Five Thousand Seven Hundred Sixty Cardiovascular Injuries in 4459 Patients

Epidemiologic Evolution 1958 to 1987

KENNETH L. MATTOX, M.D., DAVID V. FELICIANO, M.D., JON BURCH, M.D., ARTHUR C. BEALL, JR., M.D., GEORGE L. JORDAN, JR., M.D., and MICHAEL E. DEBAKEY, M.D.

Large epidemiologic analyses of cardiovascular injuries have been limited to studies of military campaigns compiled from many surgeons working in many hospitals with variable protocols. A detailed civilian vascular trauma registry provides a unique opportunity for an epidemiologic evolutionary profile. During the last 30 years in a single civilian trauma center directed by a consistent evaluation and treatment philosophy, 4459 patients were treated for 5760 cardiovascular injuries. Eighty-six per cent of the patients were male, and the average age was 30.0 years. Penetrating trauma was the etiology in more than 90% (GSW,51.5%; SW,31.1%; SGW,6.8%). All other injuries were iatrogenic or secondary to blunt trauma. Truncal injuries (including the neck) accounted for 66% of all injuries treated, while lower extremity injuries (including the groin) accounted for only 19%. Injuries to the abdominal vasculature accounted for 33.7% of the injuries. One thousand fifty-seven patients had 2 or more concurrent vascular injuries, and 32 patients had 4 or more separate vascular injuries. The 27 patients-per-year average of the early 1960s has risen to a current average of 213 patients per year. Economic and population factors influenced wounding agents and injury patterns during the evaluation period. This extensive civilian series presents epidemiologic profiles that are distinctly different from military reports and serves as a guide for current trauma center and health planners.

From the Cora and Webb Mading Department of Surgery, Baylor College of Medicine, and the Ben Taub General Hospital, Houston, Texas

THE CURRENT CONCEPTS OF cardiovascular trauma epidemiology are attributable to large military series and selected civilian experience. The military experience is basically from the two great European wars and the two Eastern Asian conflicts of the 20th century.[1-7] Beginning in the 1950s, sizeable series of cardiac and vascular injuries from Memphis, New Orleans, Dallas, Houston, San Francisco, San Antonio, Denver, and other cities were reported.[8-25] The European military series focused primarily on extremity wounds and amputation rates, while the Korean and Vietnamese series began to focus on early evacuation and reconstructive techniques. The civilian series during the last three decades present factors contributing to management and overall survival from specific cardiovascular injuries. This paper is an epidemiologic report of 4459 patients with 5760 cardiovascular injuries. All patients were treated at the county hospital of Houston, Texas by surgical services with a consistent philosophy of approach.

Materials and Methods

Description of Facilities

During the period of evaluation from 1958 to 1988, the patients described were treated at either the Jefferson Davis or Ben Taub General Hospital. In 1949, the Jefferson Davis Hospital (350 beds) became the nation's first recognized and funded trauma research center. Until October, 1979 (Table 1), the Jefferson Davis Hospital and/or the Ben Taub General Hospital served as the only recognized or "de facto" trauma centers for the greater Houston area. In October, 1963, Jefferson Davis Hospital remained open as an obstetrical, neonatal, and chronic respiratory care hospital, but all acute care, including trauma, was provided at the Ben Taub General Hospital (480 beds). Until 1965, these city–county hospitals were supported by both city and county funds. In 1965, a Hospital District taxing authority was formed that provided financial resources for these two hospitals and neighborhood health clinics. During the entire study period, care of trauma patients was provided by the Department of Surgery at Baylor College of Medicine. One or more of the authors of this paper was responsible for the management of the patients included in this report.

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Correspondence and reprint requests: Kenneth L. Mattox, M.D., Professor of Surgery, Baylor College of Medicine, One Baylor Plaza, Houston, Texas 77030.

