ORIGINAL ARTICLE

Simultaneous Gastrointestinal Surgery in Patients With Elective Abdominal Aortic Reconstruction

An Additional Risk Factor?

Thomas Luebke, MD; Ulrich Wolters, MD, PhD; Michael Gawenda, MD; Jan Brunkwall, MD, PhD; Arnulf H. Hoelscher, MD, FACS, FRCS

Hypothesis: The management of simultaneously occurring intra-abdominal abnormalities and abdominal aortic aneurysms or aortoiliac occlusive disease is controversial. The aim of this retrospective study was to analyze whether gastrointestinal operations performed at the same time as aortic repair increase the postoperative morbidity and mortality rate.

Method: Between January 1, 1989, and December 31, 1997, a total of 42 patients underwent open aortic tube (n=33) or bifurcated grafting (n=9) and simultaneous surgery of 1 or more gastrointestinal abnormalities. In a matched-pairs analysis for each of the aforementioned patients, a control patient with an exclusive aortic procedure was selected. For each matched pair the following aspects were noted: the type of operative procedure, time of execution, duration of the surgical procedure, the duration of postoperative ventilatory assistance, intensive care unit and hospital stays, the number of blood units transfused, the use of antibiotics, and the main postoperative complications.

Results: The comparison between the matched pairs revealed no statistically significant difference for postoperative morbidity or mortality rate or length of intensive care unit and hospital stays. There were no operative or hospital deaths. None of the patients has (median follow-up, 68 months) shown evidence of graft infection.

Conclusion: A 1-stage operation management is feasible if appropriate care is given to the technical details and if the rules of antisepsis are followed.

Arch Surg. 2002;137:143-148

From the Department of Visceral and Vascular Surgery, University of Cologne, Cologne, Germany.

PATIENTS considered for abdominal aortic surgery have been shown to have a high incidence of coexistent cardiac, vascular, and other diseases, that affect operative risk, perioperative complications, and survival. Aneurysms of the infrarenal abdominal aorta (AAA) and aortoiliac occlusive diseases are encountered in patients older than 60 years, at a rate of 2% to 5% of the population.[1] The aneurysms are combined with a concomitant abdominal nonvascular disease in an incidence of 7% to 29%,[2] with cholecystopathy at a rate of 4.9% to 19.2%,[3] with neoplasia at a rate of 4% to 8%,[4] and with other vascular anomalies at a rate of 2.3%.[2]

The concomitant occurrence of AAA and gastrointestinal diseases still remains a therapeutic dilemma, mainly with respect to the potential of prosthetic graft infection in cases of simultaneous surgery. The main controversy revolves around whether to treat the lesions simultaneously or as staged procedures, especially in cases of coexisting intra-abdominal malignant neoplasms. There is a scarcity of experience reported in the literature to assist in making an appropriate decision. Most surgeons[3,5] think that the lesion with the most dangerous or symptomatic complications should

See Invited Critiques at end of article

be operated on first and, thus, have elected to treat the majority of patients sequentially. Only small case series report the results of a policy of performing a combined procedure in cases of concurrent symptomatic malignancy.[6-8] The goal of this study was to analyze whether gastrointestinal operations performed at the same time as aortic repair would increase the postoperative morbidity and/or mortality rate.

RESULTS

The operative procedures carried out are listed in **Table 2**. All concurrent gastrointestinal malignancies were symptomatic (**Table 3**). The most common symptoms relating to the carcinoma were anemia, weight loss, gastrointestinal tract

PATIENTS AND METHODS

From January 1, 1989, to December 31, 1997, a total of 851 patients having AAA and 379 patients with an aortoiliac occlusive disease were operated on electively (502 tube grafts; 728 aortoiliac-femoral bypasses) in the Department of Visceral and Vascular Surgery, University of Cologne, Cologne, Germany. During the same period, 42 patients (4.9%), 35 men and 7 women, with a median age 67 years (age range, 49-84 years) underwent aortic surgery (33 because of AAA and 9 because of aortoiliac occlusive disease) and simultaneous surgery of 1 or more gastrointestinal abnormalities (1-stage operation). The nonvascular abnormality was diagnosed either in the preoperative period (ie, colorectal carcinoma, 5; sigmoid colon diverticulosis-diverticulitis, 5; gastric carcinoma, 2; and cholelithiasis, 10) or discovered at the time of surgery (ie, colonic infarction, 1; Meckel diverticulum, 5; small-bowel carcinoid, 1; adhesion-incomplete ileus, 3; inflammatory small-bowel tumor, 3; appendicitis, 2; and cholelithiasis, 5). All the aneurysms were located infrarenal and their median transverse diameter was 5.0 cm (diameter range, 3.5-16 cm) as measured by computed tomography.

