The centralization of ATAAD to a high-volume center may be one of the important reasons a weekend effect was not found in this study.

The second consideration is whether patients admitted or operated on during the weekend are more comorbid. Admissions/procedures are not randomly assigned on weekdays, and there may be selection bias for more comorbid patients on weekends, resulting in worse mortality. The role of selection bias in the difference between weekend and weekday mortality was investigated by LaBounty *et al.*, who found that the number of acute coronary syndrome (ACS) admissions on weekends was less than expected (P<0.001), but the proportion of ACS patients with ST-segment elevation myocardial infarction (STEMI) was 64% higher on weekends (P<0.001). The increased proportion of STEMI resulted in an increased proportion of ACS with AMI on weekends (+10%, P=0.006) (19). Sun *et al.* found that the weekend effect was not significant when adjusted for disease severity (20). In other words, patients with non-emergent or less severe conditions are less likely to present to the hospital on a weekend, but this bias does not apply to patients with severe, life-threatening issues. For example, ATAAD is a fatal disorder with 1% of mortality per hour, leaving little room for admission bias; there is no evidence demonstrating that day of the week should impact the incidence of ATAAD. The results in this study showed that the basic characteristics of the weekend group were almost identical to that of the weekday group, reflecting the "randomization effect" of ATAAD presentation throughout week. Notably, a higher proportion of cases in the weekend group was combined with Penn Aa [62 (43.4%) *vs.* 103 (30.7%), P=0.010] and a lower proportion was combined with Penn Ab [77 (53.8%) *vs.* 224 (66.7%), P=0.011] compared to the weekday group. However, even when adjusting for confounders using logistic regression and propensity scores, no significant weekend effect was found.

There are two multicenter studies by Gallerani *et al.* (21,22) that support the weekend effect in aortic surgery. However, these studies included all aortic ruptures and dissections (whether type A, type B, or abdominal aorta), which is not in line with the cohort within this study. Importantly, the public database [Region Emilia Romagna (RER)] utilized by Gallerani *et al.* is not aortic dissection-specific (or even aortic disease-specific) and lacks crucial variables such as malperfusion status. Despite the large total sample size (n=17,319), there were only 1,057 cases of thoracic aortic dissections (including both type A and type B). Of note, the subgroup analysis showed no difference in weekday and weekend mortality rates for thoracic aortic dissection (OR: 1.361, 95% CI: 0.999–1.853, P=0.052) (22).

Limitation

The quality of healthcare systems and its available resources may vary from country to country, potentially limiting the generalizability of this study. Caution should be exercised before extrapolating the current results to other regions. Furthermore, this is an observational study. A randomized controlled trial might be a better choice to determine whether the weekend effect truly exists, but such an experiment is quite unpractical for ATAAD.

Conclusions

In conclusion, based on this single-center experience and the pooled evidence from available literature, the weekend effect was not found to be applicable to ATAAD outcomes. Notably, the weekend effect is disease-specific and may vary across healthcare systems. Two fundamental aspects that need to be considered are available medical resources and the influence of disease severity on the timing of patient admission. These are factors that should be considered in evaluating whether the weekend is adequately supported for more specific treatment processes.

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Footnote

Reporting Checklist: The authors have completed the STROCSS reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-22-1639/rc

Data Sharing Statement: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-22-1639/dss

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-22-1639/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institutional Review Board of Guangdong Provincial People's Hospital on July 6th, 2021 (No. 2019-842H-1). Written informed consent was not required due to the retrospective nature of the study.

