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## Neurocirculatory asthenia and the soldier

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NEUROCIRCULATORY ASTHENIA

AND THE SOLDIER

by

Harmon E. Rider

Senior Thesis

Presented to

The College of Medicine  
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"And if so be any man object unto me that this discourse is only compiled together of certayne rapsodyes of the antique chyrurgians, I willingly heere confes and acknowledge that in this Treatise there is verye little, or nothing at all, of myne own Invention".

Jacques Guillemean

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## INTRODUCTION

One has to read little of the medical history of the last world war to realize cardiac conditions were a serious problem. This is contrary to what one would expect, for all modern soldiers are given rigid physical examinations before entering the army and the average soldier is in an age group where cardiac conditions are relatively rare. By far the most common of the cardiac conditions was one under various headings, chief of which was "soldiers heart" in the military literature. It is quickly seen from the history and picture of these patients with so called "soldiers heart" that they are suffering from a malady known in civilian practice generally as neurocirculatory asthenia.

With the present world at war and in a war, like, that has never been, with the modern machines of terror, the use of propaganda and fear, it seems to me as though neurocirculatory asthenia will be a very vital problem to the Military Doctor.

Expecting to be a Military Doctor in this modern War, I thought it would be very appropriate to write my senior thesis on Neurocirculatory Asthenia and the Soldier.

## DEFINITION AND NOMENCLATURE

The subject under discussion is the kind of a disease known to older men as "morbi sine materico", a disease without lesion. Allbutt (1 ) points out "Disease" is a clinical and not a pathological term and consists of a series of symptoms recurring with a fair uniformity. Our subject consists in the main of the following terms or symptoms, submammary pain, palpitation and quickened pulse, shortness of breath on exertion, tremor, exhaustion, dizziness and certain vasomotor phenomena. This group of symptoms is too uniform to be fictitious or fantastic.

Dorland (19) terms the subject "Neurocirculatory Asthenia" and defines it as a symptom complex, characterized by the occurrence of breathlessness, giddiness, a sense of fatigue, pain in the chest in the region of the precordium and palpitation. Occurring chiefly in soldiers in active war service, though it is seen in civilians. It is also called soldiers heart, irritable heart, effort syndrome and disordered action of the heart. (D.A.H.)

Lewis (33) in his monograph goes into great detail on the nomenclature of this symptom complex. He prefers the term "effort syndrome"; he points out it is non-committal on the pathological side; it expresses

a fact of which there is general recognition, namely, that the chief symptoms are unmasked or aggravated by exertion. He thinks the trouble with the phrase neuroasthenia and such terms as "heart strain" and Da Costa's (17) "irritable heart" is that each infers a knowledge of the essential pathology which at the present time we do not possess. The term "soldiers heart", sometimes employed, is open to the objection that the condition infrequent amongst civilians; the term "athletes heart" wrongly implies that it is confined to the athletic; each term has the disadvantage that it presupposes the heart to be the primary seat of mischief.

After the United States had declared war, Lewis, (35) working in conjunction with American Military physicians, suggested the term neuro-circulatory asthenia. It was selected because it was descriptive, non-committal, and shortened to "N.C.A." would be understood, and not misunderstood, all along the line. These men thought it would be a mistake to introduce into the American Army the name "Disordered action of the Heart", the official nomenclature of the British Army, for, after a soldier has once been so labelled, it is difficult subsequently to persuade him that he is not suffering from organic heart trouble; this in itself retards his progress. This term neurocirculatory was approved by the Surgeon

General of the U. S. Army from this report. (35)

The British Committee of medical examination of Recruits ( 5 ) for the second World War defines "Effort Syndrome" as a condition in which the characteristic symptoms are nervousness, a feeling of exhaustion, left mammary discomfort, palpitation, giddiness, and dyspnea on exertion. They recommend that the term "Effort Syndrome" be used. Here in the United States the term neurocirculatory asthenia is at the present time the one of choice for this symptom complex.

White in a recent article (70) thinks there are types and variations to this symptom complex which are not well differentiated. So in the future we may expect various terms for a symptom complex that as yet is not fully understood.



## HISTORY

From a historical standpoint it may truly be said that neurocirculatory asthenia has been with us from the first days of civilization. Hippocrates wrote of the effect of stress and strain, emotion and excitement in the production of palpitation of the heart and other manifestations of disturbed action of the heart not based upon organic disease. However the great Hippocrates in many ways was quite ignorant of the role the heart played in disease for he thought also that the heart was not affected by disease. This later idea persisting well into the seventeenth century.

Since the earliest days the heart has been regarded not only as the seat of the soul but also as the badge of valor. Richard Coeur de Lion is one of the many examples who needed a stout heart more than a right arm. It is said many soldiers showed after death a heart shaggy like a lions mane, the result of fibrinous pericarditis. About the only lesions of the heart recognized in the Middle Ages were fatal wounds which penetrated the organ itself. In the sixteenth and seventeenth centuries with the shaking off of the cloak of the Dark Ages and with the institution of postmortem examinations, it gradually became known that soldiers as well as civilians suffered from acute and chronic heart disease apparently

unassociated with trauma.

Moon (47) points out that the serious effect of emotion upon the heart was noted by Covisant during the French Revolution, who said "I am not the only physician to whom it appeared that organic diseases of the heart during the reign of terror were more frequent than in ordinary times".

With the introduction of the stethoscope in 1819 by Luenneq and the beginning of the Golden Age in Medicine, knowledge of the heart in regard to the soldier began to be gathered like snow on a ball of snow rolling down a hill.

Neurocirculatory Asthenia was described quite fully in the British Blue Book of the Crimean War in which it was referred to as palpitation. From the writings of Lord Cline it must have been present in his troops during the conquest of India. Furbringer (24) observed it and wrote about it in the German troops of 1870.

Most of the earlier references, however, on neurocirculatory asthenia are to be found in the American Literature. Hartshorne (26) had published in 1864 an article describing the condition in the Union troops during the Civil War. He designated the condition as muscular exhaustion of the heart. He described the symptoms fairly well and thought it mainly due to

exhaustion and over exercise. He makes the statement that he was acquainted with but one distinct published recognition of it, "in the address of Dr. A. Stille, before the Philadelphia County Medical Society delivered and published in February 1863. Although Dr. Stille designates the disorder described by him as palpitation". Myers (49) in 1870 published a detailed description of this condition appearing in the English Soldiers.

In 1871 Da Costa (17) published his masterly description of this condition and termed it "Irritable Heart". His observations were made on over three hundred soldiers in the Union Army. In his paper he accurately described the symptoms and gave every logical explanation of its cause. It can truly be said that Da Costa was the first to realize the significance and importance of neuro-circulatory asthenia in Military Medicine.

From Da Costa up until the first World War little is found in the literature on this subject. The medical profession was rather lacking in their appreciation of the frequency and importance of this syndrome. However in 1887 Osler (53) did demonstrate that symptoms shown by soldiers were also found in people in civilian life, but this was also recognized by Da Costa.

With the coming of the first World War the medical profession suddenly became aware that they were dealing

with a serious problem in the conscription of the giant modern Army. From 1916 to 1919 numerous articles were published, some good and some of little value, on all phases of the subject. It became such a serious problem to the British Army that the Government commissioned Sir Thomas Lewis (33) to investigate the problem. At one time the British Army had 30,000 men hospitalized for this condition. (21) This work of Lewis and the masterly mind and foresight of Major Janeway, who was then in charge of the Division of Internal Medicine of the Surgeon General's Office, saved the Expeditionary Force of the American Army from being burdened with thousands of soldiers unfit for combat duty that at one time confronted the British.

