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The Effects of Weekend Admission on the Outcomes and Management of Ruptured Aortic Aneurysms

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Abstract

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 as compared to patients admitted on weekdays. We sought to determine if this was indeed the case for both ruptured thoracic and abdominal aortic aneurysm and elucidate the possible reasons.

Methods—Using the Nationwide Inpatient Sample (NIS), a publicly available database of inpatient care, we analyzed the incidence of mortality among 7200 patients admitted on the weekends compared to weekdays for ruptured aortic aneurysm. Among these patients 19% had thoracic aortic aneurysm and 81% had abdominal aortic aneurysm and were 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 thoracic and abdominal aortic aneurysm had a statistically significant increase in mortality as compared to those admitted on the weekdays, Odds ratio (OR) = 2.55, 95% confidence interval (CI) 1.77–3.68, p=0.03 for thoracic and OR =1.32, 95% CI 1.13–1.55, p=0.0004 for abdominal aortic aneurysm. Among those with thoracic aortic aneurysm, a surgical intervention was performed on day of admission in 62.1% of weekday admissions vs. 34.9% 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 when admitted on a weekday vs. 77.2% on weekend, p<.0001.

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Conclusions—Weekend admission for ruptured aortic aneurysm is associated with an increased mortality when compared to those admitted on the weekend and this is likely due to several factors including a delay in prompt surgical intervention.

Introduction

Patients with untreated large aortic aneurysms are more likely to die of aneurysm related complications, such as rupture or dissection, than anything else[1, 2]. In the United States, aortic aneurysms consistently are among the twenty leading causes of death and account for 4–5% 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].

In order to treat 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, and 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. None the less, 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 abdominal aortic aneurysms had higher rates of in-hospital mortality than patients admitted on the weekdays[11]. While 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 hospitalizations on weekdays[14].

However, no studies have examined the weekend effect in regards to ruptured aortic aneurysm in United States. Additionally there are many factors that play an important role in the expedited delivery of care for this devastating illness. 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 (RAA) using discharge data from the Nationwide Inpatient Sample (NIS) collected by the Healthcare Cost and Utilization Project (HCUP) in the Agency for Healthcare Research and Quality. NIS is a powerful database which includes data on approximately seven million hospital inpatient stays from approximately 1,000 hospitals selected to estimate a twenty percent stratified sample of US hospitals. NIS is regularly used to identify, track, and analyze national trends in health care utilization, charges, quality, and outcomes. All adult patients 18 years and older discharged with a main diagnosis code for RAA (ICD-9-CM codes 441) were included in the study. Data was 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 dataset, a weekend admission is defined as an admission occurring between Friday at midnight and Sunday at midnight; all other admissions were considered weekday admissions. Hospitals are classified by location and teaching status. Location status was obtained from the AHA Annual Survey of Hospitals which defined a metropolitan statistical area as urban, and a non-metropolitan area as rural. Teaching hospitals are defined by having either an AMA-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 based on information obtained from the AHA Annual Survey of Hospitals. Each hospital was then categorized as small, medium or large.

Comorbid conditions individually identified using Comorbidity software developed by Agency for Healthcare Research and Quality (Rockville). This software assigns variables that identify comorbidities in hospital discharge records using 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 outcomes of interest. Since therapeutic procedures ideally should be performed as soon as indicated, we examined if these procedures are significantly delayed on weekends as compared to 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. Additionally, since 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 1). TAA accounted for only 19% of total admissions while AAA accounted for the remaining 81%. For TAA admissions on the weekdays, 72.3% were male and 27.7% were female. While for admissions on the weekend, 72.4% were male and 27.6% were female. For AAA admissions on the weekdays, 50% were male and 57.9% were male 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 prayer for patients with TAA but less so with AAA (Table 1). Patients admitted for ruptured aortic aneurysms on the weekdays had some minor differences in comorbidities from patients admitted on the weekend (Table 2).

In-hospital Mortality

Unadjusted mortality was not significantly higher in weekend versus weekday admission among those with ruptured abdominal aortic aneurysm (AAA) (Figure 1), however among those with ruptured thoracic aneurysm (TAA), 51.8% of those admitted on the weekend had mortality compared to 40.9% of those admitted on the weekday ($p= 0.0004$) (Figure 1). 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: OR 2.55, 95% Confidence Interval (CI), 1.77–3.68; AAA: OR 1.32, 95% CI, 1.13–1.55) (Table 3).