The aortic graft surgery was performed through a transperitoneal approach. In all patients the aortic grafting was performed first and the peritoneum was closed over the prosthesis, followed by the completion of the second procedure. No retroperitoneal approach was used. In cases of coincidental intestinal abnormalities (eg, Meckel diverticulum), we performed bowel cleaning via "on the table lavage." All patients received 5000 IU of heparin sodium before aortic cross clamping, and heparin was not inactivated by giving protamine hydrochloride during the rest of the operative procedure. Thirty-three patients (78.6%) received open aortic tube grafts; 9 patients (21.4%) underwent a bifurcated graft.

In a matched-pairs analysis for each of the aforementioned patients, a control patient with an exclusive aortic procedure was selected and matched for the following variables: age, sex, American Society of Anesthesiologists' classification of the patient's health, and type of aortic surgery. The atherogenic risk factors, concomitant diseases, and American Society of Anesthesiologists' scores of the patient's health for the control group are given in **Table 1**. In the present investigation, for each matched pair the following aspects were analyzed: the type of operative procedures and the time of their execution, the duration of the surgical procedure, the duration of postoperative ventilatory assistance, the duration of intensive care unit and hospital stays, the number of units of blood transfused, the use of antibiotics, and the main postoperative complications.

To analyze significant relations of the preoperative, intraoperative, and postoperative data, the Fisher exact test, or χ^2 test was used for the categorical parameters; the Mann-Whitney test was used for the continuous parameters. Results are expressed as medians; statistical significance was set at $P<.05$.

Table 1. Preoperative Risk Factors

Risk Factor	No. (%) of Patients Undergoing Simultaneous Surgical Procedures (n = 42)	No. (%) of Matched-Control Subjects (n = 42)
Hypertension	31 (74)	32 (76)
Smoking	26 (62)	24 (57)
Cardiac disease	25 (59)	25 (59)
COPD*	14 (33)	15 (36)
Renal insufficiency	7 (17)	6 (14)
American Society of Anesthesiologists classification, grade†		
I	1 (2)	1 (2)
II	13 (31)	13 (31)
III	24 (57)	24 (57)
IV	3 (7)	3 (7)
V	1 (2)	1 (2)

*COPD indicates chronic obstructive pulmonary disease.
†The American Society of Anesthesiologists classification grades are as follows: I, healthy patient with local pathologic process; II, patient with mild to moderate systemic disease; III, patient with severe systemic disease limiting activity but not incapacitating; IV, patient with incapacitating systemic disease; and V, moribund patient not expected to live.

Table 2. Simultaneous Operative Procedures

Operative Procedure	No. (%) of Subjects	No. of Subjects With Malignancy	No. of Subjects*	No. of Subjects†
Gastrointestinal tract	42 (58)	8	0	0
Colon resection	11 (15)	5	9/2	9/2
Small-bowel resection	12 (16)	1	11/1	11/1
Gastrectomy	2 (3)	2	1/1	1/1
Appendectomy	2 (3)	0	2/0	2/0
Cholecystectomy	15 (21)	0	10/5	10/5

*Numerator indicates the number of subjects undergoing open aortic tube repair; denominator, the number of subjects undergoing bifurcated grafting.
†Numerator indicates the number of subjects having aneurysms of the infrarenal abdominal aorta; denominator, the number of subjects with aortoiliac occlusive diseases.

bleeding, a recent change in bowel habit, and intestinal transit problems or obstruction. All 15 patients who had cholelithia sis had episodes of right upper quadrant pain, liver dysfunction, or both at the same time. At the time of their operation, they showed no signs of cholecystitis or cholangitis. Perioperative single-shot antibiotic prophylaxis (a second-generation cephalosporin and metronidazole) was administered routinely in all patients. In 5 patients who underwent simultaneous surgery and 4 patients who underwent aortic repair alone, antibiotic therapy was continued postoperatively.