It would be foolish to try and list the men who studied and worked on this problem in both the Armies of Britian and United States. The frequency and importance of this syndrome was by these men brought to the attention of the rest of the medical profession, and who later applied this knowledge in their civil practice.

From the World War up to our present World War, the literature is fairly extensive. Out of necessity practically all the work has been done on the civil population. It is interesting to note that men like White (20) have found the incidence as high as 15% in their cardiac

patients and prior to 1918 it was generally not recognized. In the last twenty years there has been much work done on the etiology of the syndrome and as yet there are many pieces missing from the puzzle.

Now with the coming of the second World War and the raising of gigantic armies from the civilian population "Neurocirculatory asthenia" once again will become a serious problem confronting the Army Doctor. As yet it is too early to find many original observations made on the subject in regard to this War. We can however predict that this War will be an important chapter in the history of this syndrome and that our concept of neurocirculatory asthenia will be much more clear than it is today.

## ETIOLOGY

The precise mechanism by which this syndrome is brought about is unknown. Basically it is classified with the neurasthenias, that group of borderline psychic disorders wherein fatigue is prominent and the other symptoms present are referred to almost any region or organ. The development of neurasthenia appears to be an hereditary characteristic. In some members of the family the symptoms may be referable to the gastrointestinal tract, in others to the nervous system, and still others may have the syndrome of neurocirculatory asthenia.(8) Campbell (7) has put forth evidence that these variable symptoms in individuals may be due to an idiosyncrasy of these patients.

White (70) thinks that in the present state of knowledge that neurocirculatory asthenia is not established as yet primarily as a psychoneurosis although such is at least a common complexion. A cardiac or other neurosis may be present with none of the evidence of neurocirculatory asthenia which is clinically a symptom complex resulting chiefly from fatigue and consisting of various combinations of palpitation, heartache, dyspnea, (often sighing) faintness, easy fatigability, tremor and nervousness in whole or in part.

Da Costa (17) in an analysis of 200 soldiers dur-

ing the Civil War brought forth various etiological factors which were:

	Number	Per cent
1. Fevers	34	17
2. Diarrhea	61	30.5
3. Hard Field Service	69	38.5
4. Injuries, rheumatism, scurvy, ordinary duties and doubtful causes.	<u>36</u>	<u>18</u>
	200	100%

He concluded that the condition was mainly due to over work and strain. "It seems to me that most likely the heart has become irritable, from its over action and frequent excitement and that disordered innervation keeps it so".

This viewpoint of Da Costa's has been pretty well disproved. (68) (37) Lewis (37) thinks it is an inherent improbability that so vital a muscle as that of the healthy heart is materially exposed to damage during exercise. Yet Lewis (33) thinks strain and especially the strain of heavy marches, plays an important role as a provocative cause.

The psychoneurotic factor in neurocirculatory asthenia was thoroughly studied by Oppenheimer and Rothschild (52) in the last War. In their work the question came up whether some cases were not congenital or even hereditary in character, particularly when dealing with soldiers who belong to a group which they termed constitutionally asthenic.

Out of 100 unselected cases they found a positive family history of one or several of the characteristics selected in 56% of cases of "irritable heart" and in 38% of the controls, but the contrast between the two classes becomes far more striking when certain of the individual items are compared. Thus with reference to nervousness in the family history there are 45% among the "irritable heart" group and only 15% among the controls; in regard to insanity and epilepsy there are 23% and 15% respectively in the families of cases of "irritable heart" and none among the controls.

The percentage of cases with a positive personal history of psychoneurosis is 51% among cases of "irritable heart", 12% among the controls and of those with positive family and personal histories there are 46% among the former group, and but 6% among the latter. There was a prevalence of previous nervousness of a history of epilepsy or fits, of previous breakdowns, of moodiness and of enuresis. Of the 100 cases analyzed 61 gave a positive family or personal history for psychoneurotic factors. In these cases with psycho-neurotic factors in their family and personal histories 70% (32 out of 46) showed symptoms of constitutional physical asthenia before the age of 17.

The causes of invaliding were studied in all the 100



cases and is notable that among the cases with psychoneurotic factors there is frequently, in fact 20 out of 46 cases nothing definite; on the other hand, in the group where there were no psychoneurotic factors, there is more frequently a definite precipitating cause such as an infection like trench fever or dysentery, prolonged service, gassing or shell explosion.

Among cases of "irritable heart" there are those belonging to the constitutional group who suffer from chest pain etc., and those who belong to the exhaustion or the post-infectious group, who have fatigue symptoms but rarely much pain. This first group complain almost invariably of chest pain among their other symptoms, indeed these patients are apt to "stick it" until pain develops, then they become alarmed and report sick. The patients in the second group rarely complain of chest pain, but suffer more from exhaustion and weakness; they are "done up," to use their expression.

Brooks (16) confirms the findings of these men. He found from the patients histories other members of the immediate family and near relatives showed some form of emotional disturbances. He also found, for the greater number of cases, the trait had been transmitted from the maternal side, although by no means uncommon to see both parents present perfectly clear stigmata of the

condition. Robey and Boas (61) also in their observations on these patients concluded that the fundamental cause of neurocirculatory asthenia is due to a nervous instability of the patient that cannot be cured. They found that such patients give a family history of nervousness, or some members of their family may be easily upset. Davies and Priestly (18) state that if the patient is examined very carefully he will often reveal symptoms dating back to childhood.

Fraser and Wilson (22) made a series of experiments on effort syndrome patients and normal men. They noted the effect of adrenalin and apocodeine upon these two different types of individuals. They observed through the course of the experiment that those patients of irritable heart reacted more strongly to these drugs than normal people. Their conclusion was that the mechanism of the symptoms in effort syndrome was due to the greater instability of the sympathetic nervous system, whose hypersensitiveness allowed for a greater number of stimulations.

Lewis states (33) the predominant etiological factor in the clinical histories is infection of one kind or another. He found out of 558 patients, the history of onset is definitely dated from rheumatic fever in 68 instances, (12%), from dysentery in 14 instances, from

typhoid fever and diarrhea in 14 also, from pneumonia, pleurisy and bronchitis in 25, from pyrexia of unknown origin and influenza in 28, in miscellaneous infections in 30 instances. In all of these the symptoms of the malady were first noted during convalescence from the disease in question, the history is of this kind in 182 out of 558 patients (or 33%). Of the remaining 376 cases, 65 of them belong definitely to the rheumatic class, although the significance of rheumatism in relation to the malady is in many uncertain. Of the remaining 311 patients a further considerable proportion had suffered prior to the onset of symptoms from pneumonia, pleurisy, bronchitis, dysentery and other infectious diseases; a history of repeated tonsillitis was frequent among them. In at least 50 to 60% infectious diseases may be held to play a chief part in promoting the disease in its initial stages.

Friedlander and Frehof were strong supporters of the theory that foci of infection was responsible, at least in a large part for the precipitation of this condition of effort syndrome. (23) They observed that out of fifty men affected, 50 to 90% had trouble with their teeth, sinuses and tonsils, etc.

Rothschild (62) roughly classified this symptom complete into two main groups:

1. Cases following various infections.
2. The constitutional cases.

In the constitutional type comprising about 70% of the cases no definite pathology can be found to which to ascribe the clinical conditions. By the term "constitutional asthenia" is meant a relative inferiority or an anomaly in the assemblage of inherent characteristics both functional and morphological which go to make up the organism. Sir William Osler put it picturesquely, (62) "something wrong with the blastoderm". It must be emphasized that apart from neuropsychiatric factors, there is a constitutional tendency which predisposes certain individuals to develop neurocirculatory asthenia.

