Symptomatic, Nonruptured Abdominal Aortic Aneurysms: Are Emergent Operations Necessary?

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To evaluate current morbidity and mortality and to define the best strategy of management, we retrospectively reviewed the clinical histories of 36 patients (24 males and 12 females) who underwent repair of symptomatic, nonruptured abdominal aortic aneurysms (AAAs) between April 1, 1987, and April 30, 1992, at the Mayo Clinic (3.2% of 1111 patients with AAA repair). Ages ranged from 54 to 94 years (mean 75 years). All patients were hemodynamically stable and presented with abdominal and/or back pain of 1 to 60 days' duration (mean 11.6 days). The diagnosis of AAA was confirmed by CT scan in 26 patients, ultrasonogram in seven, and plain abdominal films in three. Fourteen patients (38.9%) were operated on emergently within 4 hours of admission, 11 (30.5%) between 4 and 24 hours, and 11 between 24 hours and 7 days following presentation (mean 28.9 hours). Eight (22.2%) had inflammatory aneurysm. AAAs were repaired with a straight graft in 17 patients and a bifurcated graft in 19. Complications occurred in 24 patients (66.7%). Mortality was 11.1% (4/36). The association between emergency repair (< 4 hours) and 60-day mortality was significant ($p < 0.05$). There were no deaths among those patients whose operation was delayed. Comparison to a matched control group of 72 patients who underwent elective AAA repair revealed an increased incidence of inflammatory aneurysm and female gender among our study group. The symptomatic patients had larger aneurysms (6.5 vs. 5.6 cm, $p < 0.05$) and required more intraoperative transfusions. Intensive care unit and hospital stay was longer in the symptomatic patients ($p < 0.001$); morbidity was markedly increased ($p < 0.001$). We conclude that repair of symptomatic, nonruptured AAA continues to be associated with increased mortality and high morbidity in comparison to elective aneurysm repair. Emergency repair of symptomatic, nonruptured aneurysm may contribute to the higher morbidity rate. (Ann Vasc Surg 1994;8: 121-126.)

Recent reports from our institution confirm the persistent high mortality rate associated with ruptured abdominal aortic aneurysms[1] (AAAs) and the safety of elective repair.[2] Data from the literature suggest that patients with symptomatic, nonruptured AAAs have higher morbidity and mortality rates compared with those undergoing elective repair.[3-6] The cause remains unclear, and the optimal management of patients with acutely symptomatic but nonruptured abdominal aortic aneurysms is not well defined.

CT has become the test of choice to exclude a ruptured or leaking aneurysm in patients who present with abdominal or back pain but without a history of hypotension.[7,8] Preoperative evaluation has been advocated in this group. Despite

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attempts to optimize the comorbid conditions, morbidity following repair of symptomatic aneurysm remains high.[9]

To define the current morbidity associated with this condition, we reviewed the clinical histories of 36 patients with symptomatic but nonruptured aneurysms. We also reviewed the histories of 72 matched controls who underwent elective aneurysm resection during the same time period for comparison with our study group.

PATIENTS AND METHODS

Between April 1, 1987, and April 30, 1992, 36 patients presented with abdominal or back pain in whom the diagnosis of a symptomatic, nonruptured AAA was confirmed at operation. These 36 patients, who were the subjects of this study, represented 3.2% of the 1111 patients who underwent repair of AAAs at our institution during this time period. Patients with contained or free rupture or those found to have other causes for their pain were excluded from the study. Demographic data, cardiovascular risk factors, family or personal history of aortic aneurysms, baseline laboratory results, intraoperative fluid requirements and cross-clamp time, operative findings, and postoperative clinical data were recorded.

For each patient in the study, two control patients who had undergone elective AAA repair were selected. These patients were matched for the surgeon performing the procedure and type of aortic prosthesis used (straight vs. bifurcated). The controls were also matched chronologically by selecting a similar procedure immediately prior to and following the index case performed by a given surgeon. Patients were not matched for age, gender, or risk factors to detect differences in these variables among patients with symptomatic aneurysms.

Statistical analysis. Comparisons between the index cases and control group were made using the chi-square test for categorical variables or Fisher's exact test when the numbers were small. Continuous variables were compared using a two-tailed t test when the distributions were normal or a rank sum test when they were not. Within the group of symptomatic patients, association of preoperative and intraoperative factors with eventual outcome was tested using the chi-square test. Multivariate analysis of potential risk factors was performed using a stepwise logistic regression model.