SHORT-TERM RESULTS

The short-term results are given in **Table 4**. There were no hospital deaths. Five patients (11.9%) who underwent simultaneous surgery and 7 patients (16.6%) who underwent an aortic procedure alone suffered postoperative complications. The surgical and nonsurgical com-

plications are shown in **Table 5**. No patient developed peritonitis after simultaneous operation. In the case of colonic surgery, no clinical anastomotic leaks were observed (tested by water-soluble iodinated [Gastrografin; Schering Germany GmbH, Berlin]–contrast medium enema in all those patients).

LONG-TERM FOLLOW-UP

Of the 42 patients who underwent simultaneous procedures, 36 (85.7%) are still alive. The length of follow-up ranges from 18 to 126 months (median, 68 months). The causes of death of 6 patients were disseminated cancer (n=2), myocardial infarction (n=3), and renal failure (n=1). Follow-up in the 42 patients who underwent an aortic procedure alone ranged from 16 to 112 months (median, 63 months). During the observation period, 7 patients died. The cause of death was renal failure (n=1), myocardial infarction (n=3), and pneumonia and respiratory failure (n=3). There has been no clinical or ultrasonographic evidence of aortic graft infection in any of the patients during long-term follow-up.

Table 3. Coexisting Intra-abdominal Disease Treated at the Same Time as Aortic Grafting in This Case Series

Type of Disease	Operative Procedure	No. of Subjects
Colorectal carcinoma	R hemicolectomy	2
	L hemicolectomy	2
	Anterior resection	1
Diverticulitis	Sigmoid colectomy	5
Colonic infarction	Subtotal colectomy	1
Meckel diverticulum	Small-bowel resection	5
Small-bowel carcinoid	Small-bowel resection	1
Adhesion/incomplete ileus	Small-bowel resection	3
Inflammatory small-bowel tumor	Small-bowel resection	3
Gastric carcinoma	Gastrectomy	2
Appendicitis	Appendectomy	2
Cholelithiasis	Cholecystectomy	15

COMMENT

In 1960 DeBakey et al[9] first reported their experience with 640 aneurysmectomies, of which 51 were combined with other intra-abdominal operative procedures (eg, cholecystectomy or appendectomy). They reported no increase in the postoperative morbidity and mortality rate, and no increase in graft infection. Since then controversial views have evolved among authors.[2,3,5,10-12] Some consider the combination of the 2 procedures generally safe, especially in cases of asymptomatic cholecystolithiasis, as opposed to those[13-16] who believe that such a combination significantly increases postoperative morbidity and mortality (**Table 6**). In String's[11] case series, 9 of 17 patients with untreated, asymptomatic gallstones developed cholecystitis or biliary tract pain after aneurysm resection. String concluded that if there were no mitigating circumstances, cholecystectomy should be combined with the aortic procedure. Thomas et al[18] reported the case series of 521 patients undergoing aortoiliac reconstructions. Eighty-five nonvascular procedures were performed in 76 patients. Overall, there were no significant differences in morbidity and mortality when nonvascular procedures were combined with aortic reconstruction. Authors who do not advocate concomitant proce-

Table 4. Short-term Results*

Variable	Subjects Who Underwent Simultaneous Surgical Procedures	Subjects Who Underwent Aortic Repair Alone	*P* Value
Duration of operation, min	185.5	161.1	.62
Duration of postoperative ventilatory assistance, h	15	20	.55
Duration of intensive care unit stay, d	2.1	2.0	.95
Duration of postoperative hospitalization, d	11	13	.81
Patients who received blood transfusions, No.	22	20	.85
Blood units transfused for each patient, No.	2.0	2.0	1.0

*Data are given as median values, except for the patients who received blood transfusions.

