

External Appearance. The body was that of a young male adult measuring about 5 feet, 10 in., and weighing about 175 pounds. The hair of the head was blond and crewcut. There was a 10 cm long dirty gash in the left temporal area of the scalp. Two quite noticeable tattoos were present on the right arm; on the inner aspect, there was a flowery tattoo with the word "Jack" in its middle, and on the lateral surface there was an enscrolled red heart. The facial surface had been blown inward, but there were only superficial lacerations of the skin in this area. There was a central fracture of the maxilla and the inferior orbital ridges. Both eyeballs were collapsed. There were also fractures of the right mandibular joint and the right side of the mandible. Multiple teeth had been broken loose, particularly the central incisors. While the right arm and both hands were uninjured, the left arm had been severely damaged. The central portion of the left humerus was the site of a comminuted fracture. The whole humerus had been shortened without breaking the skin to about half its length. The arm appeared to have been wound about this area once and then to have been unwound. The left forearm showed severe lacerations posteriorly, but the hand was undamaged. The thorax was severely deformed. There were multiple fractures of the

ribs, which could be felt from the outside of the chest. The left upper part of the chest was unusually prominent, while the lower part of the chest had been caved in. There was diffuse subcutaneous hemorrhage of the entire frontal aspect of the chest. The abdomen appeared unaffected. The genitalia were normal. The lower extremities showed severe blast injury to the posterior of both legs. The right popliteal fossa was completely destroyed, and the right knee had been dislocated forward so that it hung by the skin and patellar ligaments. The lower half of the left leg was partially missing, and ragged shreds of skin and muscle hung from the fractured tibia. There was a compound fracture of the left femur about midway between hip and knee. The wound here was posterior and comprised an avulsion of the left gluteus and quadriceps muscles. The severity of this blast injury dissipated as it spread to destruction and loss of tissue of the right buttocks and lower back, but the entire pelvis had been fractured, the sacrum thrust into the true pelvis, and the pubic symphysis separated. These injuries are summarized graphically in Fig. 4.

Abdominal Cavity. The abdominal cavity contained blood. There was hemorrhage particularly around the splenic fossa and pelvis. The spleen was partially torn from its pedicle and its capsule ruptured, but it was still hanging by the

