PAPER

CD4 Cell Counts as a Prognostic Factor of Major Abdominal Surgery in Patients Infected With the Human Immunodeficiency Virus

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Objective: To measure the prognostic utility of helper T-cell (CD4) counts in human immunodeficiency virus (HIV)-infected patients undergoing major abdominal surgery.

Design: Retrospective case series.

Setting: Three university-affiliated hospitals.

Patients: Forty-three HIV-infected patients undergoing major abdominal surgery.

Main Outcome Measures: Morbidity and mortality rates with respect to CD4 cell counts.

Results: Nineteen of 32 patients who had CD4 cell counts less than 0.20×10^9/L (200 cells/μL) suffered major complications compared with 2 of 11 patients who had CD4 cell counts greater than 0.20×10^9/L (200 cells/μL) (P=.03). Perioperative mortality was 38% for patients with CD4 cell counts less than 0.20×10^9/L, and was 9% for those with CD4 cell counts greater than 0.20×10^9/L (P=.13). Six months postoperatively, mortality rates were 47% and 9%, respectively (P=.03). Of patients with septic processes perioperatively (n=12), mortality was 75%, and was 19% (P=.009) for those with nonseptic processes (n=31). Nine patients had HIV-related intra-abdominal pathologic conditions at laparotomy. Mortality was 56% perioperatively (P=.13) and 88% after 6 months (P=.001). Sixty-eight percent of patients who received blood product transfusions developed complications, whereas only 7% of those who did not receive transfusions developed complications ($P<.001$). Overall mortality and morbidity rates were 37% and 49%, respectively. Patients with morbidity had lower CD4 cell counts (median, 0.034×10^9/L) than those without complications (median,0.102×10^9/L) (P=.02). Similarly, patients who died had lower CD4 cell counts (median, 0.031×10^9/L vs 0.088×10^9/L) (P=.05).

Conclusions: Patients with acquired immunodeficiency syndrome–defining CD4 cell counts undergoing major abdominal surgery developed more complications and had poorer outcomes at 6-month follow-up compared with HIV-infected patients whose CD4 cell counts were greater than 0.20×10^9/L (200 cells/μL). A perioperative septic process and HIV-related pathologic conditions seen at laparotomy are also associated with worse outcomes.

Arch Surg. 1998;133:626-631

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As the prevalence of human immunodeficiency virus (HIV) infection and acquired immunodeficiency syndrome (AIDS) increases, operations are being done more frequently on HIV-infected individuals. However, there is a disparity in reports on outcome and a lack of consensus on risk factors. Early reports of abdominal surgery in patients with AIDS described perioperative mortality of 50%.[1-3] A more recent report indicates a perioperative mortality of 12% in a series of patients with AIDS undergoing emergent laparotomy.[4] In that study, worse prognoses were found with a lack of ongoing prophylactic treatment for AIDS-related disease, active opportunistic infections, Walter Reed VI classification,[5] and ongoing sepsis at the time of operation.

The absolute number of circulating CD4 lymphocytes has been shown to be a clinically useful indicator of immune function in HIV-infected individuals.[6] Because the CD4 lymphocyte is the specific target of HIV, it serves as a marker for progressive immunologic deterioration and is used as a predictor of the development of AIDS in HIV-infected individuals.[7] In 1993, the Centers for Disease Control and Prevention expanded the definition of AIDS to encompass HIV-infected patients whose CD4 lymphocyte counts were less than 0.20×10^9/L (200 cells/μL) regardless of whether they had experienced an AIDS-defining opportunistic infection.[8] Certain opportunistic infections are more likely to occur when CD4 cell counts are less than 0.20×10^9/L (200 cells/μL). These infections are a direct consequence of the immunosuppression caused by HIV as a result of CD4 cell depletion.[6]