Venning of France (66) after examining and following about 7,000 effort syndrome patients over a period of two years during the World War, concluded that the chief cause was that of mental and physical strain produced during war time. He thought the next etiological factor in importance was infectious diseases, the majority of which began in civil life, chief of which was rheumatism.

Lewis (35) divides the etiological factors into two groups predisposing and exciting, very often he found a history of both causes. He found about one-half of the cases give a history of symptoms previous to enlistment and these are classed as "constitutional". His findings

were about the same as Rothschilds, (62) previously mentioned, when analyzed. Of the exciting factors, the infectious and the physical and psychic strain of war are the most important. The role of infectious has been mentioned.

He found there were a great many soldiers who were constitutionally strong and were perfectly fit at enlistment, but who have become exhausted after years of active fighting. They have been "over the top" repeatedly through several campaigns, been exposed, perhaps wounded and are simply victims of intense warfare.

The relationship of disturbances of the ductless glands such as the thyroid and adrenal to neurocirculatory asthenia has given rise to much speculation. A great deal has been written about the possibility of hyperthyroidism being the etiological factor of this symptom complex. Grile (14) states that the presence of neurocirculatory asthenia may not be recognized until after thyroidectomy, and that thyroidectomy has no effect upon the condition. Craig and White (16) in an analysis of 100 cases of neurocirculatory asthenia report one case associated with "thyrotoxicosis" and one with an "adenoma of the thyroid" in both of which after the eradication of the thyroid disease the N.C.A. remained. Rienhoff (60) states that hyperthyroidism may be and

often is engrafted upon a condition of autonomic imbalance, psychoneuroses and neurocirculatory asthenia or some other allied functional disorder. Prioleau (58) believes that hyperthyroidism and N.C.A. may coexist in which case there are characteristic features of each disease. In these cases thyroidectomy relieves the hyperthyroidism but the symptoms of N.C.A. persist, however the patient is greatly improved.

Peabody (57) did basal metabolism determinations on 57 previously diagnosed hyperthyroid cases with effort syndrome. He found that 52 had a basal metabolism below the ten percent range above which is allowed for normal, and that 54 below 15% above the normal standards. Peabody's final conclusion on this subject was that all of these patients had a normal metabolic rate. According to him these observations eliminates the possibility that hyperthyroidism is the cause of neurocirculatory asthenia.

Crile (15) points out that the energy controlling system, the brain, thyroid, adrenal sympathetic complex, is the only mechanism by which the emotions are expressed, by which fight and flight are executed. He reasons one might effect a cure by breaking the circuit of the energy controlling system.

Venereal disease, alcohol, tobacco and coffee appear

to play no appreciable role in the history of N.C.A. It should be remembered that patients belonging to the constitutional type are sexually not very active, and are as a class not alcoholic, partly because they do not tolerate alcohol well, partly because they are frequently teetotalers as a matter of principle. (35) This has been the observations of practically all writers on the subject. MacGregor (41) found the condition as frequent amongst Sikh soldiers who are non-smokers as amongst other Indian troops.

From the work of Parkinson (33) it is seen that smoking does aggravate the symptoms. He found that tobacco smoke exerts a deleterious influence, temporarily at all events, in that it enhances the resting pulse rate, increases the reactions of the pulse-rate to posture and exercise, and increases the prominence of symptoms produced by exertion.

Brooks (6) mentions a racial influence in the etiology of this condition. From a study of the soldiers presenting themselves with this affliction during and after the World War, he finds that the Jewish race included fully two-thirds of the cases, and of these the greater number are among the Russian Jews. Next in point of frequency stands the Italians, then the Irish, the Americans, the Scandinavians and last of all the

Negro. The French and British are not as frequently affected as those just mentioned. He found that in the histories of Russian Jews, he could trace the condition directly through the family. There has been no confirmation of these studies made by Brooks (6) or mention of the racial influence by other authors.

This syndrome may occur in any physical type. The constitutional type is seen mostly in the tall, slender lumbar-lardotic individual, the thorax is narrow and long and rounded in cross section, the extremities are relatively long, the abdomen is bottle shaped, they are splanchnoptotic, the skin is soft. The next commonest type is of coarse build. The chest is broad but flat, the skin coarse, the hands and feet are large. The color is spastic, a pseudo-anemia and they faint easily. (62) (32).

of

Lewis found out <sup>of</sup> 543 patients, 306 or 57% were recruited from sedentary or light occupations. (33) (32). The group in sedentary occupations includes such men as clerks, shop assistants, attendants, printers, teachers, students, etc. The light occupations include waiters, stewards, painters, etc. Clerks alone number 80 or 15% of the whole. The question naturally arises as to what extent sedentary work actually predisposes to the affection. As yet no conclusive answer can be returned,



though Lewis thought these cases strongly suggest sedentary work as a predisposing cause. The incidence of infective disease amongst clerks is heavy also.

Brooks (6) also points out that few of these patients have elected occupations of an active character. Most of them have been clerks, accountants, students, writers, musicians, artists, and the like. A very few have attempted for a time such occupations as machinist, artisan, etc. but most state frankly that they found themselves inadequate for the work, that they either lost their jobs or threw them up for something of a more pacific character. He states that a good many make the statement that their doctor forbade heavy work or exercise, and insisted on their selection of indoor or clerical work.

Da Costa (17) was the first to notice that the majority of these patients fell in the earlier age groups. Out of 200 cases, he found almost two-thirds of the cases from the 15th to the 25th year. Here the majority occurred from the 20th to the 25th year. Da Costa states that if the question was considered with reference to the number of persons under 20 years of age in the ranks, these would be found to have furnished the largest percentage. His results were as follows, 200 cases studied:

	Cases	Percent
From 16 - 18	24	12
18 - 20	26	13
20 - 25	86	43
25 - 30	34	17
30 - 35	<u>17</u>	8.5
	200	100%

Whites observations on the part that age plays in the etiology of this syndrome conforms very closely to those of Da Costas.. (68) Out of 365 cases, White found that over half were between 20 and 40 years old. Twenty-three and nine-tenths per cent of this total being in the third and 27% being in the fourth decade of life. While only a little over 7% were in the second decade of life. There was only a small percentage found in either the early or late decade of ones existence..

Rothschild (62) states the syndrome is one of youth and early adult life. He states he has seen the condition at practically all ages but with decreasing frequency after 30. It is interesting that Kerly (29) has described the condition in children, and the juvenile cases are identical with those seen in adult life and the soldier.

## SYMPTOMS

In a recent article Whishaw (67) reporting on 130 soldiers with neurocirculatory asthenia, in the present war, lists the following symptoms and percent of occurrence;

Symptom	No. of cases	Percent
Breathlessness on effort.	110	85%
Subjective breathlessness.	60	46
Palpitation.	101	78
Pain in left side of chest.	100	77
Substernal pain.	15	12
Nervous symptoms.	111	85
Exhaustion.	81	62
Giddiness or faintness.	101	78
Sweating.	49	38

It is the concensus of opinion by the majority of students on this subject, that the fore mentioned symptoms are present and in more or less about the same percentage of cases.

Craig and White (16) in an analysis of 100 cases of neurocirculatory asthenia list the chief symptoms as palpitation, shortness of breath, precordial pain or discomfort and exhaustion.

Da Costa's first description of these patients was so thorough that only modifications of the symptoms as described by him have been added. True the original symptoms

have been elaborated on and the order of their occurrence changed to some extent. Nevertheless, the essence and significance of the symptoms, as described by him in 1871, serve as a basis of the cardinal symptoms, as we know them today.

Da Costa gave the following symptoms. (17 )

1. Palpitation - Varies a great deal. Usually comes on following exertion, but not always and in some cases the attacks lasted several hours, very often accompanied with pain. Fits of palpitation were not only associated with cardiac uneasiness and pain, but in some with headache dimness of vision and giddiness. As a rule, the patient could not lie on his left side for fear of exciting fits of palpitation.