When comparing hospitals, there was no significant difference in mortality for ruptured aortic aneurysms between teaching and non-teaching hospitals, urban and rural hospitals as well as the different sizes of hospitals. However, there was a significant difference for primary payer in patients with AAA. Patients with Medicaid when compared to 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 3). Among those with AAA, self-pay and private insurance was 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 usage 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 significant fewer procedural interventions. The unadjusted odds ratios 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), Bedsize of hospital (Large, Medium, Small), and all AHRQ comorbidities. The odds ratio remained statistically significant for TAA (OR 0.42 with 95% CI 0.27–0.65). The adjusted odds ratio for surgical intervention for AAA suggests lesser 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, where 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 ($P<0.001$) and may represent an important delay life saving care (Table 4).

With regard to the breakdown by procedure type, in 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% versus 26.9% on the weekends ($P<0.001$). 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% versus 34.8%, $P<0.001$) (Table 4).

Adjunctive Medical Care

Sub-analysis 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 patient admitted on the weekend had a dramatically higher rate 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 4 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]. Without repair ruptured aortic aneurysms are 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 was admitted with a ruptured aneurysm on the weekend.

When admitted on the weekend with a ruptured aortic aneurysm we found that a patient had greater than a two and a half fold increase in the odds of dying when compared to those admitted on a weekday for ruptured thoracic aneurysm and 32% higher chance of death when admitted with 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. With regard 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 to weekend admission to gain additional insight.

In order 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 due to 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 while the difference was significant in TAA. This alone however would not explain the much more significant increase in mortality. We also found that while 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 thoracic aneurysms; this difference is also significant in ruptured abdominal aneurysms although not to such a 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 suggests 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 to the increase in weekend mortality.

Further evidence of this delay in care was illustrated by a sub-analysis 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 which 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 due to the use of a retrospective database analysis. However, with a patient population of over 7000, it can be reasonably assumed that after adjusting for many different factors that the delays in care were not due to a dramatic change in the patient population that presented on the weekends versus weekday based on the factors we measured. Any confounders would have to also vary between weekend and weekdays in order 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 co-morbidities and a greater surgical risk[25]. Strengths of our analysis are the large patient population and nationally representative sample. Additionally we had access to all interventions preformed 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. Additionally, 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.

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

References

1. Griepp, R.; Ergin, MA.; Lansman, S.; Galla, J.; Pogo, G., editors. Seminars in thoracic and cardiovascular surgery. 1991. The natural history of thoracic aortic aneurysms.

2. Giles KA, Pomposelli F, Hamdan A, Wyers M, Jhaveri A, Schermerhorn ML. Decrease in total aneurysm-related deaths in the era of endovascular aneurysm repair. Journal of Vascular Surgery. 2009; 49(3):543–550. [PubMed: 19135843]

3. Murphy SL, Xu J, Kochanek KD. Deaths: final data for 2010. National vital statistics reports. 2013; 61(4)

4. Dillavou ED, Muluk SC, Makaroun MS. A decade of change in abdominal aortic aneurysm repair in the United States: Have we improved outcomes equally between men and women? Journal of vascular surgery: official publication, the Society for Vascular Surgery [and] International Society for Cardiovascular Surgery, North American Chapter. 2006; 43(2):230.

5. Kuivaniemi H, Platsoucas CD, Tilson MD III. Aortic aneurysms an immune disease with a strong genetic component. Circulation. 2008; 117(2):242–252. [PubMed: 18195185]

6. Rubano E, Mehta N, Caputo W, Paladino L, Sinert R. Systematic Review: Emergency Department Bedside Ultrasonography for Diagnosing Suspected Abdominal Aortic Aneurysm. Academic Emergency Medicine. 2013; 20(2):128–138. [PubMed: 23406071]

7. Mohan PP, Rozenfeld M, Kane RA, Calandra JD, Hamblin MH. Nationwide trends in abdominal aortic aneurysm repair and use of endovascular repair in the emergency setting. Journal of Vascular and Interventional Radiology. 2012; 23(3):338–344. [PubMed: 22365291]

8. Chaikof EL, Brewster DC, Dalman RL, Makaroun MS, Illig KA, Sicard GA, et al. SVS practice guidelines for the care of patients with an abdominal aortic aneurysm: executive summary. Journal of Vascular Surgery. 2009; 50(4):880. [PubMed: 19786241]

9. Ten Bosch JA, Teijink JA, Willigendael EM, Prins MH. Endovascular aneurysm repair is superior to open surgery for ruptured abdominal aortic aneurysms in EVAR-suitable patients. Journal of Vascular Surgery. 2010; 52(1):13–18. [PubMed: 20471775]

10. De Bruin JL, Baas AF, Buth J, Prinssen M, Verhoeven EL, Cuypers PW, et al. Long-term outcome of open or endovascular repair of abdominal aortic aneurysm. New England Journal of Medicine. 2010; 362(20):1881–1889. [PubMed: 20484396]

