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CASE OF HYPERTROPHY,

DILATATION AND FATTY DEGENERATION OF THE HEART, CONSEQUENT UPON PROLONGED MUSCULAR EXERTION.

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(Read before the Medico-Chirurgical Society of Montreal.)

Do fatal and uncomplicated cases of hypertrophy and dilatation of the heart ever occur as consequences of severe and prolonged muscular exertion?

The following case is offered as a contribution to this question, upon which as yet there is a considerable diversity of opinion among Pathologists.

On Nov. 7th, 1876, I performed an autopsy on a large, powerfully-built, muscular man, who had died with all the symptoms of chronic valvular disease, and in whom great dilatation and hypertrophy of the heart were found, but without presenting any of the conditions commonly recognized as productive of these states,—no valvular affection, no arterial degeneration, no emphysema, or other chronic pulmonary disorder, no renal disease; there was, in fact, an entire absence of the lesions usually met with in cases of this kind.

I am indebted to my colleague Dr. Ross for permission to use

the following clinical notes, taken by Dr. James Bell, at that time the ward clerk:

J. W., æt. 39, an Englishman, was admitted into the Montreal General Hospital, Nov. 2nd, 1876. He is a large, powerfully-built man, with tremendous chest girth. He had been a soldier for 18 years, serving in the different British stations, and latterly had followed the occupation of a blacksmith. Has never had syphilis or rheumatic fever. Has always been a healthy man, though intemperate. In July last he suffered from shortness of breath and slight hæmoptysis, for which, in August, he entered the hospital, and was under treatment nearly two months for "some heart affection," being discharged very much improved. He then worked for three weeks as a day labourer, and suffered much from exposure to cold and wet. On October 20th he had a chill, which was followed by swelling of the legs and abdomen, with slight dyspnœa. He gave up work on the 24th, and was treated as an out-door patient for a few days before entering Hospital on November 2nd. When admitted, in addition to the above-mentioned symptoms he complained of great pain over the region of the heart. The legs were œdematous, and the conjunctivæ and face of a sub-icteroid hue. On physical examination, the cardiac dulness was found to extend as high as the upper border of the third rib, and to the right border of the sternum. A systolic murmur was heard at the left edge of the sternum in the third interspace. Apex beat could not be distinctly felt. The pulse at the wrist was barely perceptible. There was dulness over the lower lobe of the left lung. Rough snoring râles were heard over the front of the chest, and coarse bubbling râles behind. Liver dulness extended from the 5th interspace to the costal margin. The urine contained nearly 25 p. c. of albumen. The day after admission he expectorated nearly three pints of florid blood, and vomited very frequently. In spite of treatment (dry cupping, ergot, digitalis, etc.,) his condition became worse. On November 5th the pulse was quite imperceptible at the wrist, the cyanosis became extreme, and the patient died early on the morning of the 5th, with all the symptoms of chronic valvular disease.

Post-mortem, 30 hours after death. Face, neck, and skin of thorax intensely livid. Tissues beneath the skin of anterior part of trunk and about the root of the neck emphysematous. Scrotum much swollen. Legs œdematous.

Brain.—Sinuses of dura mater and veins of the pia mater full. Arteries at the base not diseased. Nothing abnormal in the brain substance.

Heart weighs 610 grms. (21½ oz.) Right chambers distended with dark clots and fluid blood; the venæ cavæ are also dilated and full, much blood escaping from them in the removal of the organ. Right auricle is very large, size of a small orange; walls of about the usual thickness. Right ventricle dilated, anterior wall measures ¼″ in thickness; columnæ carneæ are not hypertrophied. Tricuspid orifice 5⅞″ in circumference; valves healthy. Pulmonary valves normal; circumference of orifice 3″. Left ventricle contains some fluid blood, and a small partially decolourized clot in the mitral orifice. The chamber is much dilated, measuring 4½″ from apex to aortic ring, and bulges considerably towards the right ventricle. Endocardium thick and opaque, especially over the septum. Musculi papillares fibroid at apices; walls over middle of anterior part ⅞″ in thickness; posterior wall ½″; ventricular septum, a quarter of an inch below aortic valve, ⅝″. Mitral valves slightly thickened at the edges, otherwise healthy. Orifice measures 4¼″ in circumference. Aortic valves competent, segments thin and natural-looking; orifice at the ring measures 2¾″ in circumference. Aorta looks—relatively—smaller than natural. It is not atheromatous, either in the arch or in its course. Muscular substance of whole heart, and especially the left ventricle, looks pale, and on examination is found in a condition of advanced fatty degeneration; a good deal of fatty infiltration also exists between the individual fibres.