SUBJECTS AND METHODS

The medical records from 3 hospitals (Harper Hospital, Detroit Receiving Hospital, and Grace Hospital), which are part of the Wayne State University/Detroit Medical Center, Detroit, Mich, were reviewed for all patients who had documented infection with HIV and who had undergone major abdominal surgery between January 1987 and March 1997. Operative and pathology reports were reviewed for all patients. Major abdominal surgery was defined as any procedure that required surgical exploration of the peritoneal cavity or any laparoscopic procedure that involved the peritoneal space. Abdominal wall procedures such as ventral hernia repair were excluded. Any patient who was seropositive for HIV infection regardless of whether the patient had been diagnosed as having AIDS was included in the study. All patients in the study had documented helper T-cell counts (CD4). CD4 cell counts were obtained using the monoclonal antibody flow cytometry technique, which has been used by our laboratories for the 10-year interval of our study. The test has a margin of error of 4% (Michael Long, MD, oral communication, 1997). Data were also recorded for preoperative albumin level, platelet count, hematocrit, white blood cell count, blood product transfusions, AIDS-related medications, presence of a perioperative septic process, and patient age. All patients except 3 had general anesthesia. These 3 patients who received local anesthesia and sedation had the placement of a feeding gastrostomy tube, an open liver biopsy, and a diverting loop colostomy.

Major complications were defined as respiratory failure, renal failure, postoperative pancreatitis, abscess development, wound infections, and any illness that extended hospital stay, such as pseudomembranous colitis. Perioperative mortality was defined as death within 30 days of surgery or failure to leave the hospital alive. Sepsis was defined as an ongoing infectious process with fever or hemodynamic changes. Pathology specimens were examined and patients were classified as to whether they had HIV-related pathologic conditions or not. Statistical evaluation was performed using the unpaired *t* test, Mann-Whitney rank sum test, and the Fisher exact test. Follow-up was obtained wherever possible.

The CD4 helper T-cell count in HIV-infected individuals has not previously been shown to be a prognostic factor in postoperative outcome, although the issue has been raised.[4,9] We have reviewed our institution's operative experience with HIV-infected patients to determine whether the immunosuppression manifested by low CD4 cell counts increases the risk of major abdominal surgery and can serve as a prognostic factor.

RESULTS

The average patient age was 37.9 years (range, 22-56 years). There were 31 men and 12 women in the study. The mean duration of HIV infection was 45.6 months (range, 0-10 years). All patients in the study had documented CD4 cell counts prior to or at the time of index admission. Four patients were diagnosed as having HIV infection at index admission. Nineteen (44%) patients had CD4 cell counts obtained during admission, 13 (30%) within 1 year of operation, 3 (7%) within 2 years of operation, and the remaining 8 (19%) within 3 years of surgery (**Table 1**). The number of patients with CD4 cell counts of more than 12 months old was not significantly different between those patients with CD4 cell counts above and below 0.20×10^9/L (200 cells/μL) (18% vs 28%; $P=.62$).

Forty-three patients underwent 47 abdominal operations (**Table 2** [CD4 $>0.20\times10^9$/L] and **Table 3** [CD4 $<0.20\times10^9$/L]). Four patients underwent reoperation for complications: postoperative small-bowel obstruction secondary to a mesenteric hematoma at the anas-

Table 1. Time of CD4 Cell Count Measurement in Relation to Operation

Time of Measurement	No.	No. (%) of Patients With CD4	
		$<0.20\times10^9$/L (<200 Cells/μL)	$\geq0.20\times10^9$/L (≥200 Cells/μL)
Admission	19	11 (34)	8 (73)
Within 1 y	13	12 (38)	1 (9)
Within 2 y	3	3 (9)	0 (0)
Within 3 y	8	6 (19)	2 (18)
Total	**43**	**32 (100)**	**11 (100)**

Table 2. Operative Characteristics of Patients With CD4 Counts Greater Than 0.20×10^9/L (>200 Cells/μL)

Patient No.	Operation	Complication	CD4 Cell Count, $\times10^9$/L (Cells/μL)	Outcome
1	Exploratory laparotomy	Postoperative pancreatitis	0.240 (240)	Alive
2	Diverting colostomy	None	0.252 (252)	Alive
3	Open cholecystectomy	None	0.264 (264)	Alive
4	Laparoscopic appendectomy	None	0.286 (286)	Alive
5	Low traverse cesarean section	None	0.378 (378)	Alive
6	Laparoscopic sigmoid loop colostomy	None	0.378 (378)	Alive
7	Open cholecystectomy	Respiratory failure	0.450 (450)	Dead
8	Laparoscopic cholecystectomy	None	0.481 (481)	Alive
9	Open cholecystectomy	None	0.505 (505)	Alive
10	Left hemicolectomy	None	0.507 (507)	Alive
11	Open cholecystectomy	None	0.656 (656)	Alive*

