ANALYSIS OF 119 HOSPITAL DEATHS ON A SURGICAL SERVICE

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Critical evaluation of the primary cause and contributing factors responsible for death of an individual patient has been useful to the surgeon in many ways. Among other things, it is a means of assaying the proficiency of medical care, the progress of treatment and the validity of both diagnosis and treatment. Often, however, a series of cases must be studied before a consistent pattern can be recognized. In view of the broadening surgical horizon and the enlarging surgical armamentarium it was thought that a review of the hospital deaths among surgical patients might prove informative.

The records of all patients dying on the surgical service of the Ochsner Foundation Hospital between Jan. 1, 1950, and Dec. 31, 1952 were reviewed. During this period there were 119 deaths among 3,314 patients admitted to the surgical service and 4,375 operations performed. Obviously, not all 119 deaths occurred among patients operated upon. Also, some patients whose primary disease was nonsurgical were operated upon in an effort to further medical care, but because of the operation, were considered surgical deaths.

The ages of the 119 patients ranged from 12 hours to 88 years (Fig. 1). There were relatively fewer among the younger age group than might be generally found, but there was no obstetric service at the hospital during the period of the study. One would expect the sex ratio to be about the same as that of the general population and this is approximately true with the exception of the group from 50 to 70 years of age.

There is no explanation for this other than the incidence of carcinoma among a group of patients in whom gynecologic lesions were largely excluded.

To be of greatest value, study of any group of deaths should include a complete postmortem examination. Autopsies were performed in 100, or 84 per cent, of the 119 cases in this series. In 12 of the remaining 19 patients an antemortem diagnosis of cancer was confirmed by histologic examination, either during the period of terminal hospitalization or at a previous surgical procedure. Thus, among the entire group of 119 patients, there were only seven patients operated upon for non-neoplastic lesions who subsequently died and on whom no postmortem examination was performed.

There were 65 patients with a diagnosis of a neoplastic process which had been confirmed at a previous surgical procedure, during the time of terminal hospitalization or at postmortem examination. During the terminal hospitalization 49 of these patients were operated upon, and in 16 no surgical procedure was performed. Fifty patients died following operation for a non-neoplastic lesion and four patients with non-neoplastic lesions, and no surgical procedure, died while on the surgical service.

Obviously, it is not possible to discuss each individual case in detail. For this reason the case record, including the postmortem protocol, was reviewed. Particular attention was paid to the preoperative diagnosis, surgical procedure, time of death with reference to the postoperative or postadmission period, complications and final diagnoses. For the purpose of clarity the many irrelevant postmortem findings were omit-
ted. Also, if two or more complications contributed to the fatal outcome, these instances were listed separately.

_Pulmonary Complications._ As might be anticipated, pulmonary complications were the most frequent among the 119 patients (Fig. 2). Excluding the instances of pulmonary embolism and infarction, _asphyxia_ resulted in, or largely contributed to, the death of 49 of the patients. Postmortem examination was performed in 44 of these 49 patients.

Partial collapse of a major portion of pulmonary tissue was noted in 16 patients. However, in only three was this the only fatal complication. The first of these was a child in whom an omphalocele was reduced and the defect covered with skin. The second and third patients died after pneumonectomy for carcinoma of the lung, and thoracotomy and biopsy of an extensive thymoma, respectively.

_Bronchopneumonia_ of significant extent was found in 14 patients and was thought to be the primary cause of death in four. Three of these four patients had carcinoma and were not operated upon during the period of hospitalization under consideration, and the fourth patient had had a tracheotomy following cerebrovascular hemorrhage.

A terminal phase of severe _pulmonary edema_ was present in nine patients, of whom all but one had been operated upon. This one patient had suffered a severe electrical burn and had had several phases of acute pulmonary edema during the initial period of hospitalization. The terminal phase of this patient's course was marked by severe uremia and recurrent pulmonary edema.

_Aspiration asphyxia_ occurred in six patients. In three this was due to the massive aspiration of vomitus. In only one of these three did this occur in the immediate postoperative period. The other three patients succumbed to aspiration asphyxia secondary to hemorrhage from a tracheotomy wound, a ruptured pulmonary arterial aneurysm and a tracheobronchial stump, respectively.

Miscellaneous _pulmonary complications_ included one case each of traumatic asphyxia secondary to injury in an automobile accident, severe bronchospasm immediately following pneumonectomy, almost complete replacement of pulmonary tissue by metastatic carcinoma, and severe suppurative tracheal bronchitis.