2. Pain - Cardiac or precordial pain was almost a constant symptom. "I cannot recall a single well-marked instance of the complaint in which it was wholly absent; and often it was the first sign of disorder noticed by the patient". It was generally described as occurring in paroxysms and as sharp and lancinating, or as sharp and burning.

3. Respiration - Shortness of breath or rather oppression on exertion was constantly complained of, and was a prominent symptom during attacks of palpitation. He found that increased action of the heart did not give

rise to increased frequency of breathing.

4. Nervous Disorders - Manifested themselves chiefly by headache, giddiness, disturbed sleep, and other symptoms which, though common, are not so constant as the ones mentioned.

5. Digestive Disorders - Were frequent and all kinds of indigestion, abdominal distention and diarrhea were symptoms encountered. Da Costa thought that these were symptoms having reference rather to the causation of the cardiac trouble than due to this.

6. Disturbance of the sympathetic nervous system as shown by the presence in some cases of itching of the skin with excessive perspiration and sweating of the hands.

On further discussion it will be seen that these have been additions and some modification to these symptoms so adequately described by Da Costa.

#### Palpitation:

White (68) in his book on diseases of the heart believes that palpitation is for the most part but the keen consciousness of the forceful action of the heart beating rapidly. Meakins and Gunson (45) have clearly established its relation to excessive heart-rate in patients in whom it is provoked by exercise; for it is no longer felt after the rate has declined to a certain point. When

, the decline is gradual palpitation disappears gradually; when, as may happen, there is an abrupt decline of pulse rate, there is a simultaneous and abrupt relief from the sensation.

Lewis (33) (32) thinks it is due sometimes to the presence of premature contractions (or extra-systoles) which give rise to simple intermittences or simple groupings of the pulse-beats. The symptom complained of by the patient is an occasional uncomfortable feeling in the chest, as though the heart had turned over or thumped against the chest wall. This form of palpitation is experienced mainly during rest after exercise and disappears during exercise.

#### Pain:

Friedlander and Freyhof (23) consider pain as the most common symptom. This is not agreed on by the majority of writers, however it must be present in about three-fourths of the patients.

This pain varies in character, distribution and severity. At rest these patients rarely have pain, although many note a soreness over the precordial region. After exercise or exertion a sense of uneasiness over the precordium to an actual ache may be experienced. Not uncommonly it may radiate, spreading over a wide area of the left chest, into the neck and down the inner surface

of the left arm and rarely is it rhythmic and synchronous with the heart beat.

Meakins and Gunson in a series of 100 cases found hyperalgesia over areas of the left chest in 48% of the patients. (46) The area of hyperalgesia is inconstant. In 19 of these cases, hyperalgesia was found in a single rib-space, in five in two spaces, in fifteen over three-five spaces, in nine over the greater part of the left chest. They found that infections exercise a striking influence on precordial pain and hyperalgesia. The latter were more marked during the progress of an infectious disease, sometimes dating from it. The prognosis of the patient with an area of hyperalgesia was not as good as the patient without in regard to returning to active duty.

Murray (48) believes this cardiac pain whether accompanied by hyperesthesia or not is merely the distress signal of an organ compelled to work in spite of a food supply, at least altered chemically. For it has been shown that the reserve power of the heart is enormous and is dependent almost entirely upon its nutrition. In these cases of Meakins (46) with hyperesthesia, two cases with a known toxic factor support this. In both of these cases with the cure of the primary condition and the disappearance of the toxin, not only the local

but also the precordial hyperaesthesia disappeared.

Breathlessness:

This symptom is almost a constant complaint. At rest the respiratory rate is normal or slightly above and during sleep the rate is normal. The response of the respiratory rate to physical exercise or emotional strain is aggravated, rising at times to 60-70 per minute. At times, rates of 200 are seen, the shallow, rapid, hysterical breathing. (62)

The response of the respiratory rate to exercise is a very exaggerated one, and as a consequence it is usually somewhat raised, 25-30, in men who are up and about, but not exercising to any extent. Walking up several flights of stairs raises the respiratory rate in normal subjects a few cycles per minute, or there may be no alteration of rate, but merely some exaggeration of the depth of breathing. In patients after similar exercise the rate often rises from 40 to 70 per minute. (33) The accessory muscles of respiration are called into play, the expression becomes anxious and there is actual distress. After such a test exercise, and after a considerable rise of respiratory rate, the return to the pre-exercise rate may take ten minutes or more.

Breathlessness may arise from any one of a number of causes, some of which are mechanical and apparent,



while others are more obscure. The immediate stimulus to the respiratory center is in most cases a chemical one, namely a relative acidity of the blood flowing to the respiratory center.

Lewis working in conjunction with several other workers believed breathlessness in patients with neuro-circulatory asthenia was due primarily to a diminution of the buffer salts in the blood. (39) That the natural liberation of acid as  $\text{CO}_2$  produces an undue change in the reaction of the blood to the acid side and a corresponding stimulation of the respiratory center.

Kerr and his colleagues (30) found that disorders of breathing are often found in anxious subjects and that symptoms common to neurocirculatory asthenia resulted from over breathing in association with anxiety states. Then Sargent (63) found in certain subjects anxiety causes respiratory disturbances which may result in hyperventilation.

White and Hahn (71) found that 80% of 100 patients suffering from effort syndrome sighed excessively whereas only 19% of 400 normal controls showed the same phenomenon. However it was Maytum and Willins (43) who were the first to recognize the relation of hyperventilation to the symptoms described.

Soley and Shock (64) by a series of complicated

experiments came to the conclusion that the respiratory alkalosis resulting from hyperventilation produces the symptoms of neurocirculatory asthenia.

#### Fainting and Giddiness:

Giddiness and dizziness are symptoms present at some time in practically every case. It is noticed especially on getting out of bed in the morning or in changing to the upright position. Emotional or physical effort may aggravate these symptoms. There is a general unsteadiness with inability to focus the attention and to perform coordinate acts. As the day goes, these symptoms may improve. (62)

Fainting, with or without complete loss of consciousness is a very prominent symptom. It may be the first symptom which the patient can remember, it may have occurred on a single occasion or may have been repeated at intervals of weeks or months.

The provocative cause of this fainting is unknown (33)  
(32) The soldier falls while standing still or while walking quietly and unalarmed. In other instances sudden alarm, as by machine-gun or shell fire or slighter stimuli, has been responsible. In a few cases it has occurred during or immediately after an inoculation.

Rothschild (62) found in the examination of 4,217 men of the draft age, about 3% were rejected by the cardio-

vascular board, and 75% of these rejections, or 108 men for neurocirculatory asthenia. Fifty-three of these men gave a definite history of fainting, fifteen actually fainted during the course of the examination.

In most of the cases some premonitory signs and symptoms are observed, such as a feeling of uneasiness and restlessness, a feeling of coldness with sweating, especially on the forehead. Then dizziness or vertigo follows, at which time the patient responds slowly to questions, the pallor increases, the sweating becomes generalized, and the patient falls with a loss of consciousness.

#### Fatigue and Exhaustion:

Fatigue and lassitude even up to exhaustion, are present in practically every case. (62) The fatigue is usually more pronounced in the earlier part of the day, and may be much less as the day goes on. The inability to get going in the early forenoon is a chief source of annoyance. Neuhof (51) made a study of the early exhaustibility of fifty cases. He found that the amount of work which they could do without exhaustion was distinctly below normal. Hick (27) believes the anoxemia, previously mentioned in these patients, probably contributed to the fatigue and exhaustion of them.