Table 5. Surgical and Nonsurgical Complications

Type of Complication	Subjects Who Underwent Simultaneous Surgical Procedures, No.	Subjects Who Underwent Aortic Repair Alone, No.	Treatment
Surgical			
Continued intra-abdominal bleeding	1	1	Reoperation
Occlusion of the aortic graft	1	1	Reoperation
Superficial wound infection	1	1	Local
Wound hematoma	1	1	Conservative
Nonsurgical			
Acute cardiopulmonary decompensation	1	1	Intensive care unit care
Pulmonary embolism	0	1	Conservative
Deep venous thrombosis	0	0	Conservative
Acute renal failure	0	1	Hemodialysis

Table 6. Literature Review of Simultaneous Aortic Procedures With Coexistent Intra-abdominal Abnormality

Source, y	Total No. of Subjects	Abnormality or Surgical Procedure	Complications
DeBakey et al,[9] 1960	51	Cholecystectomy	No increase in morbidity/mortality
Ochsner et al,[12] 1960	480	Appendectomy	No increase in morbidity/mortality
Becker and Blundell,[17] 1976	14	Cholecystectomy	2 Late graft infections
Ouriel et al,[3] 1983	18	Cholecystectomy	1 Late graft infection
Thomas et al,[18] 1983	58	Nonvascular	No increase in morbidity/mortality
Bickerstaff et al,[5] 1984	113	Nonvascular	38% Complication rate in cholecystectomy
String,[11] 1984	16	Cholecystectomy	None
Fry and Fry,[15] 1986	2	Cholecystectomy	None
Evans et al,[14] 1989	13	Cholecystectomy	Increase in morbidity/mortality
Nora et al,[19] 1989	2	Colorectal cancer	No increase in morbidity/mortality, favorable outcome/long-term survival 24%
Brown and Kelly,[20] 1994	53	Gastrointestinal surgery	No increase in morbidity/mortality
Demasi et al,[21] 1994	4	Radical nephrectomy	No increase in morbidity/mortality
Komori et al,[22] 1994	5	Gastrointestinal malignancies	None
Gouny et al,[7] 1996	2	Colorectal cancer	No increase in morbidity/mortality, favorable outcome/long-term survival 24%
Konety et al,[23] 1996	10	Radical nephrectomy	No increase in morbidity/mortality
Oshodi et al,[8] 1999	9	Colonic surgery	No increase in morbidity/mortality

dures identify the potential of postoperative graft infection as a major disadvantage. Ouriel et al[3] reported that of 18 patients who underwent concomitant procedures, 1 developed a prosthetic infection in the immediate postoperative period. This patient did not have the graft retroperitonealized before cholecystectomy, and in addition had a gastrostomy and drainage of the liver bed performed. Becker and Blundell[17] reported the cases of 2 patients and Ouriel et al[3] noted 1 patient who developed late graft infection after combined aneurysmectomy and cholecystectomy. Most of these data as well as our own suggest that cholecystectomy can safely be performed at the same time of aneurysmectomy in selected patients (Table 6). Because the potential benefit of preventing postoperative cholecystitis is arguable, cholecystectomy should be deferred if any difficulty is encountered during aneurysm repair. Of course, the 1-stage operation must be scheduled during the absence of cholecystitis or cholangitis, and cholecystectomy should be carried out carefully to prevent mechanical injury of the wall of the gallbladder.

Tilson et al[24] found a significantly higher incidence of concomitant malignancy with aneurysm repair in comparison with patients who had atherosclerotic occlusive disease. They proposed that this relation could be explained by immunologic damage to the epithelial connective tissue matrix causing both aneurysms and malignancy. However, this has never been reconfirmed. In 1967, Szilagyi et al[25] were the first to report on concomitant malignancies and aneurysms. In case series published in the United States, the most common intra-abdominal malignancy identified in patients with aortic aneurysm involves the colon and rectum. The incidence of colorectal malignancy in these case series ranged from 1.7% to 3.8%.[19,26] Management of concomitant AAA and malignancy and especially colorectal malignancy causes the greatest dilemma, as there is no clear consensus on whether to treat the cancer or the aneurysm first, or, indeed, simultaneously. Szilagyi et al[25] have classified the concomitant existence of aneurysm and intraperitoneal neoplasia in 4 groups depending on the initial presentation. They concluded that the symptomatic lesion should be treated first. When both lesions are asymptomatic then priority should be given to the aneurysm if it is large and to the cancer if the aneurysm is small. If metastases are present, an AAA should only be repaired if it is symptomatic or large (<6 cm). Velanovich and Andersen[6] applied decision analysis to this therapeutic dilemma in an attempt to resolve the issue of treatment priority. Simultaneous procedures should be considered if the aneurysm is more than 5 cm in diameter and the cancer has a more than 75% to 80% chance of obstruction or perforation, provided that the operative mortality rate is likely to be less than 10%.[6]