Politicosocial Factors Influencing Patient Load

Undoubtedly, a number of political, economic, medical treatment, and social factors contributed to the statistics reported herein (Table I). Although Harris County has had as many as 66 hospitals providing various levels of emergency care, since 1949 the Jefferson Davis/Ben Taub General Hospitals have been the only ones providing constant and organized trauma care. Since 1964 Houston's population has been over 1,000,000, with only slight increases until 1988 (Table 2). In 1970 the Houston Fire Department developed a single base station for the Emergency Medical Services (EMS) System of Houston, which is located in the Emergency Center at the Ben Taub General Hospital. In 1974 the EMS System added paramedics and telemetry of physiologic information on critical patients through this single metropolitan base station. In 1972 the University of Texas Medical School opened in Houston, with Hermann Hospital as its principle affiliated hospital. In 1976 the Hermann Hospital and the University of Texas established the Life Flight Helicopter Program and developed a separate trauma service in 1979. Initially this program provided trauma services primarily for victims of industrial and automotive trauma. The helicopter service also transported trauma patients to Hermann Hospital from outlying counties. In 1982 to 1983, Hermann Hospital made a conscious effort to expand its trauma services to include victims of penetrating trauma, including nonresource patients.

During the early 1970s, an influx of new citizens from Southeast Asia occurred. A marked increase was seen in the number of illegal aliens from the United States southern border late in the 1970s and early 1980s. During the late 1970s the economic upturn brought many new residents to Houston. However, the crisis in oil production and costs in 1982 to 1983 caused a marked economic downturn that continued throughout the 1980s and resulted in a temporarily decreased Houston population. During the mid to late 1980s, drug trafficking from Central and South American countries increased, with Houston being used as a central point for illegal drug distribution in Texas.

TABLE 1. *Social, Economic and Logistic Factors Affecting Houston's Vascular Trauma*

1949	Baylor/U.S. Army Trauma Research Center, Jefferson Davis Hospital, First U.S. Civilian Trauma Center
1963	Ben Taub General Hospital (BTGH) opens in Texas Medical Center
1970	Emergency center thoracotomy popularized; Houston Fire Department (HFD) EMS/EMT Program
1972	University of Texas Medical School/Houston opens
1973	Autotransfusion research began at BTGH
1974	HFD Paramedic/Telemetry Program
1975	Houston economy downturn (2 years) Influx of new Southeast Asian immigrants
1976	Hermann Hospital Life Flight Helicopter Program
1977	Houston economic upturn
1979	University of Texas Medical School at Houston Hermann Hospital Trauma Service
1980	Emergency center arteriography by surgeons began
1982	Mexican peso value plummets 160,000 jobs lost in Houston
1986	Increased illegal drug activity
1988	Economic upturn

Source of Information

The data reported herein were accumulated from three sources: an inventory of vascular injuries obtained from the Medical Records Department, a review of the weekly surgical service activity reports, and a review of the operative log books. No one source was complete. Duplicate entries were eliminated and differences adjudicated. Because medical records older than 10 years were extremely difficult to retrieve, complete patient records were not analyzed. This retrospective review from these sources may differ somewhat from prospective or "directed" reviews of specific vascular injuries previously reported from this institution.[26–49] The terms "lacerations" and "stab wounds" were frequently used interchangeably to describe injuries caused by edged instruments. Some records did not cite the specific etiology or merely indicated "penetrating wound." When there was a discrepancy between two sources of information, the etiology is cited as unknown. Until the mid 1970s, patients of Hispanic origin were recorded as Caucasian, and until 1980, Oriental and Indian patients were inconsistently recorded. Therefore, notations of ethnic origins are unreliable and incomplete.

Results

Between July, 1958 and September, 1988, 5760 cardiac and/or vascular injuries were identified in 4459 patients. Three thousand six hundred sixty-six of these patients patients were male, 582 were female, and the sex was not obtainable from the records of 211 patients. The 47% of the patients whose ages were available for tabulation ranged from 2 to 77 years, with a mean of 30.8 ± 12.3 years (Fig. 1). The mean age did not significantly vary during the 30-year study time period.