**Died within 18 months of index operation.*

Table 3. Operative Characterisitcs of Patients With CD4 Cell Counts Less Than 0.20 ×10⁹/L (<200 Cells/µL)

Patient No.	Operation	Complication	CD4 Cell Count, ×10⁹/L (Cells/µL)	Outcome
1	LOA, retroperitoneal LN biopsy	Respiratory failure	0	Dead
2	Laparoscopic chole	Laceration cystic vein	0	Alive
3	Colostomy closure	Respiratory failure, pneumonia	0.001 (1)	Dead
4	Small-bowel resection	Pseudomembranous colitis	0.005 (5)	Alive†
5	Cecectomy	None	0.007 (7)	Alive
6	Exlap adhesiolysis	Postoperative ileus, wound infection	0.010 (10)	Alive
7	Small-bowel resection	None	0.010 (10)	Alive
8	Open appendectomy	None	0.016 (16)	Alive
9	Exlap	None	0.018 (18)	Alive
10	Ileocolectomy	None	0.020 (20)	Alive†
11	Open gastrostomy	Respiratory failure	0.022 (22)	Dead
12	Total colectomy	Ascites	0.022 (22)	Dead
13	Right hemicolectomy	Pelvic abscess, pneumonia	0.024 (24)	Dead
14	Right hemicolectomy	None	0.028 (28)	Alive
15	Splenectomy	Renal failure, cerebral vascular accident	0.030 (30)	Dead
16	Pancreatic debridement	MSOF	0.032 (32)	Dead
17	Small-bowel resection	Postoperative SBO	0.036 (36)	Alive
18	Exlap	Respiratory failure	0.039 (39)	Dead
19	Right hemicolectomy	Postoperative pancreatitis	0.041 (41)	Alive
20	Ileostomy closure	Pelvic abscess, sepsis	0.046 (46)	Dead
21	Open gastrostomy	None	0.050 (50)	Alive
22	Sigmoid loop colostomy	Postoperative pancreatitis	0.050 (50)	Alive†
23	Laparoscopic jejunostomy tube	None	0.054 (54)	Alive‡
24	Open chole and CBD exploration	None	0.054 (54)	Alive
25	Open liver biopsy	None	0.065 (65)	Alive
26	Small-bowel resection	*Clostridium difficile* colitis, fistula	0.074 (74)	Dead
27	Graham patch	None	0.088 (88)	Alive‡
28	Open appendectomy	None	0.116 (116)	Alive
29	Exlap	Postoperative ileus, wound bleed	0.126 (126)	Alive
30	Transverse loop colostomy	Stoma prolapse, pneumonia	0.161 (161)	Dead
31	Open cholecystectomy	None	0.176 (176)	Alive‡
32	Diverting colostomy	Pneumonia	0.190 (190)	Dead

**LOA indicates lysis of adhesions; LN, lymph node; Exlap, exploratory laparotomy; MSOF, multisystem organ failure; SBO, small-bowel obstruction; chole, cholecystectomy; and CBD, common bile duct.*
†Died within 6 months of index operation.
‡Died within 18 months of index operation.