11. Bell CM, Redelmeier DA. Mortality among patients admitted to hospitals on weekends as compared with weekdays. New England Journal of Medicine. 2001; 345(9):663–668. [PubMed: 11547721]

12. Cram P, Hillis SL, Barnett M, Rosenthal GE. Effects of weekend admission and hospital teaching status on in-hospital mortality. The American journal of medicine. 2004; 117(3):151–157. [PubMed: 15276592]

13. Kostis WJ, Demissie K, Marcella SW, Shao Y-H, Wilson AC, Moreyra AE. Weekend versus weekday admission and mortality from myocardial infarction. New England Journal of Medicine. 2007; 356(11):1099–1109. [PubMed: 17360988]

14. Gallerani M, Imberti D, Bossone E, Eagle KA, Manfredini R. Higher mortality in patients hospitalized for acute aortic rupture or dissection during weekends. Journal of Vascular Surgery. 2012; 55(5):1247–1254. [PubMed: 22542339]

15. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. Medical care. 1998; 36(1):8–27. [PubMed: 9431328]

16. van Walraven C, Austin PC, Jennings A, Quan H, Forster AJ. A modification of the Elixhauser comorbidity measures into a point system for hospital death using administrative data. Medical care. 2009; 47(6):626–633. [PubMed: 19433995]

17. Lesperance K, Andersen C, Singh N, Starnes B, Martin MJ. Expanding use of emergency endovascular repair for ruptured abdominal aortic aneurysms: disparities in outcomes from a nationwide perspective. Journal of Vascular Surgery. 2008; 47(6):1165–1171. [PubMed: 18394857]

18. Sullivan CA, Rohrer MJ, Cutler BS. Clinical management of the symptomatic but unruptured abdominal aortic aneurysm. Journal of Vascular Surgery. 1990; 11(6):799–803. [PubMed: 2359191]

19. Busl KM, Prabhakaran S. Predictors of mortality in nontraumatic subdural hematoma: Clinical article. Journal of Neurosurgery. 2013:1–6.

20. Béjot Y, Aboa-Eboulé C, Jacquin A, Troisgros O, Hervieu M, Durier J, et al. Stroke care organization overcomes the deleterious 'weekend effect'on 1-month stroke mortality: a population-based study. European Journal of Neurology. 2013
21. Mohan PP, Hamblin MH. Comparison of Endovascular and Open Repair of Ruptured Abdominal Aortic Aneurysm in the United States in the Past Decade. Cardiovascular and interventional radiology. 2013:1–6.
22. Nedeau AE, Pomposelli FB, Hamdan AD, Wyers MC, Hsu R, Sachs T, et al. Endovascular vs open repair for ruptured abdominal aortic aneurysm. Journal of Vascular Surgery. 2012; 56(1):15–20. [PubMed: 22626871]
23. Veith FJ, Lachat M, Mayer D, Malina M, Holst J, Mehta M, et al. Collected world and single center experience with endovascular treatment of ruptured abdominal aortic aneurysms. Annals of surgery. 2009; 250(5):818–824. [PubMed: 19809296]
24. Starnes BW, Quiroga E, Hutter C, Tran NT, Hatsukami T, Meissner M, et al. Management of ruptured abdominal aortic aneurysm in the endovascular era. Journal of Vascular Surgery. 2010; 51(1):9–18. [PubMed: 19883986]
25. Ferguson TB Jr, Hammill BG, Peterson ED, DeLong ER, Grover FL. A decade of change—risk profiles and outcomes for isolated coronary artery bypass grafting procedures, 1990–1999: a report from the STS National Database Committee and the Duke Clinical Research Institute. The Annals of Thoracic Surgery. 2002; 73(2):480–489. [PubMed: 11845863]