RESULTS

Demographic data and risk factors. The mean age of patients with symptomatic aneurysms was 74.9 years (range 54 to 94 years), significantly higher than the control group, whose mean age was 70.3 years (range 52 to 89 years; $p < 0.005$). One third of the study group was female (12 of 36), which was twice the rate of female gender in the control group (12 of 72 or 16.7%; $p < 0.05$). Preexisting risk factors were similar for the two groups with the exception of renal failure (creatinine > 2.0 mg/dl), which was more common in the study group ($p < 0.005$, Table I). An aortic aneurysm was known to be present in 15 of the 36 patients (41.6%) and was a new finding in the remaining 21. Of the 15 patients with a known aneurysm, six (40%) were diagnosed within the preceding 6 weeks, whereas nine (60%) were known to be present for 6 weeks or more.

Presentation and preoperative evaluation. Symptoms were present for a mean of 11.6 days (range 1 to 60 days) in the symptomatic group. All 36 patients presented with abdominal and/or back pain. Abdominal pain was more common, occurring in 27 patients (75%). Back pain was present in 25 patients (69.4%). Chest, flank, and groin pain were much less common (Table II). None of the patients was hypotensive. The aneurysm was tender to palpation in 20 patients (55.6%); 32 patients (88.9%) had a pulsatile mass.

The preoperative ECG was normal in 11 of the symptomatic patients (30.6%) and in 14 of the controls (19.4%). Evidence of previous myocardial infarction, however, was present in 25% of the cases (9/36) and only 15.3% of the controls. Other abnormalities such as conduction defects, ventricular hypertrophy, axis deviation, or ST-T wave changes accounted for the remaining patients. A CT scan was obtained in 26 of the 36 cases, abdominal ultrasonogram in seven, and plain abdominal x-ray films in three. In addition, aortography was performed in two symptomatic patients. CT findings indicated a leak in two of the cases (false positive) and suggested the presence of an inflammatory aneurysm in another two cases. Seven symptomatic patients had an echocardiogram or a dipyridamole thallium scan and three had pulmonary function testing prior to operation.

Operative management and findings. The mean time from admission to operation was 28.9 hours (range 1 hour to 7 days) in the symptomatic

Table I. Preexisting risk factors

Risk factor	Cases (n = 36)		Controls (n = 72)		
	n	%	n	%	*p*
Coronary artery disease	17	52.8	30	41.7	NS
Previous myocardial infarction	10	27.8	17	23.6	
Peripheral vascular disease	5	13.9	20	27.8	NS
Hypertension	12	33.3	38	52.8	0.056
Diabetes	3	8.3	5	6.9	NS
Hyperlipidemia	3	8.3	10	13.9	NS
Renal insufficiency (creatinine >2 mg/dl)	8	22.2	2	2.8	<0.005
Chronic obstructive pulmonary disease	5	13.9	22	30.6	0.059
Smoking history	19	52.8	38	52.8	NS
Family history of AAA	2	5.6	3	4.2	NS
History of cancer	5	13.9	9	12.5	NS

Table II. Presenting signs and symptoms in symptomatic patients

Symptom	No.	%
Abdominal pain	27	75.0
Back pain	25	69.4
Flank pain	5	13.9
Groin pain	5	13.9
Chest pain	2	5.6
Abdominal examination		
Pulsatile mass	32	88.9
Fullness	2	5.6
Normal	2	5.6
Lower extremity pulses		
Normal	32	88.9
Abnormal	4	11.1

patients. Fourteen patients (38.9%) underwent emergency operations (within 4 hours of admission), 11 patients (30.5%) were operated on between 4 and 24 hours of admission, and 11 patients were operated on between 1 and 7 days following admission. Fluid administration, time of anesthesia, time of operation, time of aortic cross clamp, and quantity of autologous transfusion did not differ for the symptomatic and control groups. Seventeen straight aortic grafts and 19 bifurcated grafts were placed in the symptomatic group; 34 straight and 38 bifurcated grafts were placed in the control group.

