

Effects of weekend admission on the outcomes and management of ruptured aortic aneurysms

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Objective: Ruptured aortic aneurysm is a condition with a high rate of mortality that requires prompt surgical intervention. It has been noted that in some conditions requiring such prompt intervention, in-hospital mortality is increased in patients admitted on the weekends compared with patients admitted on weekdays. We sought to determine if this was indeed the case for both ruptured thoracic aortic aneurysms (TAA) and abdominal aortic aneurysms (AAA) and to elucidate the possible reasons.

Methods: Using the Nationwide Inpatient Sample, a publicly available database of inpatient care, we analyzed the incidence of mortality among 7200 patients admitted on the weekends compared with weekdays for ruptured aortic aneurysm. Among these patients, 19% had a TAA and 81% had an AAA, and each group was analyzed for differences in mortality during the hospitalization. We adjusted for demographics, comorbid conditions, hospital characteristics, rates of surgical intervention, timing of surgical intervention, and use of additional therapeutic measures.

Results: Patients admitted on the weekend for both ruptured TAA and AAA had a statistically significant increase in mortality compared with those admitted on the weekdays (TAA: odds ratio, 2.55; 95% confidence interval, 1.77-3.68; $P = .03$; AAA: odds ratio, 1.32; 95% confidence interval, 1.13-1.55; $P = .0004$). Among those with TAA, a surgical intervention was performed on day of admission in 62.1% of weekday admissions vs 34.9% of weekend admissions ($P < .0001$). This difference was much smaller among those with an aortic aneurysm; 79.6% had a surgical intervention on day of admission on a weekday vs 77.2% on the weekend ($P < .0001$).

Conclusions: Weekend admission for ruptured aortic aneurysm is associated with an increased mortality compared with admission on a weekday, and this is likely due to several factors including a delay in prompt surgical intervention. (*J Vasc Surg* 2014;60:318-24.)

Patients with untreated large aortic aneurysms are more likely to die of aneurysm-related complications, such as rupture or dissection, than of anything else.^{1,2} In the United States, aortic aneurysms consistently are among the 20 leading causes of death and account for 4% to 5% of sudden deaths.³ Included in the complications of aortic aneurysm is the risk of rupture, which is defined as bleeding outside the wall of the aneurysm.⁴ With a mortality rate as high as 90%, rupture of an aortic aneurysm is a devastating event that requires prompt diagnosis and expedited treatment.⁵⁻⁷

For treatment of a patient with a ruptured aortic aneurysm, whether thoracic (TAA) or abdominal (AAA), surgical care is nearly universally necessary.⁸ Patients treated surgically may undergo open surgical repair or endovascular aneurysm repair (EVAR), but in an emergent situation, there are issues with aortic endografting. Up to 50% of

patients do not have anatomy that is suitable for EVAR, and it is unclear at this time if EVAR has a clinical benefit.^{9,10} Institutions are now frequently putting into place protocols for endovascular repair of ruptured aneurysms. However, given the emerging nature of this technology and the high level of specialization required to carry out the procedure, many hospitals are ill-equipped to handle ruptured aneurysms in this manner.⁹ Therefore, there continues to be a need for round-the-clock access to open surgical repair, which can require more resources and staff. Nonetheless, given the mortality associated with even treated ruptured aortic aneurysm, such critical surgical care should be available irrespective of when patients are admitted. As a result, it is alarming that in recent years, the quality of care of patients in hospitals depending on the day of admission has been increasingly called into question.¹¹

Several studies have demonstrated a higher mortality for patients admitted to the hospital on the weekends than on the weekdays for certain acute conditions including aortic aneurysms; this has been referred to as the weekend effect.^{12,13} A study examining emergency hospitalizations in a limited number of acute care hospitals of patients in Ontario, Canada, found that patients admitted on the weekend for ruptured AAA had higher rates of in-hospital mortality than did patients admitted on the weekdays,¹¹ whereas a study in Italy found that hospitalization for acute aortic dissection and aneurysm rupture on the weekend was associated with a significantly higher mortality rate than hospitalization on weekdays.¹⁴

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However, no studies have examined the weekend effect in regard to ruptured aortic aneurysm in the United States. In addition, there are many factors that play an important role in the expedited delivery of care for this devastating illness that have not been fully examined. In this study, we examined the weekend effect using a large, representative national sample of inpatients from the United States.