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Supplementary

Table S1 Studies included in the meta-analysis

First author	Year	Weekend effect	Study design	Country	Journal	Sample size	Inclusion period	Age	Male
Anders Ahlsson	2019	Negative	NORCAAD Registry	Multicenter	ATS	1159	2005-2014	61.6±12.2	784 (67.6%)
George Arnaoutakis	2020	Negative	IRAD Registry	Multicenter	JOCS	4186	1996-2019	60.7 ± 14.0	2808 (66.9%)
Simone Gasser	2020	Negative	Case-control study	Austria	ICVTS	319	2000-2018	61 (49–70)	222 (69.6%)
Katsuhito Kato	2021	Positive	JROAD-DPC Registry	Japan	Plos One	7453*, 12798**	2012-2016	71±14**	5869 (45.9%)**
First author	Overall Mortality	NOS score	Event.weekend	n.weekend	Event.weekday	n.weekday	Odds Ratio	95% confidence interval	Note
Anders Ahlsson	204 (18.0%)	9	54	270	150	889	1.04	0.67-1.60	Adjusted
George Arnaoutakis	696 (16.6%)	9	196	1148	500	3038	1.04	0.87-1.25	Calculated using epitools package
Simone Gasser	51 (15.6%)	7	NA	NA	NA	NA	0.96	0.45-1.91	Unadjusted
Katsuhito Kato	3528 (27.6%)**	6	NA	NA	NA	NA	1.41*	1.17-1.68*	Unadjusted

*, surgery cohort; **, overall cohort.

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Table S2 The baseline characteristics, operative data, and outcomes by Weekend versus Weekday group

