HEART INJURIES—WITH SUTURE*

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George Fischer, in 1868, compiled a series of 452 cases of heart injuries, with a 10 per cent. recovery without surgical intervention. Sometime later Block, in 1882, recorded his observations on experimental wounds of the heart in rabbits, which were treated surgically. Billroth, in spite of this, stated in unequivocal terms that "the surgeon who should attempt to suture a wound of the heart would lose the respect of his colleagues." At the eleventh International Medical Conference in Rome, Del Vecchio demonstrated healed wounds of the heart in dogs following suture; and about one year later, in September, 1895, Cappelan of Norway operated the first described case in the human subject. The second was done by Farina of Rome in March, 1896. The third was done by Rehn of Frankfurt in September, 1896. That of Rehn was the only one of the three to recover. In 1908, Vaughn reported a series of 150 cases compiled from the literature, including a second case of his own, which resulted in a successful termination.

I have taken, for the purpose of presentation, the compilation of Peck, in the Annals of Surgery, 1909. Of the cases operated from 1896 until that date, there are 160 cases listed.

Total recoveries	59	36.87 per cent.
Total deaths	101	63.13 per cent.
In O.R.	16	10.00 per cent.
In 24 hours	28	17.50 per cent.
Within 7 days	38	23.75 per cent.
After 7 days	19	11.87 per cent.

The next compilation I have taken is that of Pool, listing 77 cases between 1909 and 1912, published in the Annals of Surgery in 1912.

Total recoveries	42	54.5 per cent.
Total deaths	35	45.5 per cent.
In O.R.	8	10.4 per cent.
In 24 hours	11	14.3 per cent.
Within 7 days	11	14.3 per cent.
After 7 days	5	6.5 per cent.

The third compilation, listing 49 cases from 1912 to 1923, is by Smith, published in the Annals of Surgery in 1923.

Total recoveries	35	71.44 per cent.
Total deaths	14	28.56 per cent.
In O.R.	3	6.12 per cent.
In 24 hours	6	12.24 per cent.
Within 7 days	4	8.16 per cent.
After 7 days	1	2.04 per cent.

* Read before the George Washington University Medical Society, Dec. 17, 1927.

Age of patient Name of surgeon Date	Etiology Location	Time between injury and operation	Drainage	Complications	Sequelæ	Result
Rhodes: 1922: 16 years	Stab wound r. ventricle	About 2 hrs.	No	None	None	Died on table.
Vautrin & Guillemin: 1922	Stab wound l. auricle	1½ hrs.	No	None	None	Recovery.
Klose: 1922: 40 years	Stab wound r. auricle	3 hrs.	Yes	D.T.: Pericarditis: Broncho-pneumonia	None	Died, 18 days.
Rhodes: 1923: 23 years	Stab wound r. auricle	About 1 hr.	No	Pericarditis: Pleurisy: Ac. Tonsillitis. Etc.	Few pleural adhesions	Recovery.
Drummond: 1924: 25 years	Stab wound l. auricle	2 hrs.	No	Pneumothorax: pleural effusion	None	Recovery.
Maguire: 1924: 18 years	Stab wound r. auricle	About 2 hrs.	Yes	Pleural effusion	None	Recovery.
Meyer & Brams: 1924: 37 years	Gunshot wound l. ventricle	About 6 hrs.	No	None	Slight sinus arrhythmia	Recovery.
Brocq: 1924: 35 years	Stab wound l. ventricle	About 1 hr.	No	Heart stopped on table; started with massage	None	Recovery.
Comolli: 1924: 38 years	Stab wound l. ventricle	4 hrs.	Yes	None	None	Died, 5 hours.
Grove, Fernandez & Grove: (6 cases): 1924 #1. 23 years	l. ventricle	Immediate operation	No	None	None	Died, 4 hours.
#2. 30 years	Stab wound l. ventricle	Not stated	No	None	None	Died, 15 days.

#3. 20 years	Stab wound l. auricle	?	Yes	None	None	Recovery.
#4. 18 years	Stab wound l. ventricle	?	No	None	None	Recovery.
#5. 20 years	Stab wound l. ventricle	?	No	Purulent pericarditis	None	Died, 25 days.
#6. 27 years	Stab wound l. ventricle	?	No	None	None	Recovery.
Long (2 cases): 1925: #1. 32 years	Knife: left auricle	?	Yes	Serous effusion	None	Recovery.
#2. 45 years	Stab wound l. ventricle	?	No	None	None	Recovery.
Schoenfeld: 1925: 5 years	Stab wound l. ventricle	About 3 hrs.	No	None	None	Recovery.
Brocq: 1925: 24 years	Gunshot wound l. ventricle	About 3 hrs.	No	None	None	Died, 48 hours.
Flach: 1925:	Knife: l. ventricle	1 hr. or less	Yes	Pneumonia	None	Died, 5 days.
Otto: 1925: 24 years	Stab wound r. ventricle	?	No	Osteomyelitis	None	Recovery.
Lenormant: 1926	Stab: r. ventricle	About 2 hrs.	No	Pericarditis	None	Recovery.
Duschl: 1926	Stab: r. ventricle	?	No	None	Incapacitated	Recovery.
Davenport: 1920: 44 years	Stab wound r. ventricle	About 1½ hrs.	Yes	None	None	Recovery.
Hesse: 1921: 40 years	Gunshot wound l. ventricle	2 hrs.	No	None	None	Died, 2 days.

We have examined the literature, and the individual cases reported in the literature from 1923 to 1926, finding 25 cases, including our own. (See Table.)

Total recoveries	16	64.0 per cent.
Total deaths	9	36.0 per cent.
In O.R.	1	4.0 per cent.
In 24 hours	2	8.0 per cent.
Within 7 days	3	12.0 per cent.
After 7 days	3	12.0 per cent.