METHODS

This study examined mortality frequency differences between weekend admissions and weekday admissions for patients with ruptured aortic aneurysm using discharge data from the Nationwide Inpatient Sample (NIS) collected by the Healthcare Cost and Utilization Project in the Agency for Healthcare Research and Quality (AHRQ). NIS is a powerful database that includes data of approximately seven million hospital inpatient stays from approximately 1000 hospitals selected to estimate a 20% stratified sample of U.S. hospitals. NIS is regularly used to identify, to track, and to analyze national trends in health care utilization, charges, quality, and outcomes. All adult patients 18 years and older discharged with a main International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis code for ruptured aortic aneurysm (ICD-9-CM codes 441) were included in the study. Data were analyzed separately for ruptured TAA (ICD-9-CM code 441.1) and ruptured AAA (ICD-9-CM code 441.3), given the known differences in the mortality of these two conditions.

In the NIS data set, a weekend admission is defined as an admission occurring between Friday at midnight and Sunday at midnight; all other admissions are considered weekday admissions. Hospitals are classified by location and teaching status. Location status was obtained from the American Hospital Association Annual Survey of Hospitals, which defines a metropolitan statistical area as urban and a nonmetropolitan area as rural. Teaching hospitals are defined by having either an American Medical Association-approved residency program or a membership in the Council of Teaching Hospitals. Hospital size was assessed by the number of short-term acute beds in a hospital on the basis of information obtained from the American Hospital Association Annual Survey of Hospitals. Each hospital was then categorized as small, medium, or large.

Comorbid conditions were individually identified by Comorbidity Software developed by the AHRQ (Rockville, Md). This software assigns variables that identify comorbidities in hospital discharge records by the diagnosis coding of ICD-9-CM and creates the comorbidity measures reported by Elixhauser et al.¹⁵ Elixhauser comorbidity measures are significantly associated with in-hospital mortality.¹⁶ In-hospital mortality was the primary outcome of interest. Because therapeutic procedures ideally should be performed as soon as indicated, we examined if these procedures are significantly delayed on weekends compared with weekdays.

We used SAS software, version 9.3 (SAS Institute, Inc, Cary, NC) to investigate the relationship between weekend

admission and mortality, which was the primary data of interest. In addition, because therapeutic procedures ideally should be performed as soon as indicated, we examined if these procedures take longer on weekends. Logistic regression analysis was used to compare the mortality rates between weekend admissions and weekday admissions. Bivariate analysis was performed to find variables that were significantly associated with mortality. All variables with statistically significant association with mortality were included in the final model. The variables included age; race; primary payer; AHRQ comorbidities; and hospital characteristics, such as hospital location, hospital teaching status, and hospital bed size. These variables were also tested for multicollinearity. All two-way interaction terms were examined, and the terms with significance were included in the model. Linear regression examined the weekend admission effect on hospital charges and length of stay. These two variables were log transformed and normalized to satisfy normality and other regression analysis assumptions. Statistical significance was defined as $P < .05$.

RESULTS

Baseline characteristics. The 2009 NIS database included 7200 admissions for ruptured aortic aneurysm, of which 75.63% were admitted on weekdays and 24.36% were admitted on the weekend (Table I). TAA accounted for only 19% of total admissions, whereas AAA accounted for the remaining 81%. For TAA admissions on the weekdays, 72.3% were men and 27.7% were women, whereas for admissions on the weekend, 72.4% were men and 27.6% were women. For AAA admissions, 50% were men on the weekdays and 57.9% were men on the weekend. Patients admitted on the weekdays were older than those admitted on the weekend for both TAA and AAA; however, the difference was not significant. More patients admitted on the weekend were categorized as self-pay in terms of their primary payer for patients with TAA but less so with AAA (Table I). Patients admitted for ruptured aortic aneurysms on the weekdays had some minor differences in comorbidities from patients admitted on the weekend (Table II).