Simultaneous surgery has many theoretical attractions. Single-stage management has the advantage of achieving complete treatment while exposing the patient to only one anesthesia and one recovery period. Simultaneous surgery removes the risk of a second major operation with its problems of adhesions, its potential opportunity for cardiac and pulmonary complications, and the risk of complications of the untreated lesion. Furthermore, the complications of the first operation may postpone the second operation, resulting in a delay in definitive treatment for the second disease. There is a real risk of tumor spread if a cancer is untreated at the first operation[19,27] especially if the second operation is delayed. There is, in total, the risk of the increased perioperative morbidity and mortality of the 2 procedures and aneurysm rupture[5] if it is untreated.

The surgical management in cases of AAA or aortoiliac occlusive lesions and a second intraperitoneal operative procedure still remains a matter of debate. The theoretical increased risk of graft infection, despite little evidence in the literature, remains the main argument against simultaneous surgery and has made most surgeons reluctant to perform a second nonvascular procedure at the time of aortic surgery. Subsequent case series, although reporting few cases, have shown that there is no increase in morbidity and mortality when compared with elective aneu-

rysm repair alone.[4,7,8,19,20,28,29] As a result, this procedure could be the preferred approach both for elective surgery or when colon cancer or another symptomatic or life-threatening intra-abdominal abnormality is found unexpectedly during aortic surgery. Our study reinforces this message and shows that nonvascular operations may be performed at the same time as elective AAA repair or aortoiliac reconstruction without an increase in the postoperative morbidity or mortality rate and the length of intensive care unit and hospital stay, and without any enormous increase in graft infection. Our study represents another case series reporting simultaneous surgery of the abdominal aorta and a second intra-abdominal disease. In the 1-stage operation, management is feasible if appropriate care is given to the technical details including the rules of antisepsis, and if the vascular surgeon is sufficiently experienced in gastrointestinal surgery to perform the second nonvascular procedure or if help by an experienced visceral surgeon is available.

Corresponding author and reprints: Thomas Luebke, MD, Department of Visceral and Vascular Surgery, University of Cologne, Joseph-Stelzmann-Strasse 9, 50931 Cologne, Germany (e-mail: thomas_luebke@yahoo.de).