Table 4. Comparative Indexes of Operated-on Patients

Parameter	Patients With CD4 Cell Count <0.20 ×⁹/L (<200 Cells/µL)	Patients With CD4 Cell Count >0.20 ×10⁹/L (>200 Cells/µL)	*P*
Perioperative deaths†	12 (38)	1 (9)	.13
Death at 6 mo†	15 (47)	1 (9)	.03
Major complications†	19 (59)	2 (18)	.03
Age, mean, y	38.0	37.4	.80
Length of stay, mean, d	25.3	19.1	.23
Males†	26 (81)	5 (45)	.05
Hemoglobin, mean, g/L	100	109	.77
Albumin, mean, g/L	27	33	.11
Sepsis†	12 (38)	0 (0)	.02
Blood product transfusion†	24 (77)	4 (36)	.02
HIV disease†	9 (28)	0 (0)	.08

**Values are number (percentage) unless otherwise indicated.*
HIV indicates human immunodeficiency virus.
†Fisher exact test.

tomosis, anastomotic leak and pelvic abscess, wound dehiscence, and prolapsed transverse loop colostomy. Of the 11 patients who had CD4 cell counts greater than 0.20×10^9/L, 2 (18%) developed major complications and 1 subsequently died within 30 days of operation (Table 2). Thirty-two patients had CD4 cell counts below 0.20×10^9/L (200 cells/µL) (Table 3). Nineteen (59%) of these 32 had major complications (P=.03) (**Table 4**). Twelve of these patients died within 30 days of their operation or did not leave the hospital alive (38%; P=.13) (Table 4). Three more patients died within 6 months of operation, resulting in an overall mortality rate of 47% (P=.03) (Table 4) at 6 months. Major complications in patients with CD4 cell counts less than 0.20×10^9/L (200 cells/µL) are shown in **Table 5**. Major complications occurred in 2 patients with CD4 cell counts greater than 0.20×10^9/L (200 cells/µL): respiratory failure in 1 and postoperative pancreatitis in 1.

Histological examination established HIV-related intra-abdominal pathologic conditions in 9 patients (**Table 6**). All of these patients had CD4 cell counts less than 0.075×10^9/L. Five of these patients died within 30 days of operation while in the hospital or in hospice care and another 3 died within 6 months of operation. Thus, 8 of 9 patients who were found to have HIV-related intra-abdominal pathologic conditions died within 6 months of operation and only 9 of 32 patients without documented HIV-related pathologic conditions died within 6 months of operation (P=.001).

Table 5. Major Complications in Patients With CD4 Cell Counts Less Than 0.20 ×10⁹/L (<200 Cells/µL)

Complication	No.
Respiratory failure	6
Pneumonia	4
Postoperative pancreatitis	3
Pseudomembranous colitis	3
Pelvic abscess	2
Postoperative ileus	2
Abdominal wall hematoma	1
Ascites	1
Cerebral infarction	1
Enteroenteric fistula	1
Major hemorrhage into wound	1
New-onset retroperitoneal adenopathy	1
New-onset seizures	1
Prolapsed colostomy	1
Renal failure	1
Small-bowel obstruction from anastomotic hemorrhage	1
Wound dehiscence	1

There were 12 patients who had perioperative septic episodes in our study. Eleven (92%) of these patients suffered major complications and 8 (75%) died. Of 31 nonseptic patients, 10 (32%) suffered complications (P=.001) and 6 (19%) died (P=.009).

Blood product transfusion history was recorded for all but 1 patient. Twenty-eight patients received blood product transfusions and 14 did not. Nineteen (68%) patients who received a transfusion suffered major complications and 16 (57%) died within 6 months of operation. In contrast, only 1 patient not receiving a transfusion had a major complication (P<.001) and there were no deaths in this group (P<.001).

Correlation of perioperative morbidity and mortality with CD4 cell count and specific hematologic and nutritional parameters is shown in **Table 7** and **Table 8**. When evaluating patients who had major complications vs those who did not, there were no significant differences in the preoperative hematocrit, white blood cell count, platelet count, and albumin level. However, the CD4 cell count was significantly lower in the patient group with complications (P=.02).

Similarly, when assessing these same factors on mortality, preoperative hematocrit, white blood cell count, and platelet count were not found to be significantly different. However, there were significantly lower CD4 cell counts (P=.05) and preoperative albumin levels (P=.004) in patients who died within 6 months.

