Incidence and Hospital Stay for Cardiac and Pulmonary Complications after Abdominal Surgery

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OBJECTIVE: **Internists frequently evaluate preoperative cardiopulmonary risk and comanage cardiac and pulmonary complications, but the comparative incidence and clinical importance of these complications are not clearly delineated. This study evaluated incidence and length of stay for both cardiac and pulmonary complications after elective laparotomy.**

DESIGN: **Nested case–control.**

SETTING: **University-affiliated Department of Veterans Affairs Hospital.**

PATIENTS: **Computerized registry of all 2,291 patients undergoing elective abdominal operations from 1982 to 1991.**

MEASUREMENT AND MAIN RESULTS: **Strategy for ascertainment and verification of complications was systematic and explicit. The charts of all 116 patients identified by the registry as having complications and 412 (19%) randomly selected from 2,175 remaining patients were reviewed to verify presence or absence of cardiac or pulmonary complications, using explicit criteria and independent abstraction of pre- and postoperative components of charts. From these 528 validated cases and controls (23% of the cohort), 96 cases and 96 controls were matched by operation type and age within ten years. Hospital and intensive care unit stays were significantly longer ($p < 0.0001$) for the cases than for the controls (24.1 vs 10.3 and 5.8 vs 1.5 days, respectively). All 19 deaths occurred among the cases. Among the cases, pulmonary complications occurred significantly more often than cardiac complications ($p < 0.00001$) and were associated with significantly longer hospital stays (22.7 vs 10.4 days, $p = 0.001$). Combined cardiopulmonary complications occurred among 26% of the cases. Misclassification-corrected incidence rates for the entire cohort were 9.6% (95% CI 7.2–12.0) for pulmonary and 5.7% (95% CI 3.8–7.7) for cardiac complications.**

CONCLUSIONS: **For noncardiac surgery, previous research has focused on cardiac risk. In this study, pulmonary complications were more frequent, were associated with longer hospital stay, and occurred in combination with cardiac complications in a substantial proportion of cases. These results suggest that further research is needed to fully characterize the clinical epidemiology of postoperative cardiac and pulmonary complications and better guide preoperative risk assessment.**

KEY WORDS: **preoperative care; surgery/operative; pulmonary complications; cardiac complications.**
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More than three million intra-abdominal operations are performed annually in the United States.[1,2] Compared with more peripheral procedures, these operations are associated with higher risk of pulmonary and cardiac complications.[3–5] Internists are frequently involved in preoperative risk assessment and comanagement of these complications.[6–10] Considerable research regarding prediction and prevention of complications has been published in the internal medicine literature.[11–29] However, research to date provides inadequate information about the relative incidence and clinical importance of cardiac and pulmonary complications after noncardiac surgery to guide preoperative risk assessment.

Studies to identify risk factors for complications generally do not report incidence of both pulmonary and cardiac complications and have focused more often on cardiac risk.[11–33] In a continuous monthly computerized literature search since mid-1987, using broad search terms (*preoperative care* or *postoperative complications*), we have found that, for noncardiac surgery, studies of cardiac risk have outnumbered those of pulmonary risk approximately 3:1.

Available estimates for comparative incidence do not explain this greater research focus on cardiac complications.[23–28, 34–54] Among 25 studies of noncardiac operations identified by a systematic literature search,[23–28, 34–54] pulmonary complications appeared to occur as often as or more often than cardiac complications for 17 (68%).[27, 28, 34–48] Over all the studies, the ranges of incidence rates for pulmonary and cardiac complications were nearly identical: 0.2% to 22.9% and 0% to 22.5%, respectively.[23–28, 34–54] This literature is

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difficult to interpret for several reasons. Only seven of the 25 studies used explicit criteria to define at least some complications.[25–27, 34, 44, 48, 52] For eight studies, the type of surgery was mixed[25–28, 35, 38, 48, 54]; for the remainder, the types of operations were relatively homogeneous. No study explicitly reported the number of patients with multiple pulmonary or cardiac complications or the number of patients with both types of complications.