To simplify presentation of this data, the results are

TABLE 2. *City of Houston Population (Greater Houston Regional Population × 2)*

Year	Population
1958	872,000
1964	1,091,800
1968	1,187,000
1974	1,341,000
1980	1,699,000
1983	1,594,086
1988	1,705,697

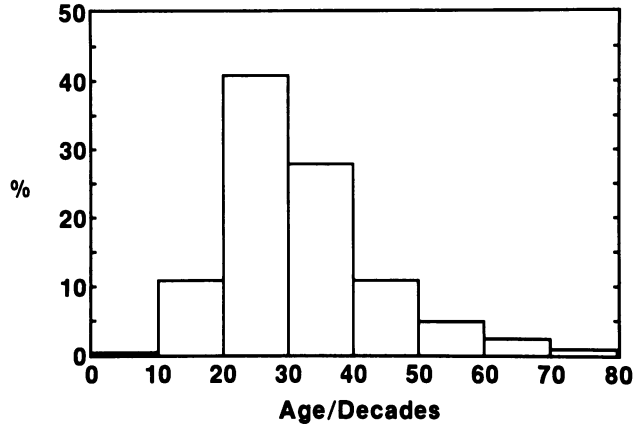

FIG. 1. Frequency distribution of age by percentage among patients whose ages were know.

grouped into 5-year time periods (Table 3). Fifty per cent of the patients with cardiovascular trauma were injured during the last 10 years. Of the 4459 patients with 5760 cardiac or vascular injuries, 3930 injuries were secondary to penetrating trauma, and only 304 were the result of blunt trauma (Table 4). One thousand fifty-seven patients had 2 or more cardiovascular injuries, and 32 patients had 4 or more such injuries. The average number of patients injured per year rose from 27 in the earliest time period to a high of 223 in the 1979 to 1983 time period (Table 5). Analyzing only the ratio of gunshot wounds to stab wounds, the lowest ratio was in 1958, and it rose to 2.7 in the 1969 to 1973 time period. Currently, stab wounds outnumber gunshot wounds. However, for the overall 30-year period reviewed, over 50% of all injuries were secondary to gunshot wounds (Table 6), and only 6.8% of the patients sustained blunt trauma. More than 90% of the patients sustained penetrating wounds.

Cardiovascular injuries occurred in virtually all named major vessels in the body (Table 7). The injured vessel is cited only if the injury resulted in operation, death, or was found incidentally during surgery performed for other organ injury. Trivial peripheral arterial injuries that did require surgery or resulted in a delayed vascular complication were not included. Both arterial and venous vascular injuries were tabulated when the injury was significant. Known and isolated venous injury not requiring operation were excluded. The heart, inferior vena cava, femoral artery and brachial artery were the organs/vessels injured most often. Lower abdominal and groin vessels were more vulnerable to gunshot wounds than were vessels in other locations. Injuries from an edged instrument predominated in the forearm and jugular vein. Only in the descending thoracic aorta was blunt trauma the predominate cause of injury (Table 7). Incidence of injuries was 33.8% in the abdomen, 20.1% in the chest, and 19.1% in the lower extremity (Table 8). Cardiovascular injuries are listed by body location and etiology, and gunshot wounds to the abdomen occurred most frequently (Table 6). If the neck is included with the trunk, 66% of the injuries are truncal, and 54% are in the chest or abdomen. Only 19% of the injuries were in the extremities (including the groin). Miscellaneous thoracic injuries included trauma to the internal mammary artery, intercostal artery, and thoracic duct. The thoracic duct injuries were usually discovered serendipitously, but injuries to the internal mammary and intercostal arteries produced significant hemothorax or hemopericardium and occasionally death. These miscellaneous thoracic injuries were most often secondary to stab wounds. Injuries from gunshot wounds most often occurred in the lower extremities and lower abdomen.

The number of patients treated for cardiovascular injuries more than doubled when the Emergency Medical Services System was begun in Houston in 1970 (Table 9).