Stratification of patients into 2 groups (CD4 count less than or greater than 0.20×10⁹/L) (200 cells/µL) demonstrates that these patients have similar characteristics (Table 4). No significant differences were seen in the mean patient age, length of hospital stay, and preoperative hemoglobin and albumin levels. Curiously, there was a significantly higher proportion of men in the low CD4 group (<0.20×10⁹/L). Of the 21 patients who had complications, medication histories were known in 16. Eight of these were being treated prophylactically against AIDS-associated diseases (zidovudine, acyclovir, pentamidine, and antituberculous and antifungal drugs), whereas 8 were not. Of the 22 who did not develop complications, medication histories were known in 19; 9 of the 22 were receiving AIDS-related medications (P=.67).

Follow-up revealed that of the 30 perioperative survivors, 6 died within 18 months of index operation and all of these had CD4 cell counts less than 0.20×10⁹/L (200 cells/µL) except for 1 patient who originally suffered no complications after open cholecystectomy. Eight of the other 24 are known to be alive; however, the majority of these were operated on in the last 6 months of the study. The other 16 are unavailable for follow-up.

Table 6. HIV-Related Pathology and Outcome

Patient No.	AIDS Pathology	CD4 Cell Count, ×10⁹/L (Cells/µL)	Outcome
1	Kaposi sarcoma	0.005 (5)	Died in 5 mo
2	Lymphoma	0.020 (20)	Died in 6 mo
3	Cytomegalovirus ileocolitis	0.022 (22)	Perioperative death
4	Kaposi sarcoma	0.050 (50)	Died in 3 mo
5	Lymphoma	0.065 (65)	Alive
6	Lymphoma	0.074 (74)	Perioperative death
7	Lymphoma	0.030 (30)	Perioperative death
8	Disseminated MAI	0.0 (0)	Perioperative death
9	HIV medication–induced pancreatitis	0.032 (32)	Perioperative death

**HIV indicates human immunodeficiency virus; AIDS, acquired immunodeficiency syndrome; and MAI,* Mycobacterium avium-intracellulare.

Table 7. Predictive Factors for Morbidity*

Preoperative Parameter	Patients With Complications	Patients Without Complications	*P*
CD4 cell count, median,† ×10⁹/L (cells/µL)	0.036 (36)	0.102 (102)	.02
Hematocrit	0.303	0.318	.50
WBC count,† ×10⁹/L	4.7	5.3	.90
Platelet count, ×10⁹/L	192	272	.06
Albumin, g/L	26	31	.13

**Values are mean except for CD4 cell count (median). WBC indicates white blood cell.*

†Mann-Whitney rank sum test; all other tests were performed with the unpaired t *test.*

Table 8. Predictive Factors for Mortality*

Preoperative Parameter	Patients Who Died Within 6 mo	Survivors	*P*
CD4 cell count, median,† ×10⁹/L (cells/µL)	0.031 (31)	0.088 (88)	.05
Hematocrit	0.290	0.322	.16
WBC count,† ×10⁹/L	6.0	4.6	.84
Platelet count, ×10⁹/L	181	262	.07
Albumin, g/L	24	32	.004

**Values are mean except for CD4 cell count (median). WBC indicates white blood cell.*

†Mann-Whitney rank sum test; all other tests were performed with the unpaired t *test.*

COMMENT

The overall morbidity (49%) and mortality (37%) rates for HIV-infected individuals in the present series is comparable to most reports.[1-3,9,10] In fact, our rates mirror the published experience of 13 series of laparotomies in patients infected with HIV, which show a complication rate of 46% and a death rate of 30%.[4] Mortality in our study was related to an ongoing septic process, AIDS-related pathologic conditions at laparotomy, and blood product transfusions. In addition, mortality at 6-month follow-up was significantly higher in patients with CD4 counts less than 0.20×10^9/L (200 cells/μL), as was the rate of major complications. Perioperative mortality was also higher and this approached statistical significance in our study.

Further examination of the low CD4 group vs the high CD4 group reveals that a significantly higher proportion of patients in the low CD4 group had an ongoing septic process (P=.02), received blood product transfusions (P=.02), suffered from major complications (P=.034), and died at 6-month follow-up (P=.03). None of the patients with a CD4 cell count greater than 0.20×10^9/L were noted to be septic, and none were found to have HIV-related pathologic conditions at the time of laparotomy. Blood product transfusions in HIV-infected patients with CD4 cell counts greater than 0.20×10^9/L occurred at a rate less than half that of patients with CD4 cell counts less than 0.20×10^9/L (200 cells/μL).