Arteries of the body do not present any signs of degeneration.

Lungs ℥xcvi of serum in left pleura, and the lung on this side is collapsed and only slightly crepitant above. Two very large spots of apoplexy in the anterior part of upper lobe, and

about them the lung tissue is hepatized. Another, also large, occupies the anterior border of the lower lobe. Right lung is crepitant, but contains much blood and serum. At the lower part of anterior lobe in front is a small, consolidated area.

Spleen, 250 grms., firm.

Kidneys, not enlarged. Capsules detach easily; surfaces smooth. On section pyramids and Malpighian tufts of the cortex are injected.

Stomach and intestines present nothing unusual, the large and small veins are very full.

Liver, a little enlarged, of good consistence; venules of hepatic vein gorged—nutmeg organ.

The degree of hypertrophy and dilatation will be seen at a glance in the following table:

Heart of J. W.		(Peacock.) Normal Heart.	(Bizot.) Normal Heart.
Right ventricle, ant. wall...,	3‴	1.85‴	
Left " " " ...	.87″	.53″	0.43″
" " post. wall...	.5″		
" " length.....	4.5′′	3.33	2.61
Mitral orifice, circumference	4.25″	3.58	4.29
Aortic " "	2.75″	3.17	2.74
Tricuspid " "	5.87″	4.50	4.81
Pulmonary orifice " - -	3.3″	3.33	2.79
Weight of Heart - - - -	21.5 oz.	9.75 oz.	

The dilatation of the left ventricle is very marked, while the hypertrophy of the walls is moderate. The mitral orifice is somewhat dilated judged by Peacock's standard, while the aortic ring is even smaller than natural, though by Bizot's standard it is just normal. It certainly appeared very much out of proportion to the huge left ventricle. The tricuspid orifice is very large, and the right chamber considerably dilated, while the opening of the pulmonary artery is about normal.

The hypertrophy and dilatation in themselves presented nothing remarkable, and the other lesions were those of every-day occurrence in organic heart disease—hydro-thorax, œdema and hæmorrhagic infarction of the lungs, venous congestion of

the liver, spleen and kidneys; the fatal result depending on the condition of the lungs. But what could account for the hypertrophy and dilatation? This was the difficulty, and so impressed was I at the time with the unusual character of the lesion that a most searching examination of the different organs was made and careful measurements of the heart were taken, but no satisfactory cause could be found for the cardiac affection, so that the notes were laid aside and the case labelled 'idiopathic.'

A few months after in Nos. 17 and 18 of the *Berliner Klinische Wochenschrift*, 1877, there appeared a paper by Dr. Zunker, one of Professor Leyden's Assistants at the Charité, Berlin, on a case of "Dilatation and Fatty Degeneration of the Heart, in consequence of over exertion," which, in its clinical features and anatomical characters is almost the exact counterpart of the one under consideration, except that the dilatation was a little more marked and the hypertrophy not so great. This gave a possible clue to the interpretation of the case, and I immediately made enquiries about the past life of the man, but was not very successful as his wife had left the city, and from her alone could definite information have been obtained. It was, however, ascertained, as stated above, that after leaving the army he had worked as a blacksmith, and latterly, for a short time, as a corporation labourer. He was, as I have said, powerfully built, and very muscular, an acquaintance describing him as a "perfect picture of a man." From the facts I have gathered, and the similarity of the case to several which have been recorded, I am inclined to regard the condition of the heart as intimately associated with and dependent upon the over use of a highly developed muscular system.

Before dealing with the question of how the abnormal state was brought about, it may be well to make a few preliminary remarks on the influence of prolonged and severe muscular effort on the circulatory system.

In the works of one or two of the older writers upon the heart very definite statements are met with bearing on this question: Thus—

Corvisart,* among other causes of heart disease, mentions muscular exertion, and records a fatal case of hypertrophy, without valvular disease, following violent exertion.

Hope† states that "occupations requiring constantly renewed muscular efforts," produce in time dilatation of the heart.

Latham‡ was, I believe, the first to recognize fully the importance of over exertion in the causation of heart affections, and under the term "shock of the heart," describes cases of rupture of valves, and of hypertrophy following sudden and severe muscular efforts.

The attention of army surgeons was early called to the prevalence of heart disease among soldiers, and in the great majority of these without any history of acute rheumatism.