In-hospital mortality. Unadjusted mortality was not significantly higher in weekend vs weekday admission among those with ruptured AAA (Fig); however, among those with ruptured TAA, 51.8% of those admitted on the weekend had mortality compared with 40.9% of those admitted on the weekday ($P = .0004$; Fig). In adjusted analysis, mortality was significantly higher for both TAA and AAA after adjustment for demographics, insurance, hospital characteristics, and all AHRQ comorbidity measures (TAA: odds ratio [OR], 2.55; 95% confidence interval [CI], 1.77-3.68; AAA: OR, 1.32; 95% CI, 1.13-1.55; Table III).

In comparing hospitals, there was no significant difference in mortality for ruptured aortic aneurysms between teaching and nonteaching hospitals, urban and rural hospitals, or the different sizes of hospitals. However, there was a significant difference for primary payer in patients with

Table I. Baseline demographic characteristics

	TAA			AAA		
	Weekday	Weekend	P value	Weekday	Weekend	P value
Total (7200)	1078 (76.9%)	322 (23.0%)		4368 (75.3%)	1432 (24.7%)	
Mean age, years (SD)	74.0 (13.0)	71.9 (14.7)	.27	75.4 (10.5)	74.4 (10.0)	.14
Male, %	72.3	72.4	.94	50.0	57.9	.01
Race, %			.04			.10
White	86.2	84.8		78.8	72.1	
Black	4.3	5.5		12.4	17.6	
Hispanic	4.8	3.6		3.1	4.8	
Asian	1.6	1.7		2.2	1.8	
Native American	0.0	0.0		0.6	0.0	
Other	2.9	4.1		2.6	3.4	
Primary payer, %			.0001			<.0001
Medicare	75.7	74.0		74.2	74.5	
Medicaid	2.9	1.0		4.9	5.3	
Private	16.6	19.1		16.8	18.6	
Self-pay	2.8	3.7		2.5	0.0	
No charge	0.0	0.0		0.0	1.4	
Other	1.8	2.0		1.4	0.0	
Location of hospital, %			.48			.01
Rural	8.4	9.0		10.9	6.3	
Urban	91.5	90.9		89.0	93.6	
Teaching status of hospital, %			.0004			.004
Teaching	54.8	60.2		70.38	61.9	
Nonteaching	45.1	39.7		29.6	38.0	
Bed size of hospital, %			.004			.19
Small	8.0	8.7		10.9	8.1	
Medium	23.2	27.1		16.0	14.0	
Large	68.7	64.0		73.0	77.8	

AAA, Abdominal aortic aneurysm; SD, standard deviation; TAA, thoracic aortic aneurysm.

AAA. Patients with Medicaid, compared with Medicare, had a consistently higher rate of mortality (OR, 2.38; 95% CI, 1.09-5.16, and OR, 3.29; 95% CI, 2.04-5.30 for TAA and AAA, respectively) (Table III). Among those with AAA, self-pay and private insurance were also associated with higher mortality. Furthermore, there were no gender differences in mortality, and race did not have a consistent association with in-hospital mortality from ruptured aortic aneurysms.

Surgical intervention. Using standard ICD-9 codes for common procedures performed on those with ruptured aneurysm, we found no significant difference in the use of any procedural repair (EVAR or open repair) in those with ruptured AAA but did find that those admitted on the weekends with ruptured TAA had significantly fewer procedural interventions. The unadjusted ORs for surgical intervention were 0.55 (95% CI, 0.31-0.98) for TAA and 1.10 (95% CI, 0.84-1.46) for AAA for weekend admissions. These results were then adjusted for age, sex, race (white, black, Hispanic, Asian, Native American, other), primary payer (Medicare, Medicaid, private, self-pay, no charge, other), location of hospital (urban, rural), teaching status of hospital (teaching, nonteaching), bed size of hospital (large, medium, small), and all AHRQ comorbidities. The OR remained statistically significant for TAA (OR, 0.42; 95% CI, 0.27-0.65). The adjusted OR for surgical intervention for AAA suggests fewer surgical

interventions among weekend-admitted patients (OR, 0.95; 95% CI, 0.81-1.13). However, this association was not statistically significant. What was most striking, however, was that in TAA, 62.1% of patients admitted on a weekday had their procedure on the day of admission, whereas only 34.9% of patients admitted on the weekend underwent surgery on the day of admission. In AAA, 79.6% of patients admitted on a weekday had their procedure on the day of admission, and 77.2% of patients admitted on the weekend underwent same-day surgery. This difference is statistically significant for both TAA and AAA ($P < .001$) and may represent an important delay in lifesaving care (Table IV).

