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Vol. XVI.

JANUARY 1947.

No. 1.

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(Established 1932.)

VOL. XVI

JANUARY 1947

NO. 1

EXTRA SYSTOLES THEIR CLINICAL ASPECT AND TREATMENT.*

BY A. KARMALLY, M.B., M.R.C.P.,

Honorary Physician, J. J. Hospital, Bombay.

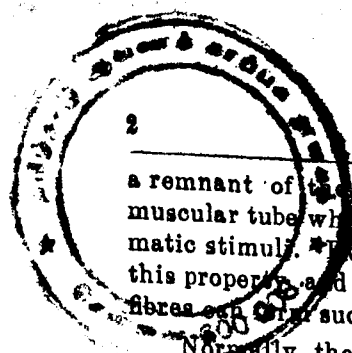
Lecturer in Medicine, Grant Medical College, Bombay.

I have selected this subject for today's lecture because of certain considerations. Extra systoles are of common occurrence and constitute a large majority of the cardiac irregularities met with in clinical practice. They are more common in general practice than in hospital practice. A general practitioner frequently meets with them and finds difficulty in diagnosing this condition. I have heard this condition referred to as an irregular pulse (without the irregularity being defined), or as a pulse that comes fast and slow, or as a pulse which has got pauses suggestive of heart block. Further this irregularity occurs more often in healthy hearts and if its significance is not understood it may lead to a diagnosis of cardiac disease with a resulting cardiac invalidism. Lastly the appropriate treatment and advice needs the appreciation of conditions producing these extra systoles.

Extra systoles in clinical practice were first described by Wenkebach. As the name indicates it suggests an extra or additional contraction of the heart. They are not strictly speaking extra contractions of the heart, as the following normal sinus beat is unable to evoke a contraction of the heart, being in the refractory period of the extra systolic beat. The extra systole with the previous beat and the following beat equals to the time taken by two normal beats and thus no additional beat has occurred. Only in exceptional cases, where the cardiac rhythm is very slow an additional contraction may occur between two normal beats when it strictly constitutes an extra systole. Such extra systoles are known as interpolated.

In order to produce an extra systole there are two conditions to be satisfied. The muscle must not be in the refractory state and at the same time there must be another focus of impulse formation which is more dominating than the sinoauricular node. Normally the regular rhythmic cardiac action is due to regular formation of stimuli in the sinoauricular node which spread along the conducting mechanism and produce contractions. The conducting mechanism,

*Being a lecture delivered to the Post Graduates on 28th in November, 1946, at J. J. Hospital, Bombay.



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a remnant of the primitive tube, is a highly specialised neuro-muscular tube which has the important property of producing automatic stimuli. Every specific fibre of the heart is endowed with this property and it is not yet known whether cardiac muscle fibres are of such rhythmic stimuli.

Normally, the impulse starts at the sino-auricular node, the pacemaker of Lewis, and the other centres are silent and inactive. This is explained by the fact that the fibres located nearer the apex have less developed power of automatic stimuli production and slower they work. The sino-auricular node has the property of producing stimuli at a higher rate than other slow working centres and thus prevents the stimuli of slow working centres from appearing.

If for some reason or other a specific fibre becomes so altered and produces a stimulation above the threshold it may evoke a ventricular contraction. As the extra systole is produced away from the normal seat of origin it is also known as an ectopic beat. This name has the advantage of indicating the seat of origin. As this extra systole occurs earlier in time very near to the preceding beat, it is said to be premature, giving rise to a premature contraction. The prematurity, as shown by its linking to the previous beat is a very important diagnostic feature. It is shown by its very nearness to the preceding beat. It is followed by a compensatory pause due to the inability of the normal succeeding beat to evoke a contraction owing to the heart being in a refractory state. An extra systole may be called a premature beat, or an ectopic beat; the latter two designations have the advantage of at least indicating their important characteristics.

Symptoms & Signs:—

Extra systoles, by themselves, may produce no symptoms. They may be a chance discovery during a medical examination for fitness, or during an insurance examination.