The majority of injuries of the heart reported in the literature are stab wounds, usually with sharp instruments, and, less frequently, are due to gunshot wounds.

Death most frequently occurs very promptly, due to shock and hemorrhage, before any treatment can be instituted. The classical symptoms described many years ago include an anxious expression with restlessness; the patient may be unconscious; there is marked shock with pallor and cyanosis; the skin is covered with cold sweat; there is usually dyspnœa, the pulse being feeble and fast.

The physical examination shows a wound over the precordium which frequently does not bleed extensively. There may be evidence of pneumothorax or hæmo-pneumothorax. The precordial area of dulness may or may not be increased in size. The apex impulse is altered. The heart sounds are usually distant.

The diagnosis of cardiac injuries is not always easy, the diagnosis being made upon symptoms which may sometimes be very readily confused with, and present an almost identical picture to that of pulmonary, pleural, and pericardial injuries.

The surgical treatment should be prompt, even in the face of many usually definite contra-indications to surgical intervention. It is felt that the gravity of heart injuries demands exploration, because, as may be seen by the figures presented above, prompt intervention has reduced the mortality of heart injuries from about 63 per cent. reported in the first series in 1909, to approximately 30 per cent. at this time.

Time does not offer for the presentation of the types of operation which may be performed, but the statement should be made that surgery should be carried out early, and that generally speaking, better results have been obtained by complete closure without drainage. Drainage lends more possibility of infection, and infection is the principal factor, along with bronchopneumonia, in the late mortality of these patients.

The repair of heart injuries is generally conceded to be carried on in the same fashion as the healing of other tissues; namely, by the laying down of fibrous tissue. Heart muscle does not regenerate in these cases. Around the area of scar there is, however, described an area of hypertrophy of the muscle cells.

CASE REPORT.—Melvin Jones, aged five years, was admitted to the Children's Hospital about 2 P.M. on September 20, 1925, with a history of having run into or fallen upon a pair of scissors at about 12.30 P.M.

At the time of admission, he was in profound shock, had a marked pallor, some cyanosis, the extremities being cold and clammy, and the body bathed in cold sweat. The pulse was hardly perceptible, and there was a puncture wound in the fourth left costal interspace, about one inch from the edge of the sternum. The left chest was hyper-resonant, particularly over the cardiac area, to beyond the left nipple line. The heart sounds could not be heard, and there was bronchial breathing over the cardiac area.

The child was given normal salt solution by hypodermoclysis, immediately, and about sixteen minims of fibrogen, following which the pulse picked up slightly.

An X-ray made at this time showed the heart normal in size and position; the lung field entirely clear. There was no evidence of pneumothorax. The lung was in no way retracted, and there was no evidence of fluid.

At about 3.40 P.M., under ethylene-oxygen anæsthesia, an incision was made through the superficial tissues over the third rib, from the costo-chondral junction to the chondro-sternal junction. A similar incision was made above the fifth rib, and the flap of skin and muscle was turned laterally. The third and fourth ribs were cut through at the costo-chondral and chondro-sternal junctions, the third and fifth intercostal muscles being sectioned transversely and at the sternum, and the entire flap was turned laterally. Following the control of hemorrhage from the internal mammary artery, the pericardium was opened transversely, releasing a large blood clot, and some free blood, from the pericardium. (It is interesting to note that on opening the chest the pericardium had dropped away from the thoracic wall.) The heart, as well as the pericardium and superficial tissues, showed a small puncture, one-quarter inch in length, extending longitudinally on the anterior surface of the left ventricle about one and one-half inches above the apex, from which, on contraction, a stream of blood was ejected about sixteen to eighteen inches. This wound was closed with two interrupted silk sutures, following which the pericardium was closed, and the superficial tissues were sutured without drainage. During the closure, high pressure was exerted by the anæsthetist with his closed anæsthesia for the purpose of dilating the collapsed lung caused by pleural injury. A large flat dressing was applied over the wound, and an adhesive dressing applied to the left chest. At the conclusion of the operation, the pulse was quite perceptible and of good force. A transfusion of whole blood was not easily done, but about a hundred c.c. of blood, which could not be infused, was given per rectum.

The day following the operation, the patient was greatly improved in every way. He was seen in consultation with Doctor Wall before leaving the hospital, who reported the chest examination normal except for slight bulging in the lower left chest anteriorly; a diffuse, poorly defined apex beat, one and one-quarter inches below the nipple; and a slight decrease in the intensity of the respiratory sounds in the left chest. The convalescence was steadily progressive up to the time of his discharge from the hospital, October 29, 1925.

On December 7, 1927, Dr. Thomas S. Lee, of Washington, very kindly consented to give the child a thorough cardio-vascular examination, which showed the chest symmetrical, except for the operative scar. Expansion was good and even on both sides; no visible pulsation; moderate epigastric pulsation when recumbent. The apex beat was barely palpable in the fifth intercostal space, within the midclavicular line. The size of the heart was normal, the teleröntgenogram showing the transverse diameter of the heart to be 8 cm., and that of the chest 19½ cm. The aortic arch was not enlarged. There were no murmurs or other signs of pericarditis or endocarditis. The myocardium was in satisfactory condition, as was shown by the quality of the cardiac tones, the normal response to moderate exercise tests, and the normal electro-cardiogram. The heart rate, sitting, was 100, the patient being somewhat nervous under examination. There was a moderate degree of sinus arrhythmia, which is of no clinical significance

in a child. The blood pressure was systolic 100 mm., diastolic 60 mm., in both arms. There was no sign of circulatory inefficiency in the lungs, the liver, or elsewhere.

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