TABLE 3. *Cardiovascular Injuries per Five-Year Time Interval*

	1958–63	1964–68	1969–73	1974–78	1979–83	1984–88	Total
Number of Patients	163	399	811	900	1117	1069	4457
Number of Injuries	198	463	1047	1140	1467	1445	5760
Injuries/patient	1.21	1.16	1.29	1.27	1.31	1.35	1.29

TABLE 4. *Etiology of Patient Cardiovascular Injuries per Five-Year Time Interval*

Etiology	1958–63	1964–68	1969–1973	1974–78	1979–83	1984–88	Total
Gunshot wound	42	236	436	501	625	456	2296
Stab/laceration	64	110	161	229	362	463	1389
Blunt trauma	1	17	58	90	62	76	304
Shotgun wound	1	15	45	55	61	37	214
Iatrogenic	1	1	0	0	4	25	31
Other/unknown	54	20	111	25	3	12	225
Total	163	399	811	900	1117	1069	4459

TABLE 5. *Ratio of Known Gunshot Wounds to Stab Wounds by Five-Year Time Periods*

	1958–63	1964–68	1969–1973	1974–78	1979–83	1984–88
Average pt/year	27	80	162	180	223	213
Ratio GSW:SW	0.6	2.1	2.7	2.2	1.7	0.9

GSW = gunshot wound; SW = stab wound; pt = patient.

TABLE 6. *Cardiovascular Injuries by Etiology*

	GSW	SW/LAC	BT	SGW	IAT	Unknown/Other	Total
# of patients	2297	1388	304	214	31	225	4459
% Total patients	51.5%	31.1%	6.8%	4.8%	0.7%	5.1%	100%
# Injuries	3133	1553	385	341	56	293	5760

GSW = Gunshot wound; SW = Stab wound; LAC = Laceration; SGW = Shotgun wound; IAT = Iatrogenic.

TABLE 7. *Specific Cardiovascular Injuries by Etiology and Grouped by Body Region*

	GSW	SW/LAC	BT	SGW	IAT	Unknown/Other	Total
Carotid artery	115	45	6	14	—	10	190
Jugular vein	116	154	4	9	—	13	296
Vertebral artery	18	13	3	3	—	2	40
Subclavian vessel	91	50	8	6	—	13	168
Heart	220	261	32	3	5	8	539
Coronary artery	3	10	—	—	3	1	14
Ascending aorta	15	12	3	3	—	—	33
Innominate artery	20	8	7	2	2	—	39
Pulmonary artery	43	25	7	3	—	1	79
Desc thorac aorta	25	5	59	—	—	—	89
Aortic arch	13	7	1	1	—	—	22
Thorac vena cava	34	15	4	1	—	1	55
Innominate vein	25	15	2	—	—	—	42
Pulmonary vein	29	5	4	1	—	1	40
Azygous vein	13	2	—	1	—	—	16
Thoracic duct	3	8	—	1	—	—	12
Int mammary artery	18	71	3	—	—	6	98
Intercostal artery	25	54	—	—	—	2	81
Abdominal aorta	180	40	5	17	2	5	249
Inf vena cava	353	100	44	21	—	17	535
Mesentric artery	136	45	14	7	—	14	216
Portal venous	116	44	22	3	—	4	189
Iliac artery	172	30	11	11	2	6	232
Iliac vein	224	32	9	11	1	12	289
Renal vessel	86	33	32	4	—	8	163
Epigastric artery	3	14	—	3	—	1	52
Hepatic veins	36	6	8	1	—	1	21
Axillary vessel	85	40	3	6	1	8	143
Brachial artery	184	163	14	38	10	37	446
Radial/ulnar art	38	169	1	10	2	41	261
Cephalic/Basilic V	4	3	—	1	1	—	0
Femoral artery	316	58	14	70	5	37	500
Femoral vein	184	34	7	36	—	19	280
Popliteal artery	88	3	36	18	—	11	156
Popliteal vein	45	5	9	14	—	9	68
Tibial artery	31	8	11	9	—	9	78
Tibial vein	4	1	—	1	—	1	7
Saphenous vein	12	—	1	1	—	1	15
Total	3134	1543	385	341	56	293	5760

art = artery; desc = descending; thorac = thoracic; V = vein; Int = internal; Inf = Inferior.