McLean§ brought the subject prominently before the authorities and the profession, believing the evils to result largely from the constricting influence upon the chest of the regulation pack and other accoutrements.

Peacock,‖ about the same time, in his lectures on valvular diseases showed how liable the valves were to injury from violent muscular efforts.

During the American civil war the injurious effect of military life upon the heart was abundantly proved, and the rich clinical material then afforded enabled several observers¶ to materially advance our knowledge in this direction.

In 1870 an important monograph by Myers** appeared

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* Treatise on the Diseases and Organic Lesions of the Heart, translated by Hobb, London, 1813. pp. 28, 63.

† A Treatise on Diseases of the Heart, 2nd edition, London, 1853.

‡ Lectures on Diseases of the Heart, London, 1846.

§ Lectures at Royal United Service Institution, 1865.—Brit. Medical Journal, 1867.

‖ Valvular Diseases of the Heart, London, 1865.

¶ Da Costa: Observations upon Heart Disease in Soldiers. Medical Memoirs of the United States' Sanitary Commission, 1867.

Taylor: Remarks on Heart Disease.—Transactions of American Medical Association, vol. 18, 1867.

Da Costa: On Irritable Heart.—"Am. Journal Med. Sciences," Jan. 1871.

Treadwell: On Over-work and Strain of the Heart.—"Boston Medical and Surgical Journal," 1872.

** Diseases of the Heart among Soldiers, London, 1870.

and since that date important articles have been written by Albutt,* Seitz,† Thurn,‡ Frânkel,§ and Levy,‖ illustrating in various ways the effects of over-work and strain on the heart.

The recent works on the heart¶ deal either not at all, or very cursorily with the subject.

The above constitutes the chief literature of the subject, and from an analysis of the papers the following conclusions may be drawn with regard to the effect of overwork on the heart.

1. Sudden and violent exertion may cause rupture or laceration of the valves—a very serious lesion, which often proves fatal within a short time.

2. The augmented resistance to the flow of blood during severe and prolonged muscular exertion increases the work of the heart, which, in response to the demand made upon it, enlarges. The blood pressure in the aorta, abnormally high, even during the diastole, is much increased, during the systole of the powerful left ventricle and the coats of the vessel yield, commonly at the arch, becoming pouched and atheromatous. Subsequently incompetency ensues, either from stretching of the aortic orifice or giving way of the valves.

3. In the functional disorder of the heart described by Da Costa, Myers, and others as common in young soldiers, and termed by the former, 'irritable heart,' there is hypertrophy of the muscular walls of the organ, caused by over-work at drill and the constricting effects of the military accoutrements. This may in time be followed by valvular disease.

4. It appears from a number of recorded cases that overwork

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* Over-work and Strain of the Heart.—St. George's Hospital Reports Vol. 5, 1872.

† Zur Lehre von der ueberanstrengung des Herzens.—Deutsches Archiv. fur Klinische Medicin, 1872.

‡ Ermudung des Herzens und die Entstehung von Herzfehlern. Republished by Seitz, together with the articles of Albutt, Da Costa, and Myers, as a separate volume.

§ Virchow's Archiv. Bd. 57.

‖ Du Cœur forcé ou de l'asystole sans lesions valvulaires. Thése inaugurale, Nancy, 1875. Resume in Archives Généralés, Janvier, 1876.

¶ Ziemssen's Encyclopedia of Practical Medicine, vol.
Balfour—Diseases of the Heart, 1875.
Hayden—Diseases of the Heart and Aorta, 1875.
Reynold's System of Medicine, vol. 4. 1877.

of the muscles may induce a primary dilatation and hypertrophy of the heart, which, without valve affection or arterial degeneration, may prove fatal with all the symptoms of chronic cardiac disease.

It is this last condition to which I wish specially to direct attention, as I believe the case reported affords an illustration of it.

Very few of the writers mentioned above, though dealing specially with effects of over exertion on the heart appear aware of the possibility of a fatal result as an immediate sequence of primary hypertrophy and dilatation.

Peacock* records three cases in which after death no affection of the valves or orifices was found, but simply hypertrophy and dilatation, and explains these conditions by supposing "that from the enlargement of the left ventricle which existed in all the cases the mitral valves had not been properly adjusted during the systole." He offered no explanation as to the cause of the enlargement of the heart, but passes on immediately after to the state of the organ in the Cornish miners, which he directly refers to the severe muscular effort necessary in their work, and in climbing long ladders up and down the shafts.