_Embolism and Infarction_ were the next most frequent fatal complications (Fig. 3). Thirty-three of the 119 patients had some form of embolus or infarction. Postmortem examination was performed on 30 of these. _Pulmonary embolism_ and _infarction_, occurred in 26 of 33 patients, and was massive in 15. In 17 of these 26 patients the primary
substantiated diagnosis was cancer. In six patients the superficial femoral veins or the inferior vena cava were ligated. Four of these patients had hypertensive cardiovascular disease and had been admitted to the medical service; but pulmonary embolism developed while they were hospitalized, and they were transferred to the surgical service. **Myocardial infarction** occurred in nine patients. In two of these it was followed by rupture of the myocardium. In several there was evidence of previous infarction and resultant myocardial damage.

Five patients showed evidence of **splenic infarction**, but in none was this of major importance. The same is not true of the five patients with cerebral infarction. In each of these instances this represented a major factor in the fatal outcome.

Four patients had **infarction of a portion of the intestine** as a result of venous or arterial thromboses. In only one of these was this a postoperative complication. This patient had had right colectomy for obstruction from metastatic melanoma. The metastatic mass was partly adherent to the superior mesenteric vein. Postoperatively, venous thrombosis developed with hemorrhagic infarction of the major portion of the small intestine and peritonitis.

One case of multiple arterial thromboses deserves particular mention. This patient had been discharged from the hospital following palliative pneumonectomy for carcinoma of the left lung, only to be readmitted with acute gangrenous cholecystitis on the twelfth postoperative day, when cholecystectomy was performed. The patient died five days later. Postmortem examination revealed arterial thromboses of the hepatic, splenic, superior mesenteric, left renal, descending anterior coronary and bilateral internal carotid arteries, with infarction of the respective organs. In addition, phlebothrombosis of the right femoral vein and a pulmonary embolus in the right pulmonary artery were found.

**Hemorrhage.** Among the 119 patients hemorrhage contributed to the fatal outcome in 35. Postmortem examination was performed in 30 of these. Three of these patients had had no surgical procedure during the period of hospitalization under consideration, but all three had been operated upon previously. One of these three died from carcinomatous erosion of the pancreaticoduodenal artery. A second patient with metastatic mammary carcinoma had a fatal hemorrhage of the left middle cerebral artery and the third patient had rupture of an abdominal aneurysm several months after banding.

In the patients dying from hemorrhage there were 15 who had had thoracotomy for a pulmonary or esophageal lesion. The second largest group was composed of those who died from hepatic failure secondary to hemorrhage. Twelve patients died from hemorrhage at the time of operation or within the first 24 hours. Five of these had been operated upon for carcinomatous lesions, two for esophageal stricture and congenitally short esophagus, one for bronchiectasis, another for tuberculosis, and three for an abdominal condition. One patient with known hypertensive arteriosclerotic disease had undergone exploration for a large spontaneous retroperitoneal hematoma. In a second patient the left lobe of the liver had been removed for obstructive jaundice, and a third had had banding of an
abdominal aneurysm which ruptured a few hours later. At the other extreme, one patient with severe viral hepatitis and enteritis had had transverse colostitis for acute diverticulitis. He had a severe gastro-intestinal hemorrhage 41 days postoperatively. Four patients among this group had ruptured aneurysms. In one patient with multiple small aneurysms of the pulmonary artery rupture of one was followed by prolonged hemorrhage and aspiration asphyxia. Exsanguinating hemorrhage occurred during pneumonectomy in two patients. In both, hemorrhage was the result of a tear in the superior vena cava and the right atrial appendage. Three other patients died of hemorrhage at the time of operation. In one of these esophagectomy had been completed for recurrent carcinoma of the esophagus; this patient also had pulmonary edema at postmortem examination. The second had had excision of the left lobe of the liver for recurrent obstruction of the right and left hepatic ducts at their junction and in the third, hemorrhage occurred during completion of the second stage of Whipple's procedure for carcinoma of the head of the pancreas. In only one case was the hemorrhage not detected clinically. This patient was admitted following gunshot wounds of the right thigh, left wrist and abdomen. At laparotomy several intestinal perforations were repaired and cecostomy was done; five days later the patient died from peritonitis, bilateral partial collapse of the lung and a massive retroperitoneal hemorrhage and hemoperitoneum.

Peritonitis. Of the 119 patients peritonitis contributed to death in 16 (Fig. 4). All 16 were examined postmortem. Fifteen had had operations. The other patient had a large reticulum cell sarcoma of the stomach with perforation and generalized peritonitis on admission to the hospital. In addition, bilateral extensive bronchopneumonia was present. Peritonitis from spontaneous perforation of the duodenum and jejunum resulted from ulceration of a Miller-Abbott tube in one patient following palliative abdominoperineal resection for carcinoma of the rectum.

In seven patients peritonitis developed from leakage of the suture line of the gastrointestinal tract. Four of these followed anastomosis of the esophagus, either to itself or to the stomach. In one patient necrosis developed about the suture line of the duodenal stump following subtotal gastrectomy because of an intractable duodenal ulcer and pancreatitis. In addition, acute hemorrhagic pancreatitis developed postoperatively and pulmonary edema terminally. The remaining fistulas developed in patients following sigmoidal resection for diverticulitis and closure of traumatic multiple intestinal perforations.