Variables	Overall	Weekday	Weekend	P value
n	479	347	132	
Baseline characteristics				
Male (%)	404 (84.3)	293 (84.4)	111 (84.1)	1.000
Age (year, median [IQR])	52.0 [45.0, 60.0]	52.0 [45.5, 61.0]	51.0 [44.8, 58.2]	0.515
Height (m, median [IQR])	1.7 [1.6, 1.7]	1.7 [1.6, 1.7]	1.7 [1.6, 1.7]	0.235
Weight (kg, median [IQR])	70.0 [63.0, 79.0]	70.0 [62.8, 79.0]	70.0 [63.0, 80.0]	0.690
BMI (kg/m^2, median [IQR])	24.5 [22.2, 27.1]	24.4 [22.3, 27.0]	24.5 [22.2, 27.3]	0.991
DeBakey II (%)	49 (10.2)	38 (11.0)	11 (8.3)	0.500
Penn Aa (%)	165 (34.4)	124 (35.7)	41 (31.1)	0.393
Penn Ab (%)	301 (62.8)	215 (62.0)	86 (65.2)	0.589
Penn Ab&c (%)	11 (2.3)	7 (2.0)	4 (3.0)	0.749
Penn Ac (%)	2 (0.4)	1 (0.3)	1 (0.8)	1.000
Aortic regurgitation (%)	157 (32.8)	118 (34.0)	39 (29.5)	0.384
Smoking (%)	163 (34.0)	118 (34.0)	45 (34.1)	1.000
Pulmonary artery hypertension (%)	34 (7.1)	23 (6.6)	11 (8.3)	0.551
Hypertension (%)	326 (68.1)	241 (69.5)	85 (64.4)	0.324
Coronary artery disease (%)	46 (9.6)	37 (10.7)	9 (6.8)	0.228
Marfan syndrome (%)	25 (5.2)	15 (4.3)	10 (7.6)	0.169
Hx of cardiovascular surgery (%)	38 (7.9)	28 (8.1)	10 (7.6)	1.000
Diabetes (%)	8 (1.7)	4 (1.2)	4 (3.0)	0.225
COPD (%)	45 (9.4)	38 (11.0)	7 (5.3)	0.078
White blood cell count (*10^9/L, median [IQR])	12.5 [10.2, 15.2]	12.5 [10.3, 15.3]	12.4 [10.0, 14.8]	0.643
Hemoglobin (g/L, median [IQR])	133.0 [123.0, 145.5]	132.0 [122.0, 144.0]	136.0 [128.0, 146.2]	0.068
Platelet count (*10^9/L, median [IQR])	184.0 [151.5, 228.0]	185.0 [153.0, 232.5]	179.5 [145.0, 217.8]	0.186
D-dimer (ng/mL, median [IQR])	10130.0 [3540.0, 20000.0]	9610.0 [3385.0, 20000.0]	15185.0 [4020.0, 20000.0]	0.122
Operative data				
Root (%)				0.746
Bentall	110 (23.0)	78 (22.5)	32 (24.2)	
Cabrol	7 (1.5)	6 (1.7)	1 (0.8)	
David	2 (0.4)	2 (0.6)	0 (0.0)	
Root sparing	322 (67.2)	236 (68.0)	86 (65.2)	
Wheat	38 (7.9)	25 (7.2)	13 (9.8)	
Arch (%)				0.902
Arch Sparing	5 (1.0)	4 (1.2)	1 (0.8)	
Hemiarch	11 (2.3)	8 (2.3)	3 (2.3)	
Hybrid TAR	2 (0.4)	1 (0.3)	1 (0.8)	
TAR	461 (96.2)	334 (96.3)	127 (96.2)	
Cannulation (%)				0.634
Arch	47 (9.8)	35 (10.1)	12 (9.1)	
FA	32 (6.7)	24 (6.9)	8 (6.1)	
IA+FA	62 (12.9)	48 (13.8)	14 (10.6)	
RSA	236 (49.3)	172 (49.6)	64 (48.5)	
RSA+FA	102 (21.3)	68 (19.6)	34 (25.8)	
CABG (%)	33 (6.9)	22 (6.3)	11 (8.3)	0.426
FET (%)	463 (96.7)	336 (96.8)	127 (96.2)	0.777
Operation time (min, median [IQR])	470.0 [420.0, 540.0]	470.0 [420.0, 540.0]	467.5 [415.0, 540.0]	0.622
CPB time (min, median [IQR])	241.0 [210.5, 280.0]	243.0 [213.0, 280.0]	232.5 [205.0, 279.2]	0.316
ACC time (min, median [IQR])	132.0 [103.0, 160.0]	132.0 [105.5, 160.0]	130.5 [101.8, 167.2]	0.862
MHCA time (min, median [IQR])	20.0 [16.0, 24.0]	20.0 [16.0, 24.0]	19.0 [16.0, 24.0]	0.727
MHCA (%)	314 (65.6)	233 (67.1)	81 (61.4)	0.238
Outcomes				
Mortality (%)	36 (7.5)	25 (7.2)	11 (8.3)	0.699
Stroke (%)	27 (5.6)	17 (4.9)	10 (7.6)	0.271
Paraplegia (%)	21 (4.4)	11 (3.2)	10 (7.6)	0.045
CRRT (%)	128 (26.7)	96 (27.7)	32 (24.2)	0.489
Re-exploration (%)	7 (1.5)	6 (1.7)	1 (0.8)	0.679
Delayed chest closure (%)	37 (7.7)	31 (8.9)	6 (4.5)	0.127
Acute lung injury (%)	132 (27.6)	94 (27.1)	38 (28.8)	0.732
Hospital stay (day, median [IQR])	23.0 [18.0, 31.0]	24.0 [18.0, 32.0]	23.0 [17.0, 30.0]	0.168
ICU stay (day, median [IQR])	7.7 [4.8, 12.3]	7.7 [4.8, 12.4]	7.7 [4.8, 11.5]	0.831
Mechanical ventilation time (hour, median [IQR])	97.0 [47.0, 169.0]	96.0 [46.5, 178.5]	112.0 [58.8, 162.0]	0.766

BMI, Body mass index; IQR, interquartile range; Hx, History; COPD, chronic obstructive pulmonary disease; TAR, total arch replacement; FA, femoral artery; IA, innominate artery; RSA, right subclavian artery; CABG, coronary artery bypass graft; FET, frozen elephant trunk; CPB, cardiopulmonary bypass; ACC, aortic cross-clamp; MHCA, moderate hyperthermic cardiac arrest; CRRT, continuous renal replacement therapy; ICU, intensive care unit.

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