#### Sweating, ~~salivation~~ and flushing:

Excessive sweating in patients is frequent and at times leads to complaint. It is frequently noticed in the palms of the hand and feet while the patients are at rest. Even on the coldest days sweating from the axillae may be noticed. Easy exercise or emotion may produce conspicuous sweating of the forehead and body. (32)

Salivation, judged from the rate of swallowing while at rest, also appears to be increased amongst them. (32)

Cotton and his co-workers (13) working with pilocarpine found sweating and salivation more prominent in patients than in controls after injection of the drug. They concluded that this difference in activity of these glands in patients and controls is to be explained as one of hyperexcitability of the peripheral mechanism rather than of the central nervous mechanism.

In many patients flushing is easily provoked by relatively slight causes. Cotton using the drug amyl nitrite investigated this phenomenon. (11) Amyl nitrite is supposed to exert its chief action directly upon the small vessels; a heightened reaction to amyl nitrite therefore would point to a sensitiveness of the vessels. Observations showed an inconspicuous increased reaction in the abnormal subjects. In these the suffusion of the skin, the rise of pulse rate and the fall of blood pressure are on the whole greater. The difference in reaction

however was less than they had anticipated.

Fraser and Wilson (22) have compared cases of neuro-circulatory asthenia and healthy subjects in respect to their reaction to adrenalin and apocodeine. In the case of each drug minute doses produced a greater action in the patients than in the controls. They concluded that the sympathetic system of nerve fibers, using the term in its physiological rather than in its anatomical sense, is relatively unstable in that it appears to be more susceptible to the stimulating and depressing influences respectively of these drugs.

Miscellaneous nervous symptoms:

Many other nervous and mental symptoms are present and sometimes dominate the picture. (62) Tremor is very common, it is a coarser shake than seen in Graves disease and is exaggerated by effort. Sometimes there may be a general ataxia for all finer movements.

Headache, especially in the morning, is common. Sleeplessness and bad dreams are frequent complaints. Inability to fix the attention for long periods often interferes with work. The reflexes are somewhat exaggerated and there is usually a general myotonic irritability.

## PHYSICAL SIGNS

Heart - rate.

Of all the signs and symptoms, that which is most constantly complained of and which serves to classify the cases is that of tachycardia. The heart rate may vary from 88 to 200. ( 6 )

Lewis (32) found that when the patients were completely rested the average heart rate would be about 85 per minute and that the rate would be normal in sleep. In patients that were up and around, the average rate would be higher being from 90 to 100 per minute. Concluding from this Lewis states, that the nearer the patients were to complete rest, the closer to normal would be their heart beat. On exercise he found that the average heart rate of the patients would be from 20 to 30 beats higher than the control when only about one-fourth to one-sixth the amount of work was done. He also noted that it took the patients a much longer time to again get back to normal.

Roby and Boas (61) working together brought out more emphatically the findings of Lewis. In all their cases the pulse rate was taken every day before the exercise, immediately afterwards, and two to four minutes after. Usually the pulse rate was accelerated out of all

proportion to the exercise, and does not drop to normal in four, or even ten minutes. However, at times they found that the pulse would become slower after exercise, or that it might first slow then become rapid.

Cotton, working in association with Wilson, (10) noted the following response to a given amount of work.

1. The pulse rate rises much higher than in controls and the high rate is longer sustained.

2. The blood pressure rises higher and the raised pressure is longer sustained than in controls.

3. The summit of the blood pressure is not delayed.

Meakin and Gunson (45) found that the pulse rate varies out of proportion to the extent of the exercise. The exercise consisted of allowing the patients and the controls to walk 75 paces and then climb up 27 steps. Their observations on 52 cases showed that the pulse rate increased to an average of 132 per minute immediately after exercise and that the pulse rate of thirty cases returned to their previous normal in one minute and the others it took more than a minute. These men noted that the degree of effort in response to exercise was greater in those patients whose pulse rate did not return to normal within a minute.

..... Parkinson made the same observations by recording the pulse rate on standing and on slight exertion. (55)

He found that an increase in pulse rate of ten was registered by the controls when they moved from a sitting to a standing position and an increase of sixteen occurred when the patients went through the same procedure. On exertion the control showed an increase of eleven over the number registered when standing. Whereas the patient showed an increase of seventeen over the former position. A longer period elapsed before the normal rate was retained by the patient than by the control.

Cotton, Rapport and Lewis (12) gave atropine to patients and controls before test exercises. They found that the effect of atropine upon the heart-rate in a patient and control is identical in its degree. They concluded that vagal tone is unaltered and that a reduction of vagal tone is not responsible for raised cardiac rate in these patients. This increased rate they thought was conditioned by the hyper-irritability of some portion of the system which includes the accelerator reflex arc.

#### Blood Pressure:

Blood pressure is another variable sign in these cases of neurocirculatory asthenia as shown by Roby and Boas and others. These two men in their study of the blood pressure of some four hundred and sixty-five cases of neuro-circulatory patients in the period during and



following the World War found that when the patient is up and about the systolic blood pressure is high, usually between 135 and 170. The diastolic pressure is generally normal. After exercise, however, the systolic pressure rises greatly and the diastolic drops. According to these men a frequent feature is the persistence and loudness of the fourth sound heard with stethoscope when taking the blood pressure. Often a loud fourth sound can be heard down to the zero mark, and as a result makes the estimation of the diastolic pressure difficult at times. (61) and (18).

Barringer in his study of these patients in 1918 (3) noted that by means of blood pressure readings taken thirty, sixty, and ninety seconds after a measured exercise that when the exercise overtakes the reserve power of the heart there is a delay in rise of the systolic pressure after the exercise. Rapport, therefore, concluded that patients with effort syndrome have a decrease in cardiac reserve power. (59) As an illustration Barringer (3) gave the following figures:

Case - Blood pressure after rest.      Pressure after 100 hops.

	Systolic	Diastolic	Systolic	Diastolic
10	155	90	175	70
16	135	65	165	
17	145	65	185	
43	150	90	170	78
	140	85	154	0

Case - Blood pressure after rest. Pressure after 100 hops.

	Systolic	Diastolic	Systolic	Diastolic
45	140	80	184	0
61	154	100	165	70
62	120	80	138	60

Lewis (33) concluded the maximal systolic blood pressure reached after the cessation of test exercise is, in the average, a measure of the actual distress produced by exercise; in given individuals, however, the relation is to some extent inconstant; the presence of a large rise of blood pressure in a given case may be of value in confirming actual distress an exercise, but the absence of such rise does not preclude actual distress.

#### Cardiac Murmurs:

Neurocirculatory asthenia is the condition most frequently mistaken for mitral insufficiency. The presence of a systolic, apical murmur in about 85% of the cases is largely responsible for this. (62) This high percent of murmurs as given by Rothschild is not confirmed by other men. Da Costa in his original work (17) states that murmurs obscuring or replacing the cardiac sounds are not as a rule present. However they are met with particularly the systolic murmur chiefly above the apex and not connected with venous hum or other signs significant of functional valvular disease. Lewis found

murmurs present in less than 50% of the cases. (33) (32)  
Out of 462 soldiers he found 266 were entirely free from cardiac murmurs, while 196 presented murmurs at one area or more.

Of 10,000 recruits examined by (Rothschild) (62) 870 of the cases presented systolic murmurs of which only 33 fulfilled the requirements for the diagnosis of mitral valvulitis; that is (1) cardiac hypertrophy, (2) an apical systolic murmur, (3) a definite history of rheumatic fever. Two of the three criteria were considered necessary for the diagnosis of real valvular disease. Conner (9) believes that nine-tenths of all systolic murmurs in young adults, belong to the class of accidental, or so called functional murmurs.