With regard to the breakdown by procedure type, for AAA there were no differences in the type of surgical intervention on the weekdays and weekends as EVAR and open repair rates were similar. However, for TAA, more patients admitted on the weekdays underwent open repair on the weekdays, 38.3% vs 26.9% on the weekends ($P < .001$). This difference in part accounted for the fact that a patient admitted on the weekday with TAA was in fact more likely to have any surgical repair (49.4% vs 34.8%; $P < .001$) (Table IV).

Adjunctive medical care. Subanalysis was conducted as well to determine if there were any important differences in the care given to patients admitted on the weekend and weekdays. One interesting finding was that patients admitted on the weekend had a dramatically higher rate

Table II. Baseline demographic characteristics (comorbidity measure)

<i>AHRQ</i> comorbidity measure	TAA			AAA		
	Weekday, %	Weekend, %	P value	Weekday, %	Weekend, %	P value
Acquired immunodeficiency syndrome	0	0	—	0	0	—
Alcohol abuse	3.1	2.9	.79	1.8	1.4	.59
Deficiency anemias	16.0	16.2	.83	14.0	20.3	.006
Rheumatoid arthritis/collagen vascular diseases	2.4	1.4	.02	1.9	1.7	.88
Chronic blood loss anemia	2.8	3.8	.06	3.2	4.9	.15
Congestive heart failure	5.2	5.1	.82	7.1	11.0	.02
Chronic pulmonary disease	28.3	30.9	.06	26.4	26.8	.87
Coagulopathies	22.5	18.6	.01	12.7	9.6	.13
Depression	2.8	4.1	.01	3.7	1.6	.05
Diabetes	14.0	16.8	.008	12.8	16.6	.07
Drug abuse	0.5	0.0	.005	1.3	1.3	.92
Hypertension	60.2	63.7	.01	72.9	64.2	.002
Hypothyroidism	7.4	7.0	.60	5.6	7.8	.14
Liver disease	0.8	2.3	<.0001	1.8	0.0	.01
Lymphoma	0.2	0.7	.003	0.9	1.4	.4
Fluid and electrolyte disorders	40.4	44.9	.002	29.4	30.2	.78
Metastatic cancer	0.89	1.4	.05	0	0	—
Other neurologic disorders	5.7	3.9	.008	7.7	4.8	.06
Obesity	7.5	10.2	.001	3.9	3.0	.43
Paralysis	2.2	2.4	.65	5.5	0	<.0001
Peripheral vascular disorders	31.9	31.6	.84	29.6	33.7	.15
Psychoses	1.4	2.4	.01	0.4	3.0	<.0001
Pulmonary circulation disorders	0.7	0.7	.76	2.2	1.4	.39
Renal failure	17.4	13.1	.0002	18.1	20.5	.34
Solid tumor without metastasis	3.0	3.1	.83	0.9	3.0	.004
Peptic ulcer disease	0.0	0.3	<.0001	0	0	—
Valvular disease	1.4	1.3	.82	4.9	6.4	.29
Weight loss	11.2	11.7	.61	8.1	13.4	.004
Hyperlipidemia	27.1	29.0	.14	35.5	26.8	.003

AAA, Abdominal aortic aneurysm; *AHRQ*, Agency for Healthcare Research and Quality; TAA, thoracic aortic aneurysm.