BLAST INJURIES 
MISSILES 

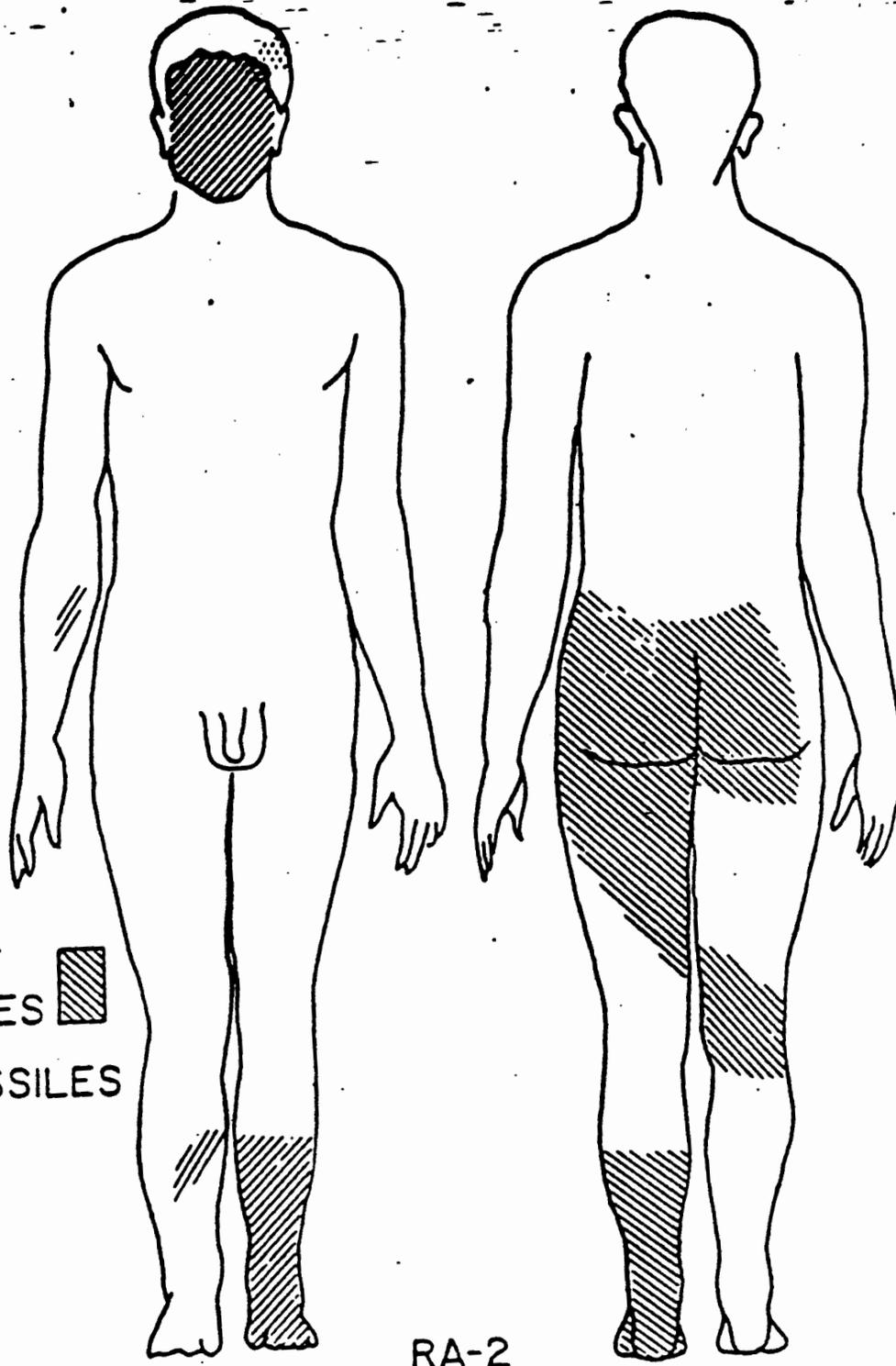


Fig. 4. Graphic summary of wounds of RA-2.

splenic artery. The right kidney had been stripped from its capsule posteriorly and also had its veins torn at the pelvis so that there was a massive retroperitoneal hemorrhage on this side. There was similar hemorrhage in the pelvis underneath the peritoneum in the region of the sacral fractures. There was gaseous dissection of the peritoneum around the torn urinary bladder. The pubic symphysis was found separated 3 cm. The comminuted sacral bones were moved into the lower pelvis without rupture of the peritoneum and muscles. The sacrum appeared to have been separated from the rest of the vertebral column in the blast.

Pleural Cavities. The ribs on the right were fractured down to the eighth rib. The ribs on the left were fractured down to the tenth rib. The floating ribs on each side were intact. The left third, fourth, fifth, and sixth ribs had been fractured twice. The fifth rib was driven through the pericardium into the heart. There was massive pericardial hemorrhage and hemorrhage into the left pleural space. The subcutaneous tissues over the entire chest were hemorrhagic. There was severe hemorrhage of the mediastinal structures with massive hemorrhage around the trachea and main bronchi.

Oral and Pharyngeal Mucous Membranes. These were covered by blood.

Thymus. The thymus was present as a solid gland surrounded by hemorrhage.

Trachea and Main Bronchi. The trachea and main bronchi were surrounded by hemorrhage in their loose areolar tissues.

Lymph Nodes. The lymph nodes were anthracotic but normal in appearance.

Lungs. Each lung weighed 500 grams. They contained diffuse petechial hemorrhages but no other gross abnormalities except pleural surfaces covered with blood.

Heart, Aorta, and Great Vessels. The heart weighed approximately 350 grams. There was a jagged penetration wound of the conus of the aorta just below the aortic valve ring. This laceration entered the left ventricle and then penetrated the interventricular septum 4 cm below the base of the heart or midway between the base and apex. There was a moderate left myocardial hypertrophy. The valves and valve rings were normal.

Liver. The liver weighed 1800 grams. Its capsule was thin, and the parenchyma was dark brown. The gallbladder showed severe post-mortem staining of the surrounding peritoneum.

Spleen. The spleen weighed approximately 120 grams. Its capsule was torn, and there was clotted blood in the torn tissue of its hilum.

Pancreas. The pancreas showed severe post-mortem digestion.

Gastrointestinal Tract. There was no obvious abnormality of the entire gastrointestinal tract. The stomach contained about 300 cc of fluid material. No attempt was made to examine it or the contents of the small or large intestine. A small amount of feces was present in the descending colon and rectum.

Adrenal Glands. Both adrenal glands were normal in size and shape. There was post-mortem autolysis of the medulla. The lipid-rich cortex measured about 1 mm in thickness.