These murmurs may be absent when the heart rate is slow, and appear with increased rate. The characteristics of the murmur may differ in no way, from murmurs heard in rheumatic valvular disease. Its transmission to the left may be as extensive, but usually the murmur is more localized. (62)

Lewis concluded from his vast experience with this condition in the last war (33) that the presence or absence of systolic murmurs is of no value in estimating the soldiers capacity for work. This practical conclusion holds irrespective of the character, conduction or point

of maximal audibility of the murmur in question.

Forcible and Diffuse Apex Beat:

Extension of visible pulsation so that it appears in two or more intercostal spaces is common. It may or may not be associated with increased force of the impulse. It is commonly regarded as a physical sign of dilatation of the heart, as forcible pulsation is regarded as a sign of hypertrophy. But orthodiagraphic examinations in these patients do not reveal enlargement of the heart and as this method is the most accurate there is for estimating the size of the heart in the living subject, it is concluded that extension of the apex beat is not a sign of enlargement in these patients.

Lewis (33) found out of 362 patients, 230 in whom the apex beat was normal, that 142 (61%) returned to duty. Of 86 patients in whom the impulse was diffuse 51 (60%) returned to duty. He concluded that extension of the impulse is without value in an estimate of the soldiers capacity. He also found of 46 patients in whom the thrust was either forcible or forcible and diffuse 20 (43%) returned to duty. Although these last named signs have a certain significance, they are not sufficiently reliable to be used as criteria in estimating fitness, and this conclusion is emphasized by the fact 43% returned to duty. A large number returned in the full duty categories.

### Size of the Heart.

Meakins and Gunion (44) examined fifty unselected patients with neurocirculatory asthenia, orthodiagraphically and x-ray method of precision in defining the outline of the heart in any given plane. Their results were as follows:

1. The heart in cases of so-called irritable heart is on the average somewhat smaller than normal.
2. In cases with diffuse apical impulse no enlargement is shown by the orthodiagraph. On the contrary the average measurement is smaller than normal, in the same proportion as in those who do not exhibit this sign.
3. When such cases rest in bed there is an average increase in the transverse diameter of the heart of 0.7 cm.
4. After strenuous exercise in cases having no material symptoms there is a decrease of one centimeter in the size of the heart, while in cases showing conspicuous symptoms there is, on the average, no appreciable change in the size of the heart.

Since orthodiagraphic examination does not show any enlargement in the size of the heart it is generally accepted as being the case, for the reason that this method is the most accurate means of determining its shape, size and contour.

### Electro-cardiograms.

The electrocardiograph has not revealed anything noteworthy in cases with neurocirculatory asthenia. Prakinson and Druny (56) summarized their work on this as follows:

1. Soldiers who suffer from "irritable heart" do not present heart block with unusual frequency. Even in those who give a history of acute rheumatism. A-V conduction, as tested by the response of the P-R intervals to exercise, shows, a normal reserve.

2. The immediate reaction of the P-R interval to exercise in soldiers suffering from "irritable heart" is a natural shortening. This statement applies both to patients who have been affected by rheumatic fever, and to those in whom the condition "irritable heart" is severe (as judged from persistently high heart rate) and in whom full courses of digitalis are being administered.

### The Blood:

Levy (40) has shown the R.B.C. is higher in patients suffering from N.C.A. than in normal individuals. The average R.B.C. of 15 patients suffering from N.C.A. was 5,837,000 which is quite in excess of anything previously observed in healthy individuals. One-third of the patients had a count of over 6,000,000 and 53% over 5,900,000. Hemoglobin was for the most part below the normal of 100% being 93.4% ranging from 87 to 100%. The average age of

the patients was 28 and there seemed to be no connection with R.B.C. with severity of symptoms. He concluded that it does not appear possible in the present state of our knowledge of the pathology of N.C.A. to suggest the significance of this polyerythrocythemie condition.

Briscoe (4) noted there was a considerable leucocytosis in patients with neurocirculatory asthenia, the degree of which depended on the amount of exercise taken before the count was made. The average count on 34 patients was 12,000 per cmm. while in the controls it was 7,400. To show the response of the white count to exercise in patients and controls she give the following figures:

	Thirteen patients	Seven controls
Before exercise	11,535	7,100
After exercise	15,400	8,200
One hour later	11,150	7,457

The differential count showed a greater variation in patients than in controls and a high lymphocyte count is common. A lymphocytosis is a feature of the cases.

From the bacteriological standpoint Mrs. Briscoe (4) ran blood cultures on 43 cases and was able to get no positive growth. From these series of experiments she was able to conclude that bacteriaemia does not play a demonstrable part in the pathology of the disease.

#### The Urine:

Dymond (33) found the quantity of the urine as

compared to the normal is reduced by 20 to 60%. The urine may be of two types. In 60% of the cases the urine gives a highly increased titration acidity and the ammonia is increased. In 20% the urine deposits phosphates on cooling. Ammonia in this type is normal in amount but amino-acids account for 30 to 50% of it. Spermatozoa are found in large numbers in the morning urines in 15% of cases.

He found in control subjects the acidity of the urine immediately after exercise is unchanged and one to one and a half hours later the titration acidity is somewhat increased. In the patients the acidity falls immediately after exercise, while one to one and a half hours later there is a great rise of acidity; a rise out of all proportion to that found in controls.



## DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

Neurocirculatory asthenia is quite easy to diagnose if certain limitations are kept in mind. The symptoms and physical signs are extremely important, the history of the patient should be studied in detail if there is any indication that this symptom complex is present.

Conner (9) points out that all the experience of the army heart examinations has shown the great danger, even with experienced examiners of mistaking this condition for some organic disease of the heart. He found that this symptom complex was very apt to be diagnosed as either myocarditis, mitral insufficiency or mitral stenosis. Heart examiners often find it difficult to believe that a soldier, on even moderate exertion, showing such an array of striking symptoms was not suffering from some organic lesion. Certain of the physical signs sometimes bear a close resemblance to those of mitral insufficiency and mitral stenosis. The pronounced and widespread cardiac impulse often suggests cardiac enlargement; the first sound at the apex was usually extremely short and sharp, and the second pulmonary sound often very loud and systolic, accidental murmur was sometimes present. Conner (9) states that a rapid heart rate during rest is very exceptional in the mild forms of mitral stenosis and anything approaching a normal heart rate even

during rest is very unusual in the "soldiers heart". There is also a distinct and unmistakable presystolic murmur in mitral stenosis and should not be diagnosed as such unless distinctly heard.

Because of the systolic murmur so often present in neurocirculatory aēsthenia, it has often been diagnosed as mitral insufficiency. Lewis (32) and others have come to the conclusion that mitral insufficiency cannot be diagnosed only on the grounds of a systolic murmur. Connor (9) again shows that the tachycardia which is so constant and marked a feature of "soldiers heart" is no part of the clinical picture of mitral leakage, and, that the pronounced subjective symptoms so characteristic of our subject are altogether lacking in the valvular cases.

Rothschild (62) believes that the differentiation of the post-infectious type of neurocirculatory from the constitutional variety is of greatest importance. It must be remembered that the constitutional type may be aggravated by acute or chronic infections.

The differentiation of this condition from Graves disease is based on the metabolic rate, on the ocular movements and symptoms, and the differences of the types of tremor. Emotional tachycardia is temporary and gives a normal exercise-response. Often when examining a patient

the pulse will be as high as 110 and upon exercising there will be a drop in the pulse instead of a rise. This is characteristic of the emotional tachycardia.

Rothschild (62) also thinks a more difficult diagnosis is to distinguish the psychoneurotic with emotional tachycardia from the constitutional asthenic individual with a neurosis. Here the help of a psychiatrist is needed. There are many borderline cases. The constitutional asthenic individual has always been so and his neurosis has been added, either in the form of cardiophobia or some other anxiety, or exhaustion neurosis. The psychoneurotic however, refers his symptoms comatically to his heart.