Generalized peritonitis developed in four patients following mesenteric thrombosis and gangrene of the intestine. One of these was a child previously operated upon for an imperforate anus. Six weeks later volvulus and gangrene of the small intestine developed. Two of the other patients had carcinoma of the pancreas; in neither of them was surgical treatment directed to the primary lesion. In one patient the inferior vena cava was ligated following pulmonary embolism, and subsequently thrombosis of the mesenteric vein and hemorrhagic gangrene of a portion of the jejunum developed. The second patient was operated upon for mesenteric thrombosis with gangrene of approximately 90 per cent of the small intestine.
She was operated upon again because of a gangrenous phlegmon of the cecum and ascending colon and died on the twenty-ninth postoperative day, with cecal fistula, bronchial pneumonia and terminal pulmonary edema. The three remaining cases of peritonitis were associated with acute pancreatitis and pancreatic necrosis.

**Hepatic failure** resulted in death in 14 patients, nine of whom had postmortem examinations (Fig. 5). Thirteen had had some form of abdominal operation. The other patient had a severe viral hepatitis and tracheotomy was done as an adjunct; he died 13 days later after progressive hepatic failure and bile nephrosis.

Carcinoma was associated with hepatic failure in seven patients, two of whom had hepatic cell carcinoma. Five patients had hepatic failure secondary to massive metastatic tumors, and two had thrombosis of the hepatic artery in addition to metastatic areas of carcinoma.

Three patients with viral hepatitis were operated upon for reasons other than the primary disease. Reference has already been made to the patient who had a tracheotomy. Another patient had a transverse colostomy for obstructing diverticulum of the sigmoid colon. The third had a gastric ulcer thought preoperatively to be malignant.

Two patients with portal cirrhosis, hypersplenism and pancytopenia died following splenectomy. Exploration and liver biopsy were performed on three patients with portal cirrhosis who subsequently died, and one patient with cirrhosis also had ligation of the inferior mesenteric vein for thrombophlebitis following hemorrhoidectomy. Local analgesia was used in three of these six operations.

Both patients with hepatic artery thrombosis have been previously noted, one an instance of multiple arterial thromboses, and the second following Whipple’s procedure for reticulum cell sarcoma of the duodenum.

**Uremia.** In many of the 119 patients some transitory oliguria and azotemia were found. However, in 11 patients uremia was severe and contributed to the fatal outcome. Five of these 11 had disseminated carcinoma, but in only one was obstruction of the ureters by metastatic masses found. The uremia was associated with periods of shock following hemorrhage in two and with shock from a pulmonary embolus in one. The last patient had associated pancreatic and hepatic necrosis and peritonitis.

Among the six patients with other than neoplastic lesions, the uremia was associated with severe hypertensive cardiovascular disease in two; it followed a severe electrical burn in one, and in the remaining three it was associated with chronic ulcerative colitis, lupus erythematosus, and long standing pulmonary fibrosis and bullous emphysema, respectively. All but the first two patients, uremic preoperatively, had periods of shock secondary to hemorrhage, emboli or intrinsic in the case of the burn.
Cardiac Arrest occurred in five of the 119 patients. The first, a child 13 months old, was observed to have cardiac arrest during bronchoscopy under general anesthesia. Cyanosis had not been noted prior to this. The second case occurred in a woman 27 years of age at the termination of right colectomy and jejunal resection for carcinoma with jejunocolic fistula. This patient also had chronic ulcerative colitis. In the third patient cardiac arrest developed on exposure and manipulation of the heart for repair of a congenital atrial defect; ventricular fibrillation was noted. The fourth patient had had a right pneumonectomy for severe bronchiectasis of the lower and middle lobes. During the procedure the superior pulmonary vein was torn. On further mobilization this extended into the right auricle. This defect was closed but massive exsanguination had taken place. Interarterial and intravenous transfusions were given. Cardiac arrest was noted and intravenous injection of procaine and intracardiac injections of ephedrine and epinephrine were given. Cardiac function was resumed but ceased suddenly after closure of the wound. Cardiac massage was instituted in each of these cases without restoration of cardiac action except in the instance just cited. Cardiac arrest occurred in the fifth patient five days following esophagogastrectomy and esophagogastrostomy for carcinoma of the stomach. Frequent bouts of auricular fibrillation had occurred during this period. The patient died while an electrocardiogram was being made, which showed evidence of ventricular fibrillation and standstill.