TABLE 8. *Body Region Locations of Specific Cardiovascular Injuries by Etiology*

	GSW	SW/LAC	BT	SGW	IAT	Unknown/Other	Total
Neck	340	262	21	33	—	38	694
Thorac/arterial	339	328	109	22	7	10	815
Thorac/venous	101	37	10	3	0	2	153
Thorac/misc	46	133	3	1	0	8	191
Abdomen	1307	334	145	78	5	68	1947
Upper extremity	311	375	18	55	14	86	859
Lower extremity	680	109	78	149	5	81	1102
Total	3134	1543	385	341	56	293	5760

Thorac = thoracic; misc = miscellaneous.

The overall peak time period for the largest number of injuries was 1979 to 1983. Thoracic and upper extremity vascular injuries continued to increase in number even after those peak years (Table 10).

Discussion

At the 1945 meeting of The Southern Surgical Association, DeBakey[2] presented his classic and often cited

TABLE 9. *Specific Cardiovascular Injuries by Five-Year Time Intervals and Grouped by Body Region*

	1958–63	1964–68	1969–73	1974–78	1979–83	1984–88	Total
Carotid artery	2	24	41	40	43	40	190
Jugular vein	5	28	26	59	83	95	290
Vertebral artery	1	0	3	10	11	15	40
Subclavian vessels	8	20	48	43	23	26	168
Heart	28	42	102	108	128	131	539
Coronary artery	1	—	1	—	3	9	14
Ascending aorta	1	1	11	17	3	10	33
Aortic arch	1	1	7	3	6	4	22
Innominate artery	1	3	9	8	11	7	39
Pulmonary artery	1	3	12	15	10	38	79
Desc thorac aorta	—	6	17	23	18	25	80
Thorac vena cava	2	4	10	12	8	19	55
Innominate vein	2	3	7	9	8	13	42
Pulmonary vein	—	2	6	4	9	19	40
Azygous vein	—	1	4	3	5	3	16
Thoracic duct	3	—	4	4	1	—	12
Int mammary artery	7	7	17	13	22	32	98
Intercostal artery	3	2	20	8	20	28	81
Abdominal aorta	12	25	53	61	45	53	249
Inferior vena cava	23	51	114	118	139	90	535
Mesenteric artery	16	22	53	34	50	41	216
Portal venous	8	20	35	32	48	46	189
Iliac artery	2	19	38	48	72	53	232
Iliac vein	7	19	50	58	109	46	289
Renal vessels	6	13	29	32	37	46	163
Epigastric artery	—	1	2	3	3	12	21
Hepatic vein	1	3	5	16	20	7	52
Axillary vessels	5	14	15	40	34	35	143
Brachial vessels	13	35	64	89	133	112	446
Radial/ulnar artery	10	10	38	35	47	121	261
Cephalic/Basilic V	1	1	—	—	4	3	9
Femoral artery	18	41	101	93	138	109	500
Femoral vein	6	22	63	53	88	48	280
Popliteal artery	3	13	16	38	47	39	156
Popliteal vein	—	4	12	18	19	23	76
Tibial artery	1	1	11	2	16	37	68
Tibial vein	—	—	2	—	3	2	7
Saphenous vein	—	2	1	1	3	8	15
Total	198	463	1047	1140	1467	1445	5760

Int = Internal; Desc = Descending; V = Vein.