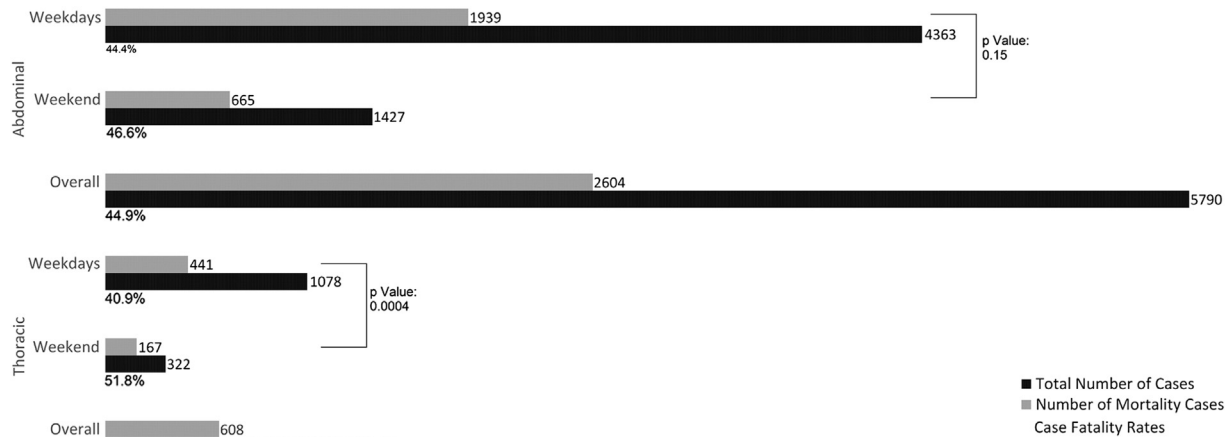


Fig. Weekday vs weekend crude mortality in those admitted with ruptured abdominal aortic aneurysms (AAA) and thoracic aortic aneurysms (TAA).

of transfusion of blood products in both TAA and AAA groups. Weekend-admitted patients underwent transfusion 39.16% of the time, whereas those admitted on the weekdays had a transfusion rate of only 29.36% in the total population. Table IV shows the data for transfusions for both groups, which are significant. Other variables, such as

need for mechanical ventilation, were compared and failed to reach statistical significance.

DISCUSSION

Aneurysm rupture is a life-threatening complication of aortic aneurysm and has a high morbidity and mortality.⁸

Table III. Multivariate analysis, weekend admission, and in-hospital mortality

	TAA		AAA	
	OR (95% CI)	P value	OR (95% CI)	P value
Weekend ^a	2.55 (1.77-3.68)	<.0001	1.32 (1.13-1.55)	.0004
Age	1.04 (1.02-1.06)	<.0001	1.07 (1.06-1.08)	<.0001
Male	0.75 (0.55-1.05)	.09	0.91 (0.77-1.06)	.23
Race				
White	Reference		Reference	
Black	0.61 (0.38-0.99)	.04	0.88 (0.63-1.23)	.47
Hispanic	0.68 (0.27-1.72)	.42	0.96 (0.69-1.32)	.80
Asian	—	.99	1.56 (0.93-2.61)	.09
Native American	—	.99	—	—
Other	0.19 (0.05-0.64)	.007	0.39 (0.25-0.60)	<.0001
Primary payer, %				
Medicare	Reference		Reference	
Medicaid	2.38 (1.09-5.16)	.02	3.29 (2.04-5.30)	<.0001
Private	0.96 (0.58-1.59)	.88	1.35 (1.11-1.63)	.002
Self-pay	0.96 (0.58-1.59)	.98	2.20 (1.49-3.24)	<.0001
Location of hospital, %				
Urban	Reference		Reference	
Rural	0.46 (0.26-0.81)	.007	1.27 (0.97-1.65)	.07
Teaching status of hospital, %				
Nonteaching	Reference		Reference	
Teaching	0.64 (0.40-1.01)	.06	0.91 (0.77-1.071)	.25
Bed size of hospital, %				
Large	Reference		Reference	
Medium	0.54 (0.30-0.96)	.03	1.08 (0.83-1.41)	.54
Small	0.78 (0.50-1.21)	.27	0.95 (0.79-1.13)	.57

AAA, Abdominal aortic aneurysm; CI, confidence interval; OR, odds ratio; TAA, thoracic aortic aneurysm.