In general, CD4 cell counts are an imperfect marker for AIDS progression as many HIV-infected patients do well for extended periods with low CD4 cell counts while others with high CD4 levels experience rapid immunologic deterioration.[11] CD4 cell counts can, however, be used to monitor immunologic deterioration in HIV-infected patients.[7] Studies have shown that CD4 cell counts can be used as a predictor of opportunistic infections such as pneumocystis pneumonia; counts less than 0.20×10^9/L (200 cells/μL) make this more likely.[6] Our data suggest that patients with a CD4 cell count less than 0.20×10^9/L (200 cells/μL) are generally in poorer medical condition and have more advanced HIV manifestations and thus have a significantly higher rate of morbidity and mortality after major abdominal surgery.

There is a trend in our data that shows that patients with a CD4 count less than 0.20×10^9/L (200 cells/μL) have a higher perioperative mortality rate compared with patients with a CD4 cell count greater than 0.20×10^9/L (200 cells/μL). Perioperative death rates are 38% vs 9%, respectively (P=.13). It may be that statistical significance will be achieved if the number of patients in the high CD4 ($>0.20\times10^9$/L) group were increased. Power analysis shows that our study has a low statistical power of 0.226. To decrease that the chance of making a type II error to 0.20 (ie, power=0.80), both groups would require a sample size of 34 to determine if a significant difference exists between perioperative death rates of 38% and 9%.

When stratifying our patients by those with and without major complications, our data confirm results of previous studies that have shown that perioperative risk factors, including hematocrit, white blood cell count, and platelet count, make no difference in final outcome.[4,10,12,13] Interestingly, the patients who suffered from major complications had a significantly lower median CD4 cell count of 0.036×10^9/L vs 0.102×10^9/L in patients without complications (P=.02). When comparing patients who died within 6 months of operation vs survivors, median CD4 cell count and average albumin level were significantly lower in patients who died. No differences in hematocrit, white blood cell count, and platelet count were seen. The finding of significantly lower CD4 cell counts in patients who died and had major complications and in those who had uneventful postoperative courses further supports the idea that CD4 cell counts are useful in selecting HIV-positive patients whose outcome will be poor with major abdominal surgery. We noted significantly lower albumin levels in patients who died after operation. However, albumin levels were recorded in only half of the patients. Thus, the significance of albumin levels as a prognostic factor should be viewed with caution.

Our finding of a significantly increased mortality (89%) when HIV-related pathologic conditions is found at laparotomy (P=.001) confirms the results of others.[4] Unlike the San Francisco, Calif, study, we did not find any difference in survival or morbidity in patients receiving ongoing prophylactic treatment for AIDS-related disease.

Our study demonstrates an increased rate of blood product transfusion in patients with CD4 cell counts less than 0.20×10^9/L, as well as an increased incidence of morbidity and mortality in those requiring transfusion. Although the increased requirement for blood product transfusion was statistically significant when stratified as above, this finding must be interpreted with caution. Blood product transfusion may have been the result of illness rather than a factor in patient outcome. In essence, these patients were probably more ill initially and required transfusions as a result of illness rather than immunosuppressive effects.

The outcome of septic patients in our study was not surprising. Three fourths of these patients died and all but 1 suffered a major complication. No patients with a CD4 cell count greater than 0.20×10^9/L were found to be septic in our study. Conversely, patients without sepsis had significantly lower rates of morbidity and mortality.

Currently, the percentage or absolute number of circulating CD4 cells is the best predictor of AIDS onset[14]; however, this has recently been challenged by reports that have shown that plasma levels of HIV-1 RNA predict outcome and progression to AIDS independent of CD4 cell counts.[15,16] In general, as levels of HIV-1 replication decline, CD4 lymphocyte counts increase.[16] The recent development of protease inhibitors has resulted in potent suppression of virus replication with subsequent increases in CD4 levels.[17] Thus, as protease inhibitors become standard in antiretroviral therapy, immunologic status in HIV-infected patients will improve, which should result in increased surgical survival and decreased morbidity. The measurement of plasma levels of HIV-1 RNA or viral load monitoring may prove useful in predicting surgical outcome in HIV-infected patients in the future. A prospective study comparing CD4 cell counts and viral load monitoring for prognostication in major abdominal surgery may prove useful.