Da Costa (17) states that tuberculosis and irritable heart are mistaken sometimes. However the aspect of the patient, the pain in the precordial region, the attacks of palpitation and the absence of physical signs of tubercle furnish the distinctive traits.

He lastly states it is impossible to discuss any malady to which soldiers are liable without discussing its being feigned. One trick of the soldier was to put a tight bandage around the upper part of his abdomen in order to get a rapid heart action. Da Costa explains that it is quite easy to catch the imposter for he knows nothing of the true symptoms and physical signs.

Lewis (33) found malingering in the sense of simulation of the full symptoms of the malady very rare in soldiers during the World War. The conscious exaggeration of symptoms however was very common.

In the present war, the British Committee of medical examination of Recruits (5) report that examining boards may be able to foretell that certain recruits, by their appearance and demeanour and by the evidence of nervous instability, which is disclosed by their history or on physical examination are prone to "effort syndrome" and are liable to breakdown. They say that habitual avoidance of exertion is particularly suggestive.

## COURSE AND PROGNOSIS

Grant (25) has made the most complete and intensive study of this problem. He followed the after histories of a series of 665 men suffering from this syndrome for a period of five years. The loss to the series during the period amounted to 64 or only 9.6%. The analysis of the after-histories is therefore legitimately confined to the 601 completed cases.

He found of these 601 cases 15.3% recovered entirely, 17.8% improved, 56.2% remained stationary while 3.2% became worse. The incidence of serious disease is 8.7%, the most frequent infection being pulmonary tuberculosis (22 cases). The deaths number 14 or 2.3%. It is found that while the death rate is no more, the incidence of pulmonary tuberculosis is 80%, greater than in the general population of London over the same period.

Analysis of the after histories as regards prognosis shows that the general prognosis alone is to some extent modified by age and tolerance of exercise. The younger the patient and the better his tolerance to exercise, the greater are his chances for recovery. For example, between the ages of 17 to 20, 25% recover and incidence of disease is 2.9%, between the ages of 41 and 50, the figures are 2.1% recover and incidence of disease is 16.7%.

In the series 118 cases or 19.6% had previously suffered from rheumatic fever or chorea, but a history of

these diseases proves to be of no material value prognostically. Prognosis is adversely affected by the presence of certain abnormal physical signs in the chest, particularly with regard to the incidence of pulmonary tuberculosis which is 8.8% as compared with 2.9% in the absence of such signs. It is considered however that the practical importance of these signs lies rather in diagnosis, and that such cases should be treated preferably as cases of actual pulmonary tuberculosis, which in many instances is most probably the unrecognized cause of their symptoms.

From the fact that the incidence of definite cardiac disease for the whole group during the period of 5 years is no more than 1%, it is felt that incipient cardiac disease cannot be regarded as the underlying cause of effort syndrome in anything but a negligible proportion of the cases. It is also found to be no material difference in the development of cardiac disease or in general health between those patients whose cardiac physical signs were normal and those who presented such signs as apical or basal systolic murmurs, a diffuse apex beat or extra-systoles. It is felt that whatever diagnostic significance be attached to these cardiac physical signs, they may be neglected at arriving at a prognosis and their chief value lies in directing attention more closely to the cardio-vascular system for the detection of other and

more definite signs of disease.

Lewis studied the after histories of 104 cases. (34) He found the symptoms changed as follows after discharge from the Army.

Very much improved -	- - -	4
Much improved - - - -	- - -	8
Slightly improved -		30
Unchanged - - - - -	-	56
Slightly worse - - - - -	- - -	4
Decidedly worse - - - - -	- - -	2
Total		104

He concluded (34) the disability of "effort syndrome" cases with fair exercise tolerance may be fairly placed at 20% or less and in those with poor exercise tolerance at 30 to 40%. Exceptionally it may be placed as high as 50% to 60% in cases where development is poor or when a history of rheumatic fever is given. The group showing poor exercise tolerance is the only group which showed, but is not the only group which will come before invaliding and pension boards.

Da Costa (17) investigated and published the results of 200 cases of soldiers who were diagnosed as having "effort syndrome. His results are tabulated.

Results	Cases	<u>Percentage</u>
Returned to regiment	76	38
Detailed for other service	13	5.5

Results	Cases	Percentage
Time expired	11	5.5
Uncertain	63	31.5
Veteran Reserve I	18	9
Veteran Reserve II	5	2.5
Discharged	<u>14</u>	
	Total	200
		100%

The 76 who returned to their regiment did so for the most part only after they had done guard duty for some time, and had been thoroughly tested. The 13 who were detailed for other services as clerks, orderlies etc. were chiefly such who, for some ailment besides the cardiac malady, were judged unfit for field work. Of the 11 whose time expired about one-half would have been sent back to their regiments, and in the same proportions would probably have been the disposition of the 63 marked uncertain results. In the veteran reserve those men who were partly incapacitated were given light work in the garrison but not in the field. While those who were discharged were cases who it was certain would not be of any service to their regiments again.

Da Costa (17) thought this condition may gradually subside or it may pass by degrees of progress into cardiac enlargement. However it has already been shown that it is the opinion of the profession today that organic pathology does not enter into the picture of neurocirculatory



asthenia.

Lewis (36) in an analysis of 558 soldiers with this condition, reported 286 or 51% were found to be unfit for all military service and of the remaining 272, 38 had to be removed later. In civilian life complete incapacity is much less frequent for two reasons, one of which is due to the degree of neurocirculatory which is less marked in civilians, and the other reason is that the strain of civilian life and the work to which the patient must return is less than that of military life.

Lewis (33) also points out that the extension of the cardiac impulse was without value in the prognosis. Out of 230 patients in whom the apex beat was normal, 142 or 61% returned to duty, and of 86 patients in whom the impulse was diffuse, 51 or 60% returned to duty. He showed that out of 46 patients in whom the thrust was either forcible or forcibly a diffuse, 20 or 43% returned to duty. Thus proving that a forcible heart beat in these patients had no prognostic value.

White states that the course of neurocirculatory asthenia is a very variable one, but the prognosis is always good so far as length of life is concerned. The degree of incapacity depends on several factors but chiefly on the intensity of symptoms and adequacy of treatment. Recovery from a considerable degree of neuro-

instability is possible with care, but the patient is always liable to a return of trouble if there is a return of the causative factors. (68)

Ellis and Hamilton (21) in their work found five years after the last war 33% of the patients were improved or well, and only 3.2% had become worse. The condition of the remainder was stationary. This must not be taken for a guide for the prognosis of neurocirculatory asthenia in civil life however. They point out that any familiarity with the severely disabled neurocirculatory asthenia soldiers shows the unfortunate fact they are more secure if they remain disabled. Feeling their inadequacy, they dread to be pronounced well and forced to take care of themselves. Reassurance can have little effect; they think one can only reassure them half-heartedly, for there is no certainty that they will succeed in being well if they try. These men also point out that followups have shown that patients with neurocirculatory asthenia are good life insurance and operative risks as a whole.

## THERAPY AND PROPHYLAXIS

In all diseased conditions the etiological factors largely determine the therapeutic measure. As neuro-circulatory asthenia is not a clinical entity, each case must be thoroughly studied for causative or predisposing factors. The early cases of organic heart disease should be weeded out. It must be remembered that patients with constitutional inferiority may develop any disease, such as acute rheumatic fever, tuberculosis etc. The combination of neurocirculatory asthenia and chronic valvular defects is not rare, and is a most difficult therapeutic problem. In general the post-infectious variety is the simplest to treat, it simply needs convalescent care, graduated exercises in the form of play and games, and positive assurance that they have not heart trouble, no valve leaks, no leaking heart, etc. (62)

Lewis and his collaborators (33) (38) found that one of the most successful methods of treatment used in the army in the last war was that of graded exercise. These exercises were used both as an aid to categorization and as a therapeutic measure.