TABLE 10. *Body Region Location of Specific Cardiovascular Injuries by Five-Year Time Intervals*

	1958–63	1964–68	1969–73	1974–78	1979–83	1984–88	Total
Neck	16	72	118	152	160	176	694
Thoracic	50	75	227	217	252	338	1159
Abdominal	75	173	379	402	523	394	1946
Upper extremity	29	60	117	164	218	271	859
Lower extremity	28	83	206	205	314	266	1102
Total	198	463	1047	1140	1467	1445	5760

review of arterial injuries from World War II. That report consisted of 2471 cases accumulated over many years from many surgeons in numerous surgical hospitals. In 1970, Drapanas[11] presented to the American Surgical Association a review of three decades of vascular injuries from New Orleans. That report, just 19 years ago, consisted of a review of 226 patients, or an average of less than 10 patients per year. In 1974, Hardy[14] presented his classic 17-year epidemiologic review of 353 arterial injuries to The Southern Surgical Association meeting in Boca Raton.

The great wars of the 20th century have provided the surgeon with large volumes of patients with cardiovascular injuries (Table 11). Likewise, these war injuries have provided the opportunity to analyze results and complications and to direct further advances in the care of civilian trauma. Civilian series of cardiovascular injuries have focused on specific injuries and relatively few large series involve overall epidemiologic analysis of etiology and distribution (Tables 12 and 13). Although there are similarities between military and civilian cardiovascular injuries, the differences mandate separate analyses. Most of the military and civilian citations of cardiovascular trauma are limited to arterial injuries. A few of the reports contain some incidence of concomitant venous injury and even name the injured venous structures. This review includes venous injuries because those cited were as significant as the arterial injuries because they needed surgical intervention, especially in the trunk. Algorithms for operative necessity in isolated extremity venous injuries are not as clear as are those for arterial injury, except possibly for injuries of the popliteal vein.

Wounds in warfare are secondary to high-velocity missiles, fragments, land mines, bone fragments, and, occasionally, other puncture wounds.[50,51] In civilian trauma, handguns are usually the wounding agent, followed in

TABLE 11. *Location of Reported Vascular Injuries in Major Wars*

	Neck	Chest	Abdomen	Upper Extremity	Lower Extremity	Total
Makins—WWI[4]	176	—	11	367	648	1202
DeBakey—WWII[2]	34	—	49	871	1517	2471
Hughes—Korea[3]	14	—	7	109	304	304
Rich—Vietnam[7]	76	4	354	416	840	1377
Total	300	4	421	1763	3179	5667

TABLE 12. *Location of Cardiovascular Injuries in Civilian Epidemiologic Vascular Trauma Reports*

Author	City	Year	Neck	Chest	Abdomen	Upper Extremity	Lower Extremity	Total
Morris[19]	Houston	1957	16	5	13	62	39	136
Ferguson[13]	Atlanta	1961	15	1	32	93	56	200
Smith[23]	Detroit	1962	3	2	8	25	21	57
Treiman[24]	Los Angeles	1966	14	10	56	67	86	233
Dillard[10]	St. Louis	1968	4	8	10	32	31	85
Drapanas[11]	New Orleans	1970	28	11	31	97	59	226
Perry[21]	Dallas	1971	65	14	75	213	141	508
Moore[16]	Galveston	1971	45	57	35	56	37	250
Cheek[9]	Memphis	1975	46	10	88	30	60	200
Kelly[15]	Denver	1975	14	—	62	52	47	175
Hardy[16]	Jackson	1975	39	41	66	98	116	360
Bole[8]	New York	1976	8	12	31	25	50	126
Sirinek[22]	San Antonio	1983	17	35	218	—	—	270
Total			315	206	725	850	763	2859

TABLE 13. *Etiology of Cardiovascular Injuries in Civilian Epidemiologic Vascular Trauma Reports*

Author	City	Year	GSW	SW	BT	SGW	Other	Total
Ferguson[13]	Atlanta	1961	67	100	9	24	—	200
Smith[23]	Detroit	1962	13	5	19	—	24	61
Treiman[24]	Los Angeles	1966	66	86	40	—	—	152
Dillard[10]	St. Louis	1968	34	35	24	—	—	88
Drapanas[11]	New Orleans	1970	115	89	22	—	—	226
Perry[21]	Dallas	1971	143	92	24	—	—	259
Moore[16]	Galveston	1971	95	64	33	—	58	250
Kelly[15]	Denver	1975	58	29	16	3	37	143
Hardy[14]	Jackson	1975	155	91	48	37	29	360
Bole[8]	New York	1976	63	42	21	—	—	126
Sirinek[22]	San Antonio	1983	97	74	46	—	9	219
Totals			906	707	302	64	157	2136

frequency by stab wounds, automobile accidents, and, rarely, high-velocity missiles. In both military and civilian series, the victims are usually young men. In military practice, there is generally more tissue destruction and associated contamination.