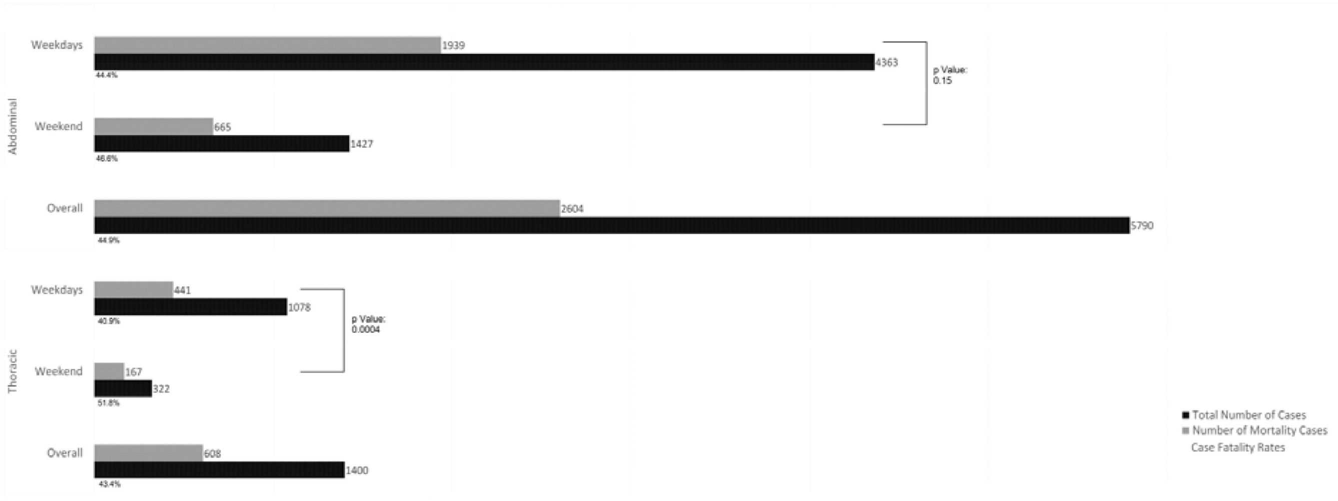

Figure 1.

Weekday versus Weekend Crude Mortality in those admitted with Ruptured Abdominal and Thoracic Aortic Aneurysms

Table 1

Baseline Demographic Characteristics

	Thoracic Aortic Aneurysm			**Abdominal Aortic Aneurysm**		
	Weekday	**Weekend**	**p Value**	**Weekday**	**Weekend**	**p Value**
Total (7200)	*1078 (76.9%)*	*322 (23.0%)*		*4368 (75.3%)*	*1432 (24.7%)*	
Age, mean (SD)	74.0 (13.0)	71.9 (14.7)	0.27	75.4 (10.5)	74.4 (10.0)	0.14
Male (%)	72.3	72.4	0.94	50.0	57.9	0.01
Race (%)			0.04			0.10
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 (%)			0.0001			<0.0001
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 (%)			0.48			0.01
Rural	8.4	9.0		10.9	6.3	
Urban	91.5	90.9		89.0	93.6	
Teaching status of hospital (%)			0.0004			0.004
Teaching	54.8	60.2		70.38	61.9	
Nonteaching	45.1	39.7		29.6	38.0	
Bedsize of hospital (%)			0.004			0.19
Small	8.0	8.7		10.9	8.1	
Medium	23.2	27.1		16.0	14.0	

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	Thoracic Aortic Aneurysm			Abdominal Aortic Aneurysm		
	Weekday	Weekend	p Value	Weekday	Weekend	p Value
Large	68.7	64.0		73.0	77.8	

Table 2

Baseline Demographic Characteristics (comorbidity measure)

	Thoracic Aortic Aneurysm			Abdominal Aortic Aneurysm		
	Weekday	Weekend	p Value	Weekday	Weekend	p Value
AHRQ comorbidity measure (%)						
Acquired immune deficiency syndrome	0	0	-	0	0	-
Alcohol abuse	3.1	2.9	0.79	1.8	1.4	0.59
Deficiency anemias	16.0	16.2	0.83	14.0	20.3	0.006
Rheumatoid arthritis/collagen vascular diseases	2.4	1.4	0.02	1.9	1.7	0.88
Chronic blood loss anemia	2.8	3.8	0.06	3.2	4.9	0.15
Congestive heart failure	5.2	5.1	0.82	7.1	11.0	0.02
Chronic pulmonary disease	28.3	30.9	0.06	26.4	26.8	0.87
Coagulopathies	22.5	18.6	0.01	12.7	9.6	0.13
Depression	2.8	4.1	0.01	3.7	1.6	0.05
Diabetes	14.0	16.8	0.008	12.8	16.6	0.07
Drug abuse	0.5	0.0	0.005	1.3	1.3	0.92
Hypertension	60.2	63.7	0.01	72.9	64.2	0.002
Hypothyroidism	7.4	7.0	0.60	5.6	7.8	0.14
Liver disease	0.8	2.3	<0.0001	1.8	0.0	0.01
Lymphoma	0.2	0.7	0.003	0.9	1.4	0.4
Fluid and electrolyte disorders	40.4	44.9	0.002	29.4	30.2	0.78
Metastatic cancer	0.89	1.4	0.05	0	0	-
Other neurological disorders	5.7	3.9	0.008	7.7	4.8	0.06
Obesity	7.5	10.2	0.001	3.9	3.0	0.43
Paralysis	2.2	2.4	0.65	5.5	0	<0.0001
Peripheral vascular disorders	31.9	31.6	0.84	29.6	33.7	0.15
Psychoses	1.4	2.4	0.01	0.4	3.0	<0.0001
Pulmonary circulation disorders	0.7	0.7	0.76	2.2	1.4	0.39
Renal failure	17.4	13.1	0.0002	18.1	20.5	0.34
Solid tumor without metastasis	3.0	3.1	0.83	0.9	3.0	0.004