Upon arrival at the hospital, these cardiac patients are immediately examined and those who have unquestionable organic disease of the heart or blood vessels, pulmonary tuberculosis or who for other reasons are obviously unfit

for military duty are recommended for permanent discharge from the army. The group which remains is made up principally of cases of N.C.A., but also includes a small number of cases of doubtful valvular lesions and of questionable cardiac hypertrophy. All of these men are then placed at once on a system of graduated exercises. Experience has shown that in the doubtful cases of organic disease the tolerance of these exercises is the best single criterion by which to determine the final disposition of the case.

They used routine British army drills with such alterations as would allow for gradation in duration and intensity. There are five different drills of gradually increasing severity, the first two are 15 minute exercises and the last three are 30 minute exercises. The longer drills are supplemented by afternoon route marches of two to four miles without pack. Five drills and four marches are given each week. A chart is kept for each patient upon which is recorded the presence or absence of such symptoms as dyspnea, precordial pain, vertigo, weakness and palpitation. More attention is paid to the objective signs than to the subjective symptoms, and complaints are not encouraged. The patients however soon become aware that they are classified largely on exercise tests, and consequently symptoms are always to

be accepted with reserve. It is found better to privilege men on the higher exercises and route marches.

When the patients tolerance to exercise has been definitely determined and no improvement is to be expected the patient is ready for final categorization and discharge. The tolerance to exercise is the most important guide in the final decision, but consideration must be given to facts elicited in the past history and by physical examination.

The patients who tolerate the highest grade of exercises well and perform the route marches without distress are discharged in category, as fit for full service. Patients who can do the higher exercises but cannot do them quite so well are discharged in category 2, as fit for further service in light or full duty categories after subsequent hardening at a command depot. When the lighter exercises only are tolerated, the patient is discharged in category 3, as fit for light or sedentary military employment at home. Cases showing a still lower exercise tolerance are discharged from the army as permanently unfit.

By the use of this system Lewis and his workers reduced the average hospital stay 50%, and the stay is actually six to seven weeks. As far as they knew, no injury had been done by these exercises even in the most

severe cases of neurocirculatory asthenia.

Lewis points out (35) the value of general hygiene, of congenial surroundings, of the moral support and constant encouragement of the medical staff.

Wolverton points out the value of psychotherapy in these patients. (73) Having satisfied himself that no organic heart disease exists, he says the physician must convince the patient beyond question that this is true. His method is to explain to the patient that an individual may vary in his sensitiveness to a given stimulus under different conditions. He is told that once he accepted without reservation the belief that his heart is sound his threshold to sensation will return gradually to normal and his symptoms will disappear and that in the interval he must learn to bear any symptoms that occur.

Da Costa (17) advocated bed rest and the use of digitalis in these patients. Further study has shown that these methods have no effect or may be harmful.

Parkinson (54) studied digitalis in full doses that was exhibited in twenty soldiers with cardiac symptoms and a frequent pulse. The heart rhythm was normal. The rate of the heart was reduced but little, the increase in rate produced by standing and by exertion was not controlled to any appreciable extent. The systolic

and diastolic blood pressure was unaffected. Further the degree of breathlessness induced by test exertion was not reduced by the drug. It is concluded that digitalis scarcely influences the group of patients classified as "soldiers heart" or "irritable heart" even when the pulse is frequent, and that it is not indicated in this condition.

Lewis (33) points out it has been his universal experience in the hospital that patients who are tested before and after periods of a week or more of absolute bed rest show greater distress upon exercise after the rest than before it.

Rothschild (62) states that the therapy of the constitutional type of neurocirculatory asthenia is a very complex and difficult problem. Early diagnosis is of extreme importance. Once the patient is given the idea that he has heart disease, it is very difficult to convince him that this is not so. The patient must be convinced he has no heart trouble. His exercise tolerance must be tested and can be improved by graduated work or games. He must be made to exercise. Over-fatigue should be prevented. Gradually he can be trained by various hydro-therapeutic procedures to stand cold. He should be taught proper posture and breathing exercises. Games and sports should be encouraged. Morning setting-up

exercises followed by a cold rub and then a bath or shower gets these patients going and prevents much of the dizziness and morning fatigue. The assistance and cooperation of a psychologist is important. One must gain their confidence and explain the various symptoms.

Crile (15) reasoning that the energy controlling system the brain, thyroid and adrenal sympathetic complex is the only mechanism by which the emotions are expressed, thought in those cases resistant to medical management, he might effect a cure by breaking this circuit of the energy-controlling system. He found out of 114 cases of neurocirculatory asthenia treated by adrenal denervation and followed up, in 107 cases or 93.86% the condition was cured or improved. Failure resulted in only 7 cases or 6.14%. Adrenalectomy (unilateral) did not prove as effective as bilateral denervations of the adrenal glands. These results are not as effective as those followingeliac ganglionectomy. Out of 13 cases, 12 were cured or improved, that is 92% and only 1 failure.

Lewis (35) from his vast field of experience suggested the following to limit this disorder in a prophylactic, was:

1. Measures be taken for the early recognition of cases of N.C.A. when the men are called to service and



at the training camps.

2. Men who are seen to flag or show signs of breathlessness by their drill instructors should be reported to the medical officer and thoroughly overhauled from the point of view of this syndrome at an early date.

3. The period of convalescence after infectious diseases be made sufficiently long, and after complete recovery, the soldiers be gradually hardened before returning to full duty.

Moon (47) warns that medical labels are had for soldiers and perhaps for other people, too, while nothing is more unwise than a false precision. Medical officers are often much hampered by the rigidity of the official nomenclature of disease which tends to impress the soldier too much with the name of his complaint to which he clings with a pathetic persistence. Also it leads to that "education of disease" so strongly deprecated by Plato in the Republic.

## CONCLUSION

In this brief paper I have attempted to point out the mile stones in the history of this subject. Da Costa first defined it during the Civil War. Little was understood or little done about his observations until the World War. At this time the British Army became so crippled from the condition that they were forced into intense study regarding all phases of it. Our Army, quick to learn its lesson from the British, was fairly successful in keeping it from the ranks of the first A.E.F.

Neurocirculatory Asthenia or as the British call it, "effort syndrome" is a symptom complex and not in itself a clinical entity. There are very definite symptoms and physical signs, the cardinal of which are shortness of breath, palpitation, precordial pain, exhaustion and tachycardia. From these, the diagnosis is relatively easy to make.

From an etiological standpoint the precise mechanism by which this syndrome is brought about is unknown. Psycho-neurotic factors often found in the patients history must play a big part and a large per cent are constitutionally inadequate. The rigor of war, fright, shock, infections and unfamiliar military strain, play decided roles as exciting causes to neurocirculatory asthenia in the soldier.

In this present War and the so called War of Nerves

not only the soldiers in the field are put under terrific abnormal strains but also the civilians of whole countries. From what we know of the etiological factors at the present time we should expect a much higher incidence of Neuro-circulatory Asthenia during this present crisis.

Now at the present time when this country is raising the largest army in its history it is necessary for the Military Doctor to understand and appreciate this condition. From an economical and a military standpoint it is extremely important to keep those prone to this malady from entering this modern army. The old saying "an ounce of prevention is worth a pound of cure" is very applicable to neurocirculatory asthenia, for with proper examination this condition can be held to a minimum in the army.

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