REFERENCES

1. Bergqvist D, Bengtsson H, Svensjö S. Prevalence of abdominal aortic aneurysms: experience from Malmö, Sweden. In: Yao JST, Pearce WH, ed. *Aneurysms: New Findings and Treatments.* Norwalk, Conn: Appleton & Lange; 1994: 49-61.
2. Matano R, Gennaro M, Mohan C, Ascer E. Association of intra-abdominal pathologies and vascular anomalies with infrarenal aortic aneurysm: a computed tomographic study. *Cardiovasc Surg.* 1993;1:27-29.
3. Ouriel K, Ricotta JJ, Adams JT, Deweese JA. Management of cholelithiasis in patients with abdominal aortic aneurysm. *Ann Surg.* 1983;198:717-719.
4. Komori K, Okadome K, Itoh H, Funahaski S, Sugimachi K. Management of concomitant abdominal aortic aneurysm and gastrointestinal malignancy. *Am J Surg.* 1993;166:108-111.
5. Bickerstaff LK, Hollier LH, Van Peenen HJ, Melton LJ, Pairolero PC, Cherry KJ. Abdominal aortic aneurysm repair combined with a second procedure: morbidity and mortality. *Surgery.* 1984;95:487-491.
6. Velanovich V, Andersen CA. Concomitant aortic aneurysm and colorectal cancer: a decision analysis approach to the therapeutic dilemma [review]. *Ann Vasc Surg.* 1991;5:449-455.
7. Gouny P, Leschi JP, Nussaume O, Cheynel-Hocquet C, Decaix B, Vayssairat M. Single-stage management of abdominal aortic aneurysm and colon carcinoma. *Ann Vasc Surg.* 1996;10:299-305.
8. Oshodi TO, Abraham JS, Kelly JF. Simultaneous aortic aneurysm repair and colonic surgery. *Br J Surg.* 1999;86:217-218.
9. DeBakey ME, Ochsner JL, Cooley D. Associated intra-abdominal lesions encountered during resection of aortic aneurysm. *Dis Colon Rectum.* 1960;3:485-490.
10. Vanek VW. Combining abdominal aortic aneurysmectomy with gastrointestinal or biliary surgery. *Am J Surg.* 1988;54:290-296.
11. String ST. Cholelithiasis and aortic reconstruction. *J Vasc Surg.* 1984;1:664-669.
12. Ochsner JL, Cooley D, DeBakey ME. Associated intra-abdominal lesions encountered during resection of aortic aneurysm. *Dis Colon Rectum.* 1960;3:485-490.
13. Thomas JH. Abdominal aortic aneurysmorrhaphy combined with biliary or gastrointestinal surgery [review]. *Surg Clin North Am.* 1989;69:807-815.
14. Evans WE, Hayes JP, Waltke EA, Kleckner SC. Screening for cholelithiasis prior to aortic reconstruction. *Am J Surg.* 1989;157:208-209.
15. Fry RE, Fry WJ. Cholelithiasis and aortic reconstruction: the problems of simultaneous surgical therapy. *J Vasc Surg.* 1986;4:345-350.
16. Goldstone J, Moore WS. Infection in vascular prostheses: clincial manifestations and surgical management. *Am J Surg.* 1974;128:225-233.
17. Becker RM, Blundell PE. Infected aortic bifurcation grafts: experience with fourteen patients. *Surgery.* 1976;80:544-549.
18. Thomas JH, McCroskey BL, Iliopoulos JI, Hardin CA, Hermreck AS, Pierce GE. Aortoiliac reconstruction combined with nonvascular operations. *Am J Surg.* 1983; 146:784-787.
19. Nora JD, Pairolero PC, Nivatvongs S, Cherry KJ, Hallett JW, Gloviczki P. Concomitant abdominal aortic aneurysm and colorectal carcinoma: priority of resection. *J Vasc Surg.* 1989;9:630-636.
20. Brown TH, Kelly JF. Synchronous aortic and gastrointestinal surgery. *Br J Surg.* 1992;79:1017-1018.
21. Demasi RJ, Gregory RT, Snyder SO, Gayle RG, Parent FN, Wheeler JR. Coexsistent abdominal aneurysm and renal carcinoma: management options. *Am Surg.* 1994;60:961-966.
22. Komori K, Okadome K, Funahashi S, Itoh H, Mori M, Sugimachi K. Successful simultaneous resection of abdominal aortic aneurysm and rectal cancer. *Vasc Surg.* 1994;28:223-228.
23. Konety BR, Shuman B, Webster M, Steed DL, Bahnson RR. Simultaneous radical nephrectomy and repair of abdominal aortic aneurysm. *Urology.* 1996;47: 813-818.
24. Tilson MD, Fieg EL, Harvey M. Malignant neoplasia in patients with abdominal aortic aneurysms. *Arch Surg.* 1984;119:792-794.
25. Szilagyi DE, Elliott JP, Berguer R. Coincidental malignancy and abdominal aortic aneurysm: problems of management. *Arch Surg.* 1967;95:402-412.
26. Morris DM, Colquitt J. Concomitant abdominal aortic aneurysm and malignant disease: a difficult management problem. *J Surg Oncol.* 1988;39:122-125.
27. Swanson RJ, Littooy FN, Hunt TK, Stoney RJ. Laparotomy as a precipitating factor in the rupture of intra-abdominal aneurysms. *Arch Surg.* 1980;115:299-304.
28. Hughes TB, Masson J, Graham AR, Tracy GD. Combined gastrointestinal and abdominal aortic aneurysm operations. *Aust N Z J Surg.* 1998;58:805-810.
29. Egeberg T, Haug ES, Thoresen JE, Myhre HO. Concomitant intra-abdominal disease in aortic surgery. *Eur J Vasc Endovasc Surg.* 1997;14(suppl A): 18-23.