The size of aneurysm recorded at operation was larger in the symptomatic group (6.5 cm) as compared with the control group (5.6 cm; $p < 0.05$). The symptomatic group required more banked blood ($p < 0.001$) (Table III). Inflammatory aneurysms were present more frequently in symptomatic patients. Eight of the 32 symptomatic patients (22.2%) were found to have inflammatory aneurysms as compared with only 4 of the 72 controls (5.6%; $p < 0.01$). Accordingly, the incidence of suprarenal cross clamping and left renal vein division was higher in the symptomatic group than in the control group (Table III). The incidence of intraoperative complications did not differ for the two groups, however.

Postoperative course. The symptomatic group had a more complicated postoperative course than the control group. Symptomatic patients required a mean of 4.6 days of ventilatory support compared with 1.6 for the controls ($p < 0.0005$). Similarly, intensive care unit stay was longer for

Table III. Operative management and findings

Management	Cases (n = 36)	Controls (n = 72)	*p*
Fluid administration	6.3 L	6.8 L	NS
Autologous transfusion	786 ml	737 ml	NS
Packed red blood cells	2.0 units	0.3 units	<0.0001
Fresh frozen plasma	0.9 units	0.1 units	<0.0001
Platelets	1.7 units	0.1 units	<0.0005
Anesthesia time	274 min	277 min	NS
Operative time	204 min	197 min	NS
Cross-clamp time	58 min	56.5 min	NS
Aneurysm size	6.5 cm	5.6 cm	<0.05
Inflammatory aneurysm	8 (22.2%)	4 (5.6%)	<0.01
Suprarenal aneurysm	2 (5.6%)	0	NS
Iliac aneurysm	9 (25%)	23 (32%)	NS
Intraoperative complication	2 (5.6%)	3 (4.2%)	NS
Left renal vein ligation	5 (13.9%)	2 (2.8%)	<0.05
Renal revascularization	4 (11.1%)	1 (1.4%)	<0.05
Suprarenal clamp	4 (11.1%)	0	<0.05

Table IV. Postoperative course

	Symptomatic patients		Controls		
Course	n	%	n	%	*p*
Overall morbidity	24	66.7	22	30.6	<0.0001
Major morbidity	17	47.2	20	27.8	<0.05
Mortality	4	11.1	2	2.8	NS
Bleeding	3	8.3	3	4.2	NS
Myocardial infarction	2	5.6	4	5.6	NS
Renal failure	4	11.1	2	2.8	NS
Dialysis	2	5.6	1	1.4	NS
Adult respiratory distress syndrome	2	5.6	1	1.4	NS
Pneumonia	6	16.7	4	5.6	NS (0.06)
Sepsis	7	19.4	3	4.2	<0.01
Urinary tract infection	5	13.9	3	4.2	NS
Days on ventilator	4.6 ± 1.4		1.6 ± 0.5		<0.0001
Days in intensive care	8.4 ± 1.5		4.1 ± 0.6		<0.0001
Hospital days	20 ± 1.7		13 ± 0.8		<0.0005

Table V. Timing of operation and mortality

		Morbidity					
		Overall		Major		Mortality	
Timing	Patients	n	%	n	%	n	%
Emergent (within 4 hr)	14	10	71	8	57	4	28.6
Urgent (4-24 hr)	11	7	64	4	36	0	0
Delayed	11	7	64	4	36	0	0

the index group (8.4 vs. 4.1 days; $p < 0.0005$). The overall complication rate in the symptomatic group was more than twice that seen in the control group (66.7% vs. 30.6%; $p < 0.0001$). Mortality was also increased in the symptomatic group (4/32, 11.1%, vs. 2/72, 2.8%), although this did not achieve significance (Table IV). However, when mortality was compared with the timing of operation, those patients operated within 4 hours of admission had a higher mortality (4/14, 28.6%) than those whose operations were delayed (0/22, 0%; $p < 0.05$) (Table V).

Renal failure alone and in combination with pneumonia and sepsis accounted for two of the deaths in the symptomatic group; hepatic failure and cardiac failure after myocardial infarction accounted for the remaining two. Multivariate analysis suggested a relationship between both postoperative renal failure and postoperative bleeding with mortality. Because of the small numbers of deaths, however, this analysis may not be reliable. One of the control patients died suddenly at home 1 week following an uneventful 8-day hospitalization. The second patient died several days postoperatively following a myocardial infarction.