Seitz† gives a remarkable series of cases observed in Biermer's Clinic in Zurich, almost all of which presented the following symptoms: "Palpitations, and ill-defined sensations in the cardiac region, as if the heart were about to stop, shortness of breath, anxiety, feeling of faintness, cyanosis, anasarca, enlargement of the liver, irregularity and intermittent action of the pulse, dilatation of the heart, apex beat feeble and dislocated downwards and outwards, increase in cardiac dulness. Heart sounds sometimes normal, but not unfrequently murmurs at the apex." Post-mortem, the anatomical changes were confined to "Hypertrophy of the walls, and dilatation of the chambers, valves unaffected; degeneration of a few muscle fibres; rarely fatty." He regards over work as the most important factor in the production of these cases.

In the case reported by Dr. Zunker from Leyden's Clinic, the-

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* Loc. cit.

† Loc. cit. p. 61

connection between the over-exertion and the heart disease is very well brought out. The patient, a journeyman mason, had enjoyed good health up to six weeks before his admission. During this time he had been engaged in the unusually severe work of carrying heavy stones up long ladders. He stood this very well for three weeks, when he began to suffer from want of breath and a slight cough. Soon palpitations came on, the shortness of breath increased, the legs began to swell and he was forced to take to his bed. He got rapidly worse, and was sent to the Charité cyanotic and almost moribund. Hydrothorax of the right side was detected, the chest was tapped, and 128 cc. of clear fluid drawn off with great relief. The attacks of dyspnœa recurred, and he died four days after admission with all the symptoms of chronic heart disease. At the autopsy the heart was found enormously dilated, the walls in a condition of fatty degeneration; no valvular disease, no chronic renal or pulmonary affection.

In the case of J. W., the evidence of prolonged muscular effort is presumptive rather than direct. The occupations which the man had followed guaranteed a tolerably active exercise of his voluntary muscles, and it has been from among soldiers and smiths that a very large proportion of these heart cases have been described. Moreover, the high development of his muscular system afforded the best possible proof of its constant use. There must have been some agency at work to produce the dilatation and hypertrophy, and considering the above facts, and in the absence of all the recognized causes, I feel more inclined to regard it as due to overwork than to look upon it as spontaneous or idiopathic.

But how, it may be asked, is all this brought about? Severe muscular exertion affects the circulation in two ways: first, by interfering with respiration and the free passage of blood through the lungs; the right heart gets over-loaded, the systemic veins full, and thus an obstacle is offered to the outflow of blood from the arteries; in consequence of which the left ventricle becomes dilated and must hypertrophy to overcome the increased resistance to the arterial flow. According to Peacock, the large-

hearts of the Cornish miners are produced in this way. In the June number of Von Ziemssen's Archiv, there is an interesting article on "Das Tubinger Herz.," by Dr. Münzinger, descriptive of a form of heart disease similar in some respects to the one under consideration. It is met with among the vine dressers who undergo very severe work in carrying manure in baskets on their backs long distances up the mountains. The exertion required is very great, and the respiration considerably interfered with by the constricting pressure of shoulder straps. Sooner or later they suffer from dilatation and hypertrophy; but as this has always been found associated, post-mortem, with emphysema, it is difficult to say in these cases how much is due to this condition and how much to the muscular effort itself.

Secondly, the effect of over exertion may act in a much more direct manner. The experiments of Traube upon dogs have shown that during extensive muscular contraction the blood pressure in the arteries is greatly increased, and the same may reasonably be inferred of men. The more laborious the work, and the more violent the contraction of the muscles, so much the greater difficulty has the blood in flowing through the systemic arteries. The arterial pressure is increased and the blood tends to accumulate in the aorta and the left ventricle. If the nutrition be maintained no ill effect will follow from this, for the left ventricle hypertrophies and the balance is restored. That this state does exist is a well attested fact, and Albutt speaking of this early condition of hypertrophy says "that he has found in a few autopsies of such men killed by accident or acute disease, that the ventricles, the left especially, are, like their bicipites, large and red," the heart weighing as much as 16 oz.

The lower animals furnish good examples of hypertrophy following severe exercise. Houghton* states that the heart of the celebrated greyhound, 'Master Magrath,' weighed 9.57 oz., just three-fold in excess of the normal proportion of heart-weight to body-weight, and no other cause could be assigned for the great enlargement than the prolonged muscular effort in coursing.

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* "British Med Journal," 1872..