Our data show that there are several variables that correlate with outcome in HIV-positive patients who undergo major abdominal surgery. CD4 cell counts less than 0.20×10^9/L (200 cells/μL), perioperative sepsis, and HIV-

related pathologic conditions all correlate with increased morbidity and mortality. Nevertheless, indications for major abdominal surgery have not changed despite a patient's HIV status. However, both the surgeon and the patient should be aware that a certain subset of patients are at higher risk for a poor outcome, specifically, septic HIV-positive patients with low CD4 cell counts and those subsequently found to have AIDS-related disease at laparotomy.

Presented at the 105th Scientific Session of the Western Surgical Association, Colorado Springs, Colo, November 19, 1997.

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DISCUSSION

Christine Cocanour, MD, Houston, Tex: The authors looked at all HIV-infected patients undergoing intra-abdominal surgery over about a 10¼-year period. They specifically correlated the outcome of these 43 patients with their CD4 counts.

Unlike others who have looked at a similar question, they found that in the 32 patients with CD4 counts less than 200 cells/μL (0.20×10^9/L), 59% had complications, while only 18% of those 11 patients with CD4 counts greater than 200 had complications. Although there were more perioperative deaths in patients with CD4 counts less than 200, it did not become significantly different until the number of deaths were followed up for 6 months.

Not surprisingly, they also found that septic patients were significantly more likely to have complications and die than nonseptic patients, and the patients who had HIV-related intra-abdominal processes were much more likely to be dead within 6 months.

The nutritional parameter albumin was not significantly different between those with complications and those without, but it was a significant factor in those who died.

Might the one fourth of patients who had CD4 counts obtained 2 or 3 years prior to their abdominal operation have potentially skewed your data? You would expect that the CD4 counts would be even lower, unless of course the patients had been receiving protease inhibitors. Were any of the patients in your study on protease inhibitors? Would these agents decrease perioperative complications and morbidity and mortality?

You noted that blood transfusions also led to a worse prognosis. Did you try to stratify the complexity or length of the operation with the number of complications or mortality? Did the patients with CD4 counts less than 200 require more extensive surgery?

Raymond J. Joehl, MD, Chicago, Ill: Increasingly what we do as surgeons at the end of life will be scrutinized, and this leads to my first question. How many of your patients in this report had advance directives or a living will in the chart before surgery? Are you now using the CD4 count of less than 200 as a criterion indicating that an operation is not indicated in selected patients?

Jorge L. Rodriguez, MD, Minneapolis, Minn: I have a question concerning the cofactor of medications. Was any analysis done besides protease inhibitors—AZT (zidovudine) and so forth—that can actually affect the prognosis of the CD4 and the indications for operation and survival? This is an important point to be able to associate the count with the medications the patients are taking.

David L. Bouwman, MD, Detroit, Mich: We did correlate outcome to CD4 counts, and I will try to answer Dr Cocanour's questions. Twenty-five percent of the CD4 counts were old, and over 90% of these patients antedated the use of antiproteases. We would expect that current CD4 counts overall would have been lower. These statements also address the questions of the other discussants: our data reflect the natural history of AIDS and CD4 counts before the introduction of antiproteases. Today, most of our patients are taking the cocktail of the antivirals and antiproteases and we have seen restoration of CD4 counts. Therefore, if you see a patient today who has a low CD4 count who is not newly diagnosed, and who has been on medication, indeed the low count is a very strong prognostic indicator that this patient is entering the end stage of disease.

Dr Joehl, we agree that frequently surgery in this group of patients can be end-of-life surgery. There were patients with directives and who, with input from their primary care infectious disease doctors, refused the operation on the basis of prognostic counseling. We have no overall count on how many people did have advance directives. So do we use CD4 counts below 200 as a criterion now? For counseling patients, yes, taking into account the history and use of medications.