Kidneys. The right kidney had already been stripped of its capsule. There was hemorrhage around its pelvis and around the major blood vessels. The parenchyma was extremely pale, as is often the case in exsanguination. The cortical medullary markings in both kidneys were normal.

Genitourinary Tract. The ureters and urinary bladder were normal in appearance. The urinary bladder was devoid of urine.

Prostate. The prostate was normal in size and shape.

Testes. The testes were normal in size, shape, and consistency.

Brain and Meninges. The brain was normal in size. The

gyri and sulci of the cerebral cortex were covered by a thin (up to 4 mm in thickness) layer of blood which was present on the convexity, as well as the base. There was no evidence of cranial fractures or tears in the dura. The primary was removed successfully.

Gross Anatomical Diagnosis. Severe blast injuries consisted of avulsion of the muscles and soft tissues of the left buttocks, lower back, upper left thigh, left lower leg, and right popliteal space; fractures of the facial bones, left midhumerus, left midfemur, lower left leg and foot, sacrum, ischial bones, and pubis; dislocation of right knee; rupture of both optic orbs; and gaseous dissection of pelvis retroperitoneum. Severe crushing injuries consisted of multiple fractures of the ribs (right 1 through 6 and left 1 through 10) with compression of the left lower chest, penetrating myocardial stab wound by left fifth rib, and massive pericardial, mediastinal, and pleural hemorrhage; massive subcutaneous and intramuscular hemorrhage of the anterior thorax; splenic and left renal rupture with massive upper abdominal hemorrhage; diffuse subdural hemorrhage; persistent thymus; and tattoos of right forearm.

3.2.3 RA-3

External Appearance. The body was that of a young adult male about 5 feet, 6 in., in height and weighing about

160 pounds. His body was well muscled but had been severely injured by blast so that both feet dangled from the legs by shreds of skin. The left leg was almost completely severed from the body by a shearing, destructive force which completely destroyed the left hip joint and the left side of the pelvis, and dissected the skin of the left side of the body up to the level of the umbilicus, where a band approximately 20 cm wide of full skin thickness held this leg to the body. There was a wound roughly 20 cm in length located to the left of the pubis, which entered the abdominal cavity through the inguinal insertion of the abdominal muscles. About 10 feet of mesentery and intestine protruded from this wound. The external genitalia were not injured. The inner aspects of both thighs showed reddish, dark blue to purple areas, which appeared typical of superficial flash burns. The right femur had a fracture in it about 15 cm below its surgical neck. There were tears in the buttocks posteriorly, although this leg was not torn quite so extensively from the body as the left one. The wrists had similar tears in them so that both wrists were partially torn away and the hands dangled from the arms. The hands were dark blue and appeared also to have been injured by heat. The face had been flattened. The eyes had been ruptured. The nose, maxillary bones, and lower jaw had all been pushed back into the neck

and base of the skull. The calvarium was severed cleanly, as if by a cheese knife, from the rest of the skull. The calvarium had a similarly sized piece of scalp with dark brown hair attached to it. The brain was soft and showed severe post-mortem autolysis. It appeared severely torn although still recognizable. There was a tattoo of a letter "C" and a bumblebee on the right shoulder, and on the skin of the inner aspect of the left forearm a 20 cm long dancing sailor girl was tattooed. The upper half of the torso was twisted 180° around to the right so that the left shoulder and scapula were in the position of the right shoulder. The right shoulder occupied the similar position of the left shoulder. This twist occurred in the vertebral column in the first and second lumbar segments, which were also compressed. These injuries are summarized graphically in Fig. 5.

Abdominal and Pleural Cavities. The abdominal and pleural cavities were single because the diaphragm was torn and partially missing. This cavity communicated with the outside through a 20 cm tear in the lower abdominal wall and pelvic floor. The lungs, heart, and mediastinum were torn from their attachments and were free in the pleural space. The lungs were collapsed. The liver was lacerated and only about one-half of it was recognizable. It was dark red, in general, but had areas that appeared cooked. The intestines