In addition to these cases there were two instances of sudden respiratory arrest. The first patient had had a left thoracotomy and biopsy of a large thymoma which completely filled the anterior mediastinum and extended into the left side of the chest. The tumor surrounded and was intimately attached to the great vessels in the superior mediastinum. Upon completion of the operation the patient suddenly stopped breathing while being placed on a litter. Artificial respiration and later cardiac massage failed to revive the patient. Examination revealed collapse of the left lung. The second such case occurred in a 60-year-old man with carcinoma of the lung. At the termination of left pneumonectomy progressive decrease in respiratory exchange was noted, and respirations suddenly ceased. Bronchoscopy within a short period revealed no pathologic lesion. Epinephrine and aminophylline were given without effect. At necropsy a second primary carcinoma was found in the right upper lobe bronchus with collapse of this lobe. Metastases were found in the regional lymph nodes. It was postulated that the patient had sustained severe bronchospasm.

Another case of interest is that of a woman 37 years of age who had a left upper lobectomy for blastomycosis. An unusually rapid pulse rate was noted after induction of anesthesia and continued throughout the remainder of the operation. Near the end of the operation hypotension developed which did not respond to therapy, and the patient died. Autopsy revealed pheochromocytoma of the left adrenal.

Chronic Shock. In the final category is a group of nine patients. Postmortem examination was performed on seven of these. All had formidable disease, but examination failed to reveal any single cause of death other than chronic progressive shock. One patient had sudden thrombosis of the left common iliac. Exploration with removal of arteriosclerotic plaques produced proximal but no distal flow. Shortly after operation, both lower extremities became cadaveric, and this condition progressed to the lower costal margin before the patient died 24 hours postoperatively. Examination revealed thrombosis of the distal aorta. The second patient had had total colectomy for chronic ulcerative colitis and an ileocolonic fistula developed. Following revision of the ileostomy the patient gradually became more cachectic. A small area of ulcerative ileitis, terminal patchy broncho-
pneumonia and cachexia were the chief postmortem findings.

The third patient was admitted to the hospital in a critical condition. Severe ulcerating lesions throughout the alimentary tract were subsequently demonstrated. Ileostomy was done because of the severe ulcerations in the colon, but the peritoneal cavity was not contaminated at this time. No pathogenic organisms were cultured either during life or from specimens obtained at autopsy. The most significant postmortem findings, other than the intestinal lesions, were degeneration and hemorrhage of the adrenal cortex.

The remaining six patients were observed over a period of from eight to thirty-six days in the terminal phases of carcinomatosis. Multiple obstructive metastatic lesions of the small intestine were present in two patients, but there was no evidence of gangrene of the intestine or peritonitis. Both of these patients had metastatic carcinoma in multiple organs.

SUMMARY AND CONCLUSIONS

In this study of the causes of death among 119 patients on the surgical service of Ochsner Foundation Hospital during a three year period certain aspects of the problem have become more clearly manifest (Fig. 6). Pulmonary complications apparently are still the primary cause of death, being responsible for 49 of the 119 deaths in this series. This number would be increased by addition of the 26 cases of pulmonary embolus and infarction in this series.

That hemorrhage was a contributing cause of death in 35 cases indicates that this complication is still of major concern to the surgeon despite the ready availability of blood for replacement. The number of cases in which initial hemorrhage played a role in aggravating or initiating hepatic failure or uraemia could not be ascertained, but there were 14 patients in whom hepatic failure and 11 in whom uremia were primary contributing factors in the terminal failure. The incidence of peritonitis in this series (16 cases) may be considered low with respect to that of other complications; yet, there was a relatively high number of instances of dissolution or leakage at an anastomotic site. There were five instances of cardiac arrest, in four of whom cardiac massage was instituted without success.

DISCUSSION.—DR. ROBERT C. AUSTIN, Dayton, Ohio: I wish to thank the Association for the privilege of the floor.

Judging by the large number of articles on treatment of cardiac arrest, it is apparent that the millennium of safety in anesthesia has not been attained. In my opinion, the injudicious use of narcotic and anesthetic agents is responsible for a fairly large percentage of the operating room fatalities. I believe it is the surgeon's prerogative to counsel the anesthetist regarding preoperative narcotization and selection of the anesthetic agent.

Although we pay tribute to the advances in anesthesiology which are related to physiology, pharmacology, and training in the art of administration, we can solemnly ask ourselves "Has anesthesia been made safer?" There has been a trend toward use of the more hazardous anesthetic agents, or combinations of agents and relaxants, which may contribute to danger.

As surgeons, we should be concerned more about the prevention of cardiac arrest and less about its treatment. As you well know, treatment usually is futile. A physician who underwent surgery with heavy narcotization and deep anesthesia has declared: "I never have been the same since that anesthetic and that operation." It is important to carry out a program which will produce minimal disturbance of the patient's metabolism. I exhort the surgeon, therefore, to play a larger role in the choice of narcotic and anesthetic agents, as well as in the management of anesthesia.