The data about relative clinical impact of pulmonary and cardiac complications are even more sparse. Among the few studies distinguishing between minor and major complications, definitions of minor and major were inconsistent. Among the six studies reporting mortality,[25, 28, 40, 43, 52, 53] deaths attributed to cardiac complications were more frequent in four studies.[25, 43, 52, 53] Among the three surgical populations (hip fracture repair, prostatectomy, cholecystectomy) with sufficient data to estimate case fatality rates,[40, 41] the rate was higher for cardiac complications in two (prostatectomy, cholecystectomy). Again, no study reported the number of patients with multiple or combined cardiac and pulmonary complications.

In summary, the clinical epidemiology of pulmonary and cardiac complications after noncardiac surgery is poorly defined. This retrospective study of patients undergoing elective abdominal operations was undertaken to evaluate: 1) comparative incidence of pulmonary and cardiac postoperative complications and 2) relative clinical importance of these complications as measured by mortality and length of stay.

METHODS

Study Cohort/Ascertainment of Cases

The cohort included all elective intra-abdominal operations performed between 1982 and 1991 ($N = 2,291$) at the Audie L. Murphy Memorial Veterans Hospital, a 650-bed teaching hospital that has a large south Texas catchment area and is affiliated with the University of Texas Health Science Center at San Antonio. Patients were identified from a computerized registry of all general surgical procedures, which includes information about postoperative complications occurring prior to discharge from the surgery service. Data for the registry were routinely completed by surgical residents and entered by data entry personnel.

It was reasoned that two major types of misclassification could exist in the surgical registry: erroneous classification of patients as having or not having complications and misclassification of type of complication (i.e., cardiac or pulmonary). To obtain solid estimates of the rates for these types of misclassification, we used an explicit and systematic strategy for ascertainment and verification of complications. This strategy included: chart review of all patients listed by the registry as having complications; chart review for 412 randomly selected patients listed as not having complications (19% of the cohort); identical exclusion criteria for cases and control; and review by a trained abstractor who used explicit criteria for complications and independent abstraction of the pre- and postoperative sections of the chart. Cases were defined as patients undergoing elective abdominal operations who, after chart validation, had intra- or postoperative pulmonary or cardiac complications as defined by explicit criteria (Appendix A). These included pneumonia, respiratory failure, bronchospasm, tracheobronchitis, pleural effusion necessitating thoracentesis, myocardial infarction, ischemia, congestive heart failure, supraventricular tachycardia and ventricular dysrhythmia necessitating therapy, and cardiogenic shock. Last, each case was matched to a control by type of surgery and age (age difference ≤10 years). This additional step was taken to avoid bias in the incidence of pulmonary and cardiac complications due to age or specific types of surgery; only the matched sample of cases and controls was analyzed for this report.

Of the 2,291 patients undergoing elective abdominal operations in the cohort, 116 were reported by the registry as having pulmonary or cardiac complications. From the remaining 2,175 patients, 412 without reported complications were randomly selected from a computerized list stratified by type of operation. After validation of the 412 possible controls, three were excluded (one, complication present preoperatively; two, operation not elective laparotomy) and 33 who actually had pulmonary or cardiac complications were reclassified as cases. After chart validation of the 149 potential cases (116 + 33), 36 were excluded from analysis: eight, no postoperative complication; two, complication already present preoperatively; three, uniquely high-risk conditions (myasthenia gravis, amyotrophic lateral sclerosis, quadriplegia); six, operation not elective laparotomy; and 17, chart unavailable. As a next step in reducing bias toward overcounting pulmonary complications, patients whose only postoperative cardiopulmonary event was micro- or macroatelectasis were excluded as cases or controls ($n = 59$). Microatelectasis is not considered clinically important and the clinical significance of macroatelectasis is unclear.

The total number of charts reviewed in detail to verify presence or absence of complications was 528, 23% of the entire cohort. The total number of verified cases with pulmonary or cardiac complications for whom matched controls were found was 96. The cases for whom a matched control was not available ($n = 11$) had consistently undergone procedures of especially high pulmonary risk: six, Whipple procedures; two, esophagectomies; one, esophagogastrectomy; and two, gastric resections. These cases were excluded so as not to bias the results toward overcounting pulmonary complications.

Statistical Methods

Among the cases, the McNemar chi-square test was used to compare incidences of pulmonary and cardiac complications because the three patient-types of complications (pulmonary, cardiac, and both) share a common denominator. Duration of stays in the hospital and intensive care units (ICUs) were compared with two-sample t-tests after log transformation of the data.