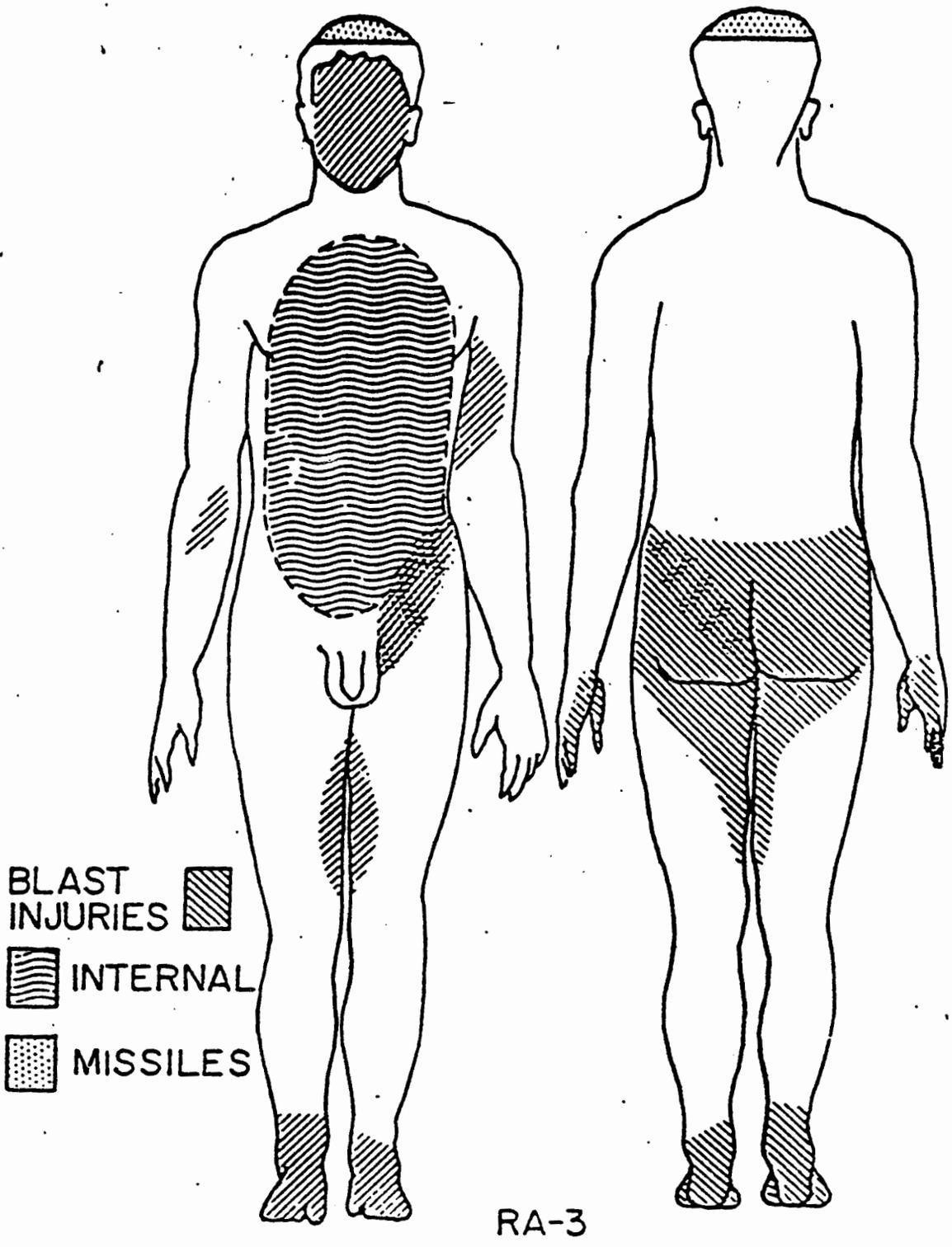


Fig. 5. Graphic summary of wounds of RA-3.

and kidneys formed one loose mass in the posterior of the abdominal cavity. All had a dusky parboiled appearance. There was remarkably little post-mortem odor and no evidence of decay, but neither the spleen nor pancreas could be found. In the process of twisting the upper half of the torso, all ribs were broken from their attachments to the vertebrae and freed from the muscles of the abdominal and thoracic walls (evidently by expanding gases).

Oral and Pharyngeal Mucous Membranes. Not examined.

Trachea and Main Bronchi. The trachea and main bronchi were torn from the upper part of the trachea and neck. They were colored dark red by hemolyzed (post-mortem) blood. The tracheobronchial lymph nodes were not recognizable.

Lungs. The lungs were collapsed and a dirty red color. They were not increased in weight.

Heart. The heart itself showed no external damage. It was not dissected. It was covered by blood and had the smoky, bluish red appearance of being partially parboiled.

Liver. The liver weighed about 600 grams. It was free from its diaphragmatic attachments but still attached to the stomach and intestines. Only the right half remained recognizable as normal dark red liver with a moderate parboiled hue. Shreds of what might have been the left lobe hung from it. No gallbladder was found.