^aAdjusted for age, sex, race (white, black, Hispanic, Asian, Native American, other), primary payer (Medicare, Medicaid, private, self-pay, no charge, other), location of hospital (urban, rural), teaching status of hospital (teaching, nonteaching), bed size of hospital (large, medium, small), all Agency for Healthcare Research and Quality (AHRQ) comorbidity measures (including acquired immunodeficiency syndrome, alcohol abuse, deficiency anemias, rheumatoid arthritis/collagen vascular diseases, chronic blood loss anemia, congestive heart failure, chronic pulmonary disease, coagulopathy, depression, diabetes, drug abuse, hypertension, hypothyroidism, liver disease, lymphoma, fluid and electrolyte disorders, metastatic cancer, other neurologic disorders, obesity, paralysis, peripheral vascular disorders, psychoses, pulmonary circulation disorders, renal failure, solid tumor without metastasis, peptic ulcer disease excluding bleeding, valvular disease, and weight loss), and total discharges.

Without repair, ruptured aortic aneurysms are nearly uniformly fatal and require a corrective procedure as soon as the rupture is identified.^{8,17,18} The necessity of prompt action in the care of ruptured aortic aneurysms makes it an excellent model for evaluation of what is referred to as the weekend effect.

We analyzed a large pool of patients who presented with ruptured aortic aneurysms in both the thoracic cavity and the abdomen. These patients were then stratified as to whether they were admitted on weekdays or weekends. Through this analysis, we discovered many important differences in the care of the two subgroups that may be associated with a significant increase in mortality when a patient is admitted with a ruptured aneurysm on the weekend.

We found that a patient admitted on the weekend with a ruptured aortic aneurysm had a greater than 2.5-fold increase in the odds of dying compared with those admitted on a weekday for ruptured TAA and a 32% higher chance of death for a ruptured AAA. This is a finding that has been seen in other studies examining several medical and surgical conditions.^{19,20} However, reasons in each condition tend to vary, and the weekend effect on ruptured aortic aneurysms had not been previously examined in the United States. As to why there is a weekend effect with regard

to ruptured aortic aneurysms, a clear explanation has yet to be elucidated; however, we examined the association of hospital- and procedure-related variables with weekend admission to gain additional insight.

To determine why there was a significant increase in mortality for weekend-admitted patients, we first looked at the rates of surgical intervention. EVAR and open surgical aneurysm repair are the predominant surgical methods used in the acute setting for a ruptured aortic aneurysm, with EVAR currently being preferred because of some studies suggesting a lower perioperative morbidity and mortality, although as stated previously, some studies also refute this.^{21,22} We found that patients admitted on the weekdays and weekends for ruptured AAA had similar rates of EVAR and open repair, whereas the difference was significant for TAA. This alone, however, would not explain the much more significant increase in mortality. We also found that whereas the rate of surgical intervention was lower on the weekend for TAA, it was not different for AAA, but the timing of those interventions was significantly different. Patients admitted on the weekdays were far more likely to have surgery on the day of admission, particularly in the case of ruptured TAA; this difference is also significant in ruptured AAA, although not to such a

Table IV. Procedures, length of stay, hospital charges, and for ruptured aortic aneurysm, weekend vs weekday admission

	TAA			AAA		
	Weekday	Weekend	P value	Weekday	Weekend	P value
Procedure on admission day, %	62.1	34.9	<.001	79.6	77.2	<.001
Endovascular repair of vessel, %	24.1	17.8	.03	24.2	24.7	.74
Resection of vessel with replacement, %	38.3	26.9	.0009	45.4	46.1	.67
Mechanical ventilation, %	17.0	13.1	.13	26.0	24.4	.26
Transfusion of blood or blood components, %	14.3	26.7	<.001	32.9	41.6	<.001
Any repair, %	49.4	34.8	<.001	59.2	61.4	.14
Mean length of stay, days (SD)	10.7 (18.2)	8.6 (13.5)	.38	9.4 (13.7)	8.8 (10.4)	.50
Mean length of stay in survivals, days (SD)	12.9 (15.8)	14.0 (17.3)	.73	13.2 (15.1)	12.4 (10.8)	.52
Total charges, USD (SD)	140,783 (204,171)	131,314 (206,697)	.74	130,595 (153,112)	138,326 (164,579)	.47