	Thoracic Aortic Aneurysm			Abdominal Aortic Aneurysm		
	Weekday	**Weekend**	**p Value**	**Weekday**	**Weekend**	**p Value**
Peptic ulcer disease	0.0	0.3	<0.0001	0	0	-
Valvular disease	1.4	1.3	0.82	4.9	6.4	0.29
Weight loss	11.2	11.7	0.61	8.1	13.4	0.004
Hyperlipidemia	27.1	29.0	0.14	35.5	26.8	0.003

Table 3

Multivariate analysis, weekend admission and in-hospital mortality

	Thoracic Aortic Aneurysm		Abdominal Aortic Aneurysm	
	Odds Ratio (95% Confidence Interval)	**P-Value**	**Odds Ratio (95% Confidence Interval)**	**P-Value**
Weekend*	2.55 (1.77–3.68)	<.0001	1.32 (1.13–1.55)	0.0004
Age	1.04 (1.02–1.06)	<.0001	1.07 (1.06–1.08)	<.0001
Male	0.75 (0.55–1.05)	0.09	0.91 (0.77–1.06)	0.23
Race				
White	**Reference**		**Reference**	
Black	0.61 (0.38–0.99)	0.04	0.88 (0.63–1.23)	0.47
Hispanic	0.68 (0.27–1.72)	0.42	0.96 (0.69–1.32)	0.80
Asian	-	0.99	1.56 (0.93–2.61)	0.09
Native American	-	0.99	-	-
Other	0.19 (0.05–0.64)	0.007	0.39 (0.25–0.60)	<.0001
Primary Payer (%)				
Medicare	**Reference**		**Reference**	
Medicaid	2.38 (1.09–5.16)	0.02	3.29 (2.04–5.30)	<.0001
Private	0.96 (0.58–1.59)	0.88	1.35 (1.11–1.63)	0.002
Self-pay	0.96 (0.58–1.59)	0.98	2.20 (1.49–3.24)	<.0001
Location of hospital (%)				
Urban	**Reference**		**Reference**	
Rural	0.46 (0.26–0.81)	0.007	1.27 (0.97–1.65)	0.07
Teaching status of hospital (%)				
Nonteaching	**Reference**		**Reference**	
Teaching	0.64 (0.40–1.01)	0.06	0.91 (0.77–1.071)	0.25
Bedsize of hospital (%)				
Large	**Reference**		**Reference**	
Medium	0.54 (0.30–0.96)	0.03	1.08 (0.83–1.41)	0.54
Small	0.78 (0.50–1.21)	0.27	0.95 (0.79–1.13)	0.57

* 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) Bedsize of hospital (Large, Medium, Small), All AHRQ comorbidity measures (including Acquired immune deficiency 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 neurological 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.

Table 4

Procedures, Length of Stay, Hospital Charges, and for ruptured aortic aneurysm, weekend versus weekday admission

	Thoracic Aortic Aneurysm			Abdominal Aortic Aneurysm		
	Weekday	**Weekend**	**P value**	**Weekday**	**Weekend**	**P value**
Procedure on admission day (%)	62.1	34.9	<0.001	79.6	77.2	<0.001
Endovascular repair of vessel (%)	24.1	17.8	0.03	24.2	24.7	0.74
Resection of vessel with replacement (%)	38.3	26.9	0.0009	45.4	46.1	0.67
Mechanical ventilation (%)	17.0	13.1	0.13	26.0	24.4	0.26
Transfusion of blood or blood components (%)	14.3	26.7	<0.001	32.9	41.6	<0.001
Any Repair (%)	49.4	34.8	<0.001	59.2	61.4	0.14
Length of Stay, mean (SD)	10.7 (18.2)	8.6 (13.5)	0.38	9.4 (13.7)	8.8 (10.4)	0.50
Length of Stay in Survivals, mean (SD)	12.9 (15.8)	14.0 (17.3)	0.73	13.2 (15.1)	12.4 (10.8)	0.52
Total Charges (SD)	140,783 (204171)	131,314 (206697)	0.74	130,95 (153112)	138,326 (164579)	0.47