Chart review revealed errors in identification of complications by the computerized surgical registry (i.e., false negatives and false positives). To compute accurate estimates of incidence of complications for the total cohort, we used log-linear regression to model and correct for these errors. Conceptually, this is a way to apply the false-negative and false-positive rates for the observed cases and controls to the entire cohort of laparotomies. The data for this model take the form of a multiway contingency table. The cohort is classified according to both reported status for cardiac and pulmonary complications in the surgical registry and true status for cardiac and pulmonary complication from chart review. Since not all individuals in the cohort were reviewed, the true status is unknown for some individuals, and the multiway table is incompletely cross-classified. With log-linear regression, logarithms of cell counts from the hypothetical completely cross-classified table are modeled as a linear function of model terms. We included main effects for reported cardiac and pulmonary complications, true cardiac and pulmonary complications, and interactions between cardiac and pulmonary complications to allow for lack of independence between the complications and interactions between true and reported status to allow for differential misclassification.[55] Incidence was computed by summing the estimated cell counts over each true status. Approximate standard errors for the incidence estimates were computed by the delta method from the covariance matrix of the log-linear regression coefficients.

RESULTS

Table 1 shows the characteristics of the cases and controls. Hospital and ICU stays were significantly longer for the cases than for the controls. All 19 deaths occurred among the cases. The cases did not differ from the controls in the proportion having preoperative diagnostic spirometry, mean forced expiratory volume in 1 second (FEV_1), mean forced vital capacity (FVC), or mean FEV_1/FVC, although mean pack-years of smoking was higher among the cases than the controls. The cases had significantly worse comorbidity scores and cardiac risk scores.

Table 2 shows the types of pulmonary and cardiac complications for the 96 cases. Table 3 gives an overview of the distribution of pulmonary and cardiac complications and their associated durations of hospital stay and days in the ICU. Among the cases, pulmonary complications were significantly more frequent than cardiac complications, for both total and severe complications. Pulmonary complications were more frequent even though the cases had significantly higher cardiac risk scores. A substantial proportion had combined pulmonary and cardiac complications: 26% of the patients with all complications and 30% of patients with severe complications. Of the 19 patients who died, the majority (11) had both cardiac and pulmonary complications. Of the 37 cases of respiratory failure, 17 (46%) were not associated with cardiac complications.

Crude estimates of complications rates for the entire cohort, as reported by the computerized surgical registry, were 4.8% (95% CI 3.6–6.0) and 1.3% (95% CI 0.7–2.0) for pulmonary and cardiac complications, respectively. However, patients with and without complications were misclassified in the surgical registry. Among the 116 patients reported by the registry as having complications, ten did not have chart-documented complications, for a false-positive rate of 9.3% (10/[116 − 9 charts not found]). Of the 412 charts randomly selected from the cases listed by the registry as not having complications (19% of the potential noncases or controls in the cohort), 33 had postoperative pulmonary or cardiac complications, for a false-negative rate of 8.2% (33/[412 − 8 charts not found]). Misclassification rates for pulmonary and cardiac complications among the false negatives were similar: 6.0% and 4.0%, respectively. From these data, we estimated misclassification-adjusted incidence rates for the entire cohort of 2,291 elective laparotomies. Estimated rates were 9.6% (95% CI 7.2–12.0) for pulmonary complications and 5.7% (95% CI 3.8–7.7) for cardiac complications.

Pulmonary complications were associated with significantly longer hospital stays (Table 3). The patients with combined cardiac and pulmonary complications (all: $n = 25$; severe: $n = 18$) had lengths of stay similar to the longer stays of the patients with pulmonary complications alone and significantly longer than those of the patients with only cardiac complications.

There was no significant difference in length of ICU stay between the patients with only pulmonary complications and those with only cardiac complications (3.6 vs 3.1 days, $p = 0.54$) and between the patients with severe pulmonary complications and those with severe cardiac complications (4.7 vs 4.1 days, $p = 0.46$). However, for the patients who had combined pulmonary and cardiac complications, mean ICU stay was significantly longer than for the patients who had either type of complication alone (Table 3).

The proportion of patients suffering severe pulmonary complications without severe cardiac complications tended to be higher among the survivors than among those who died ([31/77, 40%] vs [5/19, 26%], $p = 0.261$). The converse trend occurred for severe cardiac complications: the proportion of patients with severe cardiac complications but not severe pulmonary complications was higher among the patients who died compared with the survivors ([3/19, 16%] vs [4/77, 5%], p = 0.112). For the patients with severe combined cardiopulmonary complications, the proportion of those dying compared with the survivors was significantly higher ([11/19, 58%] vs [7/77, 10%], OR 13.8, p < 0.0001, 95% CI 4.3–43.9).