AAA, Abdominal aortic aneurysm; SD, standard deviation; TAA, thoracic aortic aneurysm.

dramatic degree. A delay in surgical intervention when a patient presents with a ruptured aortic aneurysm has been shown to have a substantial negative impact on mortality.^{23,24} Therefore, our data suggest that patients admitted on the weekend did receive appropriate surgical intervention; however, this intervention was delayed, which can be a factor leading to an increase in mortality. Of course, additional factors may play into the delay in care and the increase in weekend mortality.

Further evidence of this delay in care was illustrated by a subanalysis of the need for blood transfusions. Rupture of an aortic aneurysm causes an acute blood loss that only increases with a delay in repair. Thus, with a delay in time to surgery, it would be expected that patients admitted on the weekend would have a greater demand for blood products. This suspicion was confirmed, and we found that weekend patients had a significant increase in the need for blood products compared with the patients admitted on weekdays, although open repair can also be associated with increase in the use of blood products, given the nature of the procedure, as can changes in hemodynamics associated with this serious condition. However, in our analysis of ruptured AAA, the patients had no statistical difference in the rate of open repair based on day of admission, but still weekend patients required significantly more transfusions, and those with ruptured TAA required more transfusions on the weekend despite a lower rate of open repair. This would seem again to suggest that increased rates of transfusions were associated with a delay in care.

Other previous papers have postulated systems-based reasons for the weekend effect.^{12-14,19,20} These include a decrease in staffing at many hospitals on the weekend, which results in an increased patient-to-physician and patient-to-nurse ratio that may result in a delay in care. Additional reasons include a decrease in the availability of subspecialty consultation, operating room staff, advanced imaging, and on-site image interpretation, among others. The constellation of these factors can easily lead to a delay in diagnosis, a delay in surgery, or the combination of the two, despite the best efforts and intentions of the treating practitioners.

This study has limitations in the inability to discern the exact reason for delay in care because of the use of a retrospective database analysis. However, with a patient population of more than 7000, it can be reasonably assumed that after adjustment for many different factors, the delays in care were not due to a dramatic change in the patient population that presented on the weekends vs weekdays on the basis of the factors we measured. Any confounders would also have to vary between weekends and weekdays to attenuate our results. In fact, the patients admitted on the weekdays tended to be older, and age typically tends to be associated with more medical comorbidities and a greater surgical risk.²⁵ Strengths of our analysis are the large patient population and nationally representative sample. In addition, we had access to all interventions performed and their timing, which helped support our conclusions.

Potential implications of the failure to provide patients with the same care on the weekends as is delivered on the weekdays are numerous. To begin with, if patients are aware of this, they may wait to present to the hospital, which in fact may simply increase overall mortality as conditions such as ruptured aortic aneurysms require prompt intervention as previously discussed. In addition, there are significant health policy implications. Hospitals may need to increase weekend staffing and availability of resources. Diagnostic and therapeutic modalities need to be more readily available, as does subspecialty care. Of course, to deliver this would be costly and warrants further investigation, including prospective studies to examine weekday to weekend mortality differences.

CONCLUSIONS

The weekend effect is seen across many medical and surgical conditions. We have illustrated this effect for ruptured aortic aneurysms in a nationally representative population in the United States. We found that not only do patients admitted with ruptured aortic aneurysms have a higher mortality if they are admitted on the weekend, but this is likely due to a delay in care of a condition that demands prompt intervention. Systems-based processes of

care may need to be evaluated to help decrease the adverse outcomes associated with being admitted on a weekend.

AUTHOR CONTRIBUTIONS

Conception and design: MK, SM

Analysis and interpretation: MK, EG, SM, CL

Data collection: MK

Writing the article: MK, EG

Critical revision of the article: SM, CL

Final approval of the article: SM

Statistical analysis: MK

Obtained funding: SM

Overall responsibility: SM

EG and MK contributed equally to this article and share co-first authorship.

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