Spleen. The spleen could not be found. Macerated, unrecognizable tissue was present. A search in the posterior of the abdominal cavity was not successful.

Pancreas. The pancreas was not recognizable.

Gastrointestinal Tract. The gastrointestinal tract appeared as that of a person dead for some time. The walls were hemorrhagic dusky red, opaque, cooked in appearance, and distended moderately with gas with the odor of fecal decay. It was remarkable, however, that there was very little odor emanating from these remains, although death had occurred approximately 1 week previous to this examination.

Adrenal Glands. The adrenal glands were not found.

Kidneys. Both kidneys had been stripped of their capsules. They were attached to the aorta, which had been stripped from its paravertebral attachments. The kidneys were the light tan color of serious terminal hemorrhage.

Genitourinary Tract. The urinary bladder and ureters were not found. The penis and testes, however, were normal in appearance except for hemorrhage between the capsule of the testes and tubules. The tubules teased apart easily. They appeared remarkably well preserved. The only sections made of this autopsy were of the testes, since the other organs showed such gross blast damage.

Brain. No attempt was made to salvage the remnants of the brain for study.

Gross Anatomical Diagnosis. Multiple blast injuries

consisted of fractures of both ankles, both wrists, bones of the face, skull, and calvarium, left pelvis, hip, and femur, right femur, all ribs, and torsion fracture of cervical vertebrae and upper lumbar vertebrae; superficial burns of the inner aspects of the thighs, peritoneal surfaces, and abdominal and pleural organs; massive destruction of the muscles of the lower back, buttocks, and upper left thigh posteriorly; rupture of the abdominal wall, liver, spleen, diaphragm, lungs, aorta, and kidneys; missing spleen, pancreas, and adrenal glands; and tattoos ("C-bee" and dancing sailor girl).

3.3 Histologic Findings

3.3.1 RA-1

The pulmonary sections showed evidence of a long standing pneumoconiosis, which was still moderately active. In addition, there was acute congestion, edema, and desquamation of alveolar macrophages. Several venules showed increased numbers of leukocytes. The hilar lymph nodes had minimal anthracosis and fibrosis associated with pigment and diffusely deposited iron. The splenic arterioles were distorted by hyalinization and large deposits of PAS positive material resembling amyloid. This pathologic hyalinization

was also seen in the renal arterioles and Bowman's membrane. Except for a left shift in the myeloid series in the bone marrow, no other acute or chronic pathologic changes were noted.

Although many post-mortem changes were seen, these were remarkably few, in view of the 6 day interval between death and autopsy. Endothelium was seen free everywhere in the blood in the veins and in splenic sinuses. The mucosa of the bowel, unfortunately, was not examined but, in general, epithelial parenchyma was well preserved. The epithelial lining of thyroid acini was partially sloughed into the colloid; the epithelium of the renal collecting tubules was autolyzed, but that of the other tubules was not; the epithelium of the large pancreatic ducts was digested, but that of the small ducts was sloughed but stained well. Lymphocytes of the thymus, lymph nodes, and spleen stained well and appeared cytologically normal. The erythroid and myeloid cells in the bone marrow stained well. The entire germinative epithelium of the testicular tubules appeared normal, but chromatolysis and fading of cell outlines were seen among the testicular interstitial cells. Pancreatic acinar cells showed an irregular decrease in size, and their nuclei and cytoplasm were condensed. The cells of the islets, however, appeared normal. No autolytic changes in

the myocardial, hepatic, or adrenal parenchyma were seen.

3.3.2 RA-2

The organs of this man were also remarkably well preserved histologically. Some previously existing pathologic changes were observable such as moderate hypertrophy of myocardial fibers and their nuclei, mild chronic interstitial pneumonitis, and pulmonary and hilar nodal anthracosis. Evidence of blast damage was found in traumatic emphysema and atelectasis of the lungs and hemorrhagic destruction of the thymus and liver. Although post-mortem digestion was minimal in most organs, it was extensive in the pancreas, kidneys, and prostate in contrast to RA-1. All renal tubules were recognizable but severely altered by autolysis. The pancreas was recognizable chiefly by the outline of glands which were otherwise amorphous and failed to stain with eosin. The prostatic glandular epithelium had all sloughed into the lumina, but again the preservation of the germinal epithelium of the testis was excellent. Only a few Leydig cells showed autolysis and fading.

3.3.3 RA-3

Only sections of the testis were made. The other organs were extensively damaged by blast, and dissection beyond that