DISCUSSION

The available literature indicates that the relative incidence and impact of pulmonary and cardiac complications after abdominal operations in current times have not been adequately defined. Previous research has largely focused on cardiac surgical risk, presumably because it is higher or more clinically important. The results of this study indicate that, at least in a population of male veterans undergoing elective abdominal operations, pulmonary complications occurred more frequently than cardiac complications and were associated with longer hospital stays. Pulmonary and cardiac complications occurred together in 26% of the cases. For the patients with combined cardiopulmonary complications, the length of hospital stay was similar to the longer stay for the patients who had only pulmonary complications, and the ICU stay was significantly longer than that for the patients who had either type of complication alone. Results were consistent when the data were limited to severe cardiopulmonary complications. Statistical power is low but severe cardiac and combined cardiopulmonary complications seemed to be associated with higher mortality. There was no significant difference between the cases and the controls in degree of obstructive lung disease for those with preoperative spirometry, but mean comorbidity score and mean pack-years of smoking were higher for the cases.

This study has several important limitations, and therefore the findings should be considered preliminary. Limitations include: 1) a male veteran population with a high prevalence of smoking and chronic obstructive lung disease (thus limiting generalizability to women);

Table 1
Characteristics of the Cases with Cardiopulmonary Complications and the Controls*

	Cases (n = 96)	Controls (n = 96)
Age—mean (±SD)	65 (±9) yr	65 (±9) yr
Type of laparotomy (n)		
Biliary operations†	15	15
Esophageal procedures	9	9
Gastric procedures	12	12
Pancreatic operations	6	6
Aortic resection or graft	27	27
Colectomy, partial and total	20	20
Abdominoperineal resection	2	2
Exploratory or staging laparotomy or enterolysis	5	5
Deaths (n)‡	19	0
Length of stay—mean (±SD)‡	24.1 (±27.4) days	10.3 (±6.0) days
ICU§ stay—mean (±SD)‡	5.8 (±7.9) days	1.5 (±1.5) days
Charlson Comorbidity Score—mean (±SD)‡	2.7 (±1.8)	1.6 (±1.5)
Goldman Cardiac Score—mean (±SD)	4.9 (±2.6)	4.1 (±2.2) (p = 0.013)
Pack-years smoking—mean (±SD)	47 (±35)	36 (±43) (p = 0.054)
Preoperative spirometry done (n)	47	49
FEV_1¶—mean (±SD)	2.4 (±1.2) L	2.6 (±1.5) L
FVC‖—mean (±SD)	3.5 (±1.2) L	3.6 (±1.4) L

*All the controls and cases were male except one.
†14 open cholecystectomies, no laparoscopic cholecystectomy.
‡$p \leq 0.0001$.
§ICU = intensive care unit.
¶FEV_1 = forced expiratory volume in 1 second.
‖FVC = forced vital capacity.

2) data collection by chart audit; 3) small sample size; and 4) lack of a uniform prospective surveillance strategy for complications.

Several strategies reduced potential bias due to these limitations. All the cases and controls were validated by chart abstraction using explicit criteria for complications and independent abstraction of the pre- and postoperative components of the medical record. The patients reported by the surgical registry as having cardiopulmonary complications plus 19% of the remaining potential controls were reviewed to determine misclassification rates in the surgical registry. Overall, charts were reviewed for 23% of the cohort. The error rates that were found underscore a common difficulty with research using registries and confirm the importance of our validation of cases and controls. Sample size is small because we chose to focus on a relatively high-risk group with more homogeneous overall risk (i.e., abdominal operations) than a mixed surgical population.

Our estimate for the incidence of pulmonary complications was conservative for several reasons. To avoid an inflated estimate for pulmonary complications in the cohort, we excluded cases whose only postoperative event was atelectasis and 11 cases for which matched controls were not available and whose surgeries entailed an especially high pulmonary risk. We also matched very closely by procedure because type and duration of surgery have long been known to influence the risk of postoperative complications.[4,5,23] Therefore, it is important to control for these factors in estimating incidence of pulmonary and cardiac complications.