Except for the Vietnamese War, patients injured in military campaigns have had prolonged prehospital times between wounding and definitive care.[52] Since 1975, most major cities in United States have Emergency Medical Services Systems that have reduced transport time (time from scene to treatment facility) to 30 minutes or less. Transport times are frequently less than 12 to 15 minutes. Both military and civilian hospitals are similary staffed by qualified surgeons and are supplied with necessary supportive equipment. The civilian EMS and trauma center concepts were patterned after those in the military.

The increased incidence of vascular trauma in Houston is out of proportion to the population growth during the same time period. The casual observation or perception that each year more patients sustain gunshot wounds made with increasingly higher-caliber guns is not justified based on data in this review. Although high-velocity rifles and even larger-caliber weapons become increasingly available during the latter years of this review, handguns (including the .357 caliber magnum) were available even during the mid 1960s. During the 30 years covered in this review, numerous economic and social changes occurred in Houston. Factors that apparently did not affect the incidence or distribution of cardiovascular injuries included the opening of a new medical school, the opening of a new trauma center (literally next door to the Ben Taub General Hospital), and population fluxuations. Factors that did appear to parallel changes in the incidence, etiology, and location of cardiovascular injuries included the development of the Houston EMS system, development of protocols for emergency center thoracotomy and emergency center arteriography, and increases in illegal drug activities. The incidence of gunshot wounds appears greatest during the years of peak economy, while the incidence of stab wounds was equal or greater than the incidence of gunshot wounds during times of economic downturn.

The most obvious contrast between military and civilian cardiovascular trauma is in regard to location of the injuries. Of all reported vascular injuries, extremity wounds predominated in World War I (94%), World War II (97%), the Korean conflict (93%, and the Vietnamese conflict (91%). In this report of 5760 civilian injuries in 4459 patients, vascular injuries occurred in the extremities in only 34% of the patients. Two obvious explanations for this contrast include the type of wounding agent and the availability of emergency medical services systems that bring more patients with truncal injuries to trauma centers for resuscitation and treatment. On close analysis of other civilian series, extremity vascular injuries predominate until the mid 1970s when EMS systems began to develop in association with trauma systems designed as recommended by the American College of Surgeons.[53]

Although stab wounds, gunshot wounds, shotgun wounds, and blunt trauma were seen in all areas of the body, etiology and anatomic injury location trends were seen. One half of all injuries were produced by gunshot wounds with anatomical injury location incidence in the abdomen, lower extremity, chest, neck, and upper extremity. Of the 25% of the patients sustaining stab wounds, frequency of injury location was chest, upper extremity, abdomen, neck, and lower extremity, respectively. Blunt trauma injuries most often occurred in the abdomen, followed by the chest, lower extremity, neck, and upper extremity. The order of injury locations following shotgun wounds was the lower extremity, abdomen, upper extremity, neck, and chest.

Houston, like many of the nation's major cities, has an epidemic of cardiovascular injuries that has not abated since the mid 1970s. For all series, including this very large one from Houston, penetrating wounds of the trunk have predominated during the past 15 years. Emergency medical service systems, emergency center thoracotomy, emergency center arteriography by surgical personnel, trauma center designation, and external social factors ap-

pear to continue to slightly increase the number of patients with civilian cardiovascular injuries who arrive at a treatment facility alive. The often-cited statement that gunshot wounds are secondary to increasingly larger-caliber and higher-velocity missiles is not born out by this epidemiologic review. A reduction in the incidence and location of cardiovascular injuries will require social, economic, political, and legal modifications currently outside the control of the established trauma treatment centers.

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