Major cardiac complications occurred with similar frequency in the two groups, but dysrhythmias were more frequent in the symptomatic group. There was no difference in the development of renal failure for the two groups. Sepsis was more common in the symptomatic group. The incidence of complications in this group was associated with the requirement of banked blood transfusion at the time of operation ($p < 0.001$). Hospital stay was significantly longer in the index group (20 days vs. 13 days, $p < 0.001$).

DISCUSSION

The prognosis of patients who present with abdominal or back pain of recent onset without hypotension and who are found to have an intact AAA is unclear. Several older studies have reported increased morbidity and mortality associated with emergency repair of such aneurysms.[3,4] More recently, a prospective evaluation of 666 aneurysm repairs failed to show a difference in mortality based on the presence of symptoms or urgency of operation.[10] The morbidity of the symptomatic group was not addressed in this report. Conversely, Sullivan et al.[5] demonstrated a morbidity and mortality equivalent to that of ruptured aneurysms in a small series of patients with symptomatic aneurysms who underwent emergency repair. These differences may be explained by the definition of symptomatic AAA. In the larger series only 42.2% of the symptomatic patients were operated on emergently.[10] Our current series comprised patients who were thought to have symptoms requiring immediate hospital admission and expeditious repair of their aneurysms. We have confirmed a significant increase in morbidity in this group of patients as compared with a control group undergoing elective repair of aneurysms and have noted a tendency toward increased mortality, although this did not achieve significance.

The cause of increased morbidity in our study group is not obvious and is most likely multifactorial. The study group was older than the control group by approximately 5 years and was twice as likely to be female as compared with the control group. Crawford et al.[3] have shown an increase in mortality in patients over 80 years of age, but mortality was relatively constant in those under 80. McCabe et al.[11] showed no gender difference in mortality in his groups of elective and symptomatic aneurysm repair. Aneurysms in our symptomatic group were larger than those in the control group by about 1 cm, but this is not likely to contribute to increased morbidity. There was no difference in operative or cross-clamp times or in the amount of autologous transfusion given. Although preoperative renal failure was more common in the symptomatic group, the rate of postoperative renal failure was similar. The rates of postoperative myocardial infarction and bleeding complications were also similar. Interestingly, the rate of sepsis in the postoperative period was increased in the symptomatic patients.

The most striking difference in the groups was the increased incidence of inflammatory aneurysms seen in the symptomatic group. In our control group the rate of inflammatory aneurysm was 5.6%, whereas the incidence of inflammatory aneurysms in our study group was 22.2% ($p < 0.01$). Although previous reports on inflammatory aneurysms[12,13] have noted an increase in the percentage of patients presenting with pain (with the exception of Johnson and Scobie's series[10]), no prior report of symptomatic aneurysms requiring urgent repair has noted a propensity for inflammatory aneurysm. Interestingly, among those patients in our symptomatic group with inflammatory aneurysm, three of the eight patients (37.5%) were female. Pennell et al.[12] from our institution reported on an earlier series of 127 inflammatory aneurysms that included only four females.

The mortality in our group of symptomatic patients was related to the timing of surgery. All four patients who died were operated on within 4 hours of admission. Careful review of these charts did not suggest any distinguishing features from the remainder of the group. Previous studies have reported higher mortality in patients with symptomatic, intact aneurysms undergoing emergency repair.[3,4,11] This should not be surprising in light of the fact that emergency operations usually carry a higher mortality than elective procedures, regardless of the underlying disease process.[14] However, Johnson and Scobie[10] found no difference in mortality based on the urgency of operation in their series, and Seeger and Kiefer[9] failed to show a benefit from delayed operation with limited preoperative preparation.

CONCLUSION

Our data suggest that operation can safely be delayed in stable patients with intact, symptomatic aneurysms once the diagnosis is confirmed by CT. Delay of the operation allows for expeditious preoperative preparation. This is likely to diminish morbidity and may decrease mortality following these procedures. Our current practice in this difficult group of patients involves optimization of fluid and electrolyte status, evaluation and limited preoperative preparation of cardiac and pulmonary status when necessary, and semielective repair of the aneurysm when an experienced operating room staff is available.

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