The lack of a uniform surveillance strategy is an important limitation of the study. However, we do not think it provides sufficient potential bias to negate the findings. The most important source of error is possible overdiagnosis of pulmonary complications and underdiagnosis of cardiac complications. We doubt that we overcounted pulmonary complications because our estimate for pulmonary complications was intentionally conservative. Further, the findings were consistent for all cardiopulmonary complications and for severe complications. Chart documentation of severe complications should be less susceptible to error. Respiratory failure can be determined by intubation status. Effusion necessitating thoracentesis can be determined by a specific procedure note. We explicitly had two categories for pneumonia, definite and possible, to circumvent problems with chart data. Definite pneumonia required both radiographic evidence and new antibiotics.

Another potential source of error is underdiagnosis of cardiac complications, especially myocardial infarc-

Table 2
Types of Pulmonary and Cardiac Complications

Pulmonary	
Respiratory failure	37 (30%)
Pneumonia	36 (29%)
Possible pneumonia	22 (18%)
Effusion	15 (12%)
Tracheobronchitis	11 (9%)
Bronchospasm	3 (2%)
TOTAL	124
Cardiac	
Supraventricular tachycardia	19 (40%)
Ventricular dysrhythmia	16 (34%)
Congestive heart failure	8 (17%)
Myocardial infarction	2 (4%)
Possible infarction	1 (2%)
Ventricular fibrillation	1 (2%)
TOTAL	47

Table 3
Overview of Pulmonary (PC) and Cardiac (CC) Complications and Associated Length of Stay (LOS) and Intensive Care Unit (ICU) Stay

A. All Patients (n = 96)					
	PC Only		*CC Only*		*PC + CC*
Number of patients	57 (59%)	p < 0.00001	14 (15%)		25 (26%)
LOS—mean (±SD)	22.5 (±17) days	p = 0.001	10.4 (±4.5) days	p = 0.006	27.3 (±20.7) days
ICU stay—mean (±SD)	3.6 (±4.8) days		3.1 (±2.2) days	p = 0.001	12.4 (±11.4) days
B. Patients with Severe Complications (n = 61) (pneumonia, respiratory failure, MI*, CHF*, V Fib*)					
	PC Only		*CC Only*		*PC + CC*
Number of patients	36 (59%)	p < 0.00001	7 (11%)		18 (30%)
LOS—mean (±SD)	25 (±19.9) days	p = 0.01	10 (±5.7) days	p = 0.04	27.4 (±20.7) days
ICU stay—mean (±SD)	4.7 (±6.4) days		4.1 (±2.0) days		14.3 (±12) days†
C. Deaths (n = 19)					
	Pneumonia, Respiratory Failure		*MI, CHF, V Fib*		*PC + CC*
	5		3		11

*MI = myocardial infarction; CHF = congestive heart failure; V Fib = ventricular fibrillation.
†p = 0.0002 and 0.04 compared with PC only and CC only, respectively.

tion. In a study of veterans, Charlson et al. showed that without a prospective uniform surveillance strategy, a significant number of asymptomatic postoperative myocardial infarctions could be missed, perhaps as many as 50%.[56] We doubt this error occurred sufficiently to reverse the findings for several reasons. First, misclassification rates were similar for cardiac and pulmonary complications (6% and 4%, respectively). Second, two recent and large studies of veterans found rates for postoperative myocardial infarction that were similar to, but lower than, ours: 2.5% (12/474) and 1.8% (15/835).[19, 27] In one study of 474 veterans undergoing elective noncardiac surgery, outcome surveillance involved daily electrocardiography on postoperative days 1–7, 10, and 14, and serum creatine kinase and isoenzyme levels on postoperative days 1 and 5.[19] In the second study, two surveillance strategies were used.[27] For 512 active participants, electrocardiograms were obtained and total creatine kinase and isoenzyme levels were measured on postoperative days 1, 3, and 5. For 323 chart review patients, explicit criteria were nearly identical to ours: new Q–QS patterns and serial changes in creatine kinase MB levels. Despite the potential for underdiagnosing in chart review patients, the incidences of infarction were similar between the active and chart review patients: 1.7% (95% CI 0.4–2.7%) and 2.2% (95% CI 0.4–3.9%), respectively.[27]

Similar rates between our study and these two, with a spectrum of methods from retrospective to prospective, suggest we did not significantly underdiagnose perioperative myocardial infarction. Perhaps the focus on cardiac risk in the literature has created a very low clinical threshold and more aggressive clinical surveillance for cardiac complications since the study of different surveillance strategies by Charlson et al.[56] Even if we missed as many as 50% of infarctions, the rates for pulmonary and cardiac complications would be similar and the greater focus on cardiac risk in previous research would remain unexplained. The report by Ashton et al. corroborates this argument: incidence rates were similar for perioperative infarction and pneumonia (1.8% and 2.4%, respectively).[27] Our finding that pulmonary complications were associated with longer lengths of stay and that patients with combined complications comprised a substantial group further emphasizes the need for prospective data to define the clinical epidemiology of postoperative cardiopulmonary complications.

If the false-negative rate of 8.2% for the 412 potential control charts reviewed is applied to the remaining 1,763 patients in the cohort, there are approximately 150 more cases in the cohort. A sufficiently higher rate of cardiac compared with pulmonary complications in this group could negate our findings. We think this is unlikely because the misclassification rates in the validated charts were similar for cardiac and pulmonary complications. A systematic difference in misclassification rates for the remainder of the cohort is unlikely.

These preliminary results suggest that pulmonary complications may occur as frequently as or more frequently than cardiac complications and may be associated with longer hospital stay. If true, the traditionally greater research emphasis on cardiac risk assessment may be missing part of the overall picture of operative risk. Pulmonary risk also has been less rigorously studied. Older studies were often of poor methodologic quality.[29] Recent studies used more rigorous methods, but were small or did not explicitly compare the incidences of pulmonary and cardiac complications.[23, 24, 26] As a result, clinicians lack precise data describing relative risk and incidence of cardiopulmonary complications to guide preoperative risk assessment.

Well-done prospective studies are needed to overcome all sources of misclassification and ascertainment bias in order to determine frequencies of postoperative cardiopulmonary complications. Prospective data from large cohorts should clarify several issues: 1) comparative incidence, risks, and outcomes of postoperative cardiopulmonary complications after different types of noncardiac operations; and 2) relative yield of evaluative strategies to predict cardiac and pulmonary complications jointly or independently. For now, clinicians should recognize that pulmonary complications have been less well studied, that pulmonary complications may be as significant as cardiac complications, and that combined complications may be more important than previously recognized.

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APPENDIX A

Criteria for Pulmonary and Cardiac Complications

Pulmonary

1. Pneumonia: radiographic evidence and antibiotics.
2. Possible pneumonia: radiographic evidence but *no* intravenous antibiotics *or* negative chest x-ray but intravenous antibiotics given.
3. Respiratory failure: ventilator dependence for more than one postoperative day or reintubation.
4. Bronchospasm: clinical diagnosis resulting in change in therapy.
5. Tracheobronchitis: purulent sputum with negative chest x-ray, not treated with intravenous antibiotics.
6. Pleural effusion: resulting in thoracentesis.

Cardiac

1. Transient ischemia: angina or electrocardiogram read as ischemia by physician.
2. Supraventricular tachycardia: resulting in pharmacologic intervention or care in intensive care unit.
3. Ventricular ectopy: resulting in therapy.
4. Transmural myocardial infarction: increased MB fraction of creatinine phosphokinase plus Q waves or characteristic ST elevation on electrocardiogram.
5. Nontransmural myocardial infarction: increased MB fraction plus ST depression or T-wave changes on electrocardiogram for more than 24 hours.
6. Possible infarction: suspected but criteria for transmural or nontransmural infarction not satisfied.
7. Congestive heart failure: clinical evidence (e.g., S_3 gallop, rales, increased jugular venous pressure) or radiographic changes *and* change in therapy with inotropic or afterload reducing agents.
8. Cardiogenic shock: systolic blood pressure < 90 mm Hg, clinical and radiographic evidence and pressor agents.
9. Cardiopulmonary arrest: included ventricular fibrillation.

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REFLECTIONS

The human body is private property. We have to have a search warrant to look inside, and even then an investigator is confined to a few experimental tappings here and there, some gropings on the party wall, a torch flashed rather hesitantly into some of the dark corners.—JONATHAN MILLER (1936–), British writer and doctor. BBC TV programme, *The Body in Question*, 'Perishable Goods,' 15 Feb 1979