With some these may produce definite symptoms which are described by the patients in various ways. Here I might draw your attention to the important symptom of palpitation. Palpitation or consciousness of the beating of the heart is a symptom which may be used to describe various sensations of the beating of the heart. To some it may mean consciousness of the beating of the heart associated with or without rapid action of the heart. To others it may mean an abnormal beating of the heart. It is advisable to inquire of the patients what they mean by palpitation. Some of the patients suffering from extra systoles may describe the palpitation in various ways. Some may say the heart is stopping or turning over itself or are worried or are frightened by the powerful thumping beat which follows a pause. These symptoms may occur when the patient is retiring to bed when due to silence and the slow rate

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of the heart they become more prominent. Some may interpret the uncomfortable sensations as pains in the chest and they may be interpreted as anginoid pains.

The signs produced by an extra systole are those that are produced in the pulse and in the heart. The clinical manifestations of the pulse may show many variations. It depends upon the time of occurrence of an extra systole, if the extra systole occurs in the early diastolic period of the heart when the heart is empty, the contraction will result in no cardiac output with no opening of the semilunar valves; with the result that no pulse is felt at the wrist giving rise to a missed beat producing an intermittant pulse. If it occurs during the latter half of the diastole when there is some blood in the ventricles, it will open the valves and result in a pulse giving rise to an early premature beat at the pulse. The opening of the semilunar valves will give rise to two sharp sounds after those of a normal beat and when the valves do not open a single sound due to ventricular contraction follows the normal sounds. Therefore on simultaneous auscultation of the heart and palpation of the pulse one may find that during the pause in the pulse, we hear one sound linked to the previous two normal sounds, whilst during the premature beat at the wrist we hear two short sounds following immediately the two sounds of the normal preceding beat. The intensity of these sounds is less than the normal beat. Thus it can be differentiated from a missed beat due to a partial heart block in which condition there occurs a silence at the heart during the missed beat at the pulse.

Here I may point out that the diagnosis of the prematurity of the beat is easier by auscultation of the heart than by palpation of the pulse. The abnormal beat is relatively late in appearance in the pulse cycle at the wrist than at the heart. A weak beat travels more slowly along the arteries than does a normal strong beat. Therefore it may not be noted on palpation as premature very easily. When no beat is produced at the wrist, the resulting long pause may then be wrongly interpreted as a partial heart block or to sinus bradycardia rather than to the actual premature beat irregularity.

Another interesting feature of the pulse that one may come across is the presence of extra systole occurring after every normal beat. These are called alternate extra systoles. If these alternate systoles occur in the earlier part of the diastolic period without resulting in a pulse one may find a very slow rhythm of the heart which may be suggestive of heartblock. I have seen the diagnosis of heartblock made in these cases. But the clinical diagnosis is very easy if one does not rely merely on examination of the pulse without at the same time auscultating the heart. I would like to

draw your attention here to the advantage of counting the heart-rate by auscultation. The common practice of counting the heart-rate at the pulse should be, if not substituted, checked by counting the apex rate and, especially in the presence of an irregular pulse. It would help to diagnose such conditions. Bradycardia due to alternate extra systoles will have an apex rate which often is double the pulse rate and which will show the characteristic triple or quadruple rhythm of the heart due to sound produced during the extra systolic contraction. I have the notes of a case which came to my outpatient who had this quadruple rhythm associated with bradycardia. The rate was 92 at the apex and 46 at the wrist. I took a pulse tracing of this patient. It showed a definite feeble wave following each normal pulse wave suggesting thereby that our palpatory method is not well developed to detect slight changes in the vessel wall. This man had a feeble extra systolic pulse which by our clinical methods we were unable to palpate. The simultaneous auscultation of the heart gave the clue.

I once more emphasise that diagnosis of extra systole by palpation is a less satisfactory method than auscultation.

If the alterate premature beat is felt at the wrist, we may get coupling of the beats called Pulsus Bigeminus.

Other types of pulse which may occur at the wrist in addition to bigeminal pulse, are pulse trigeminus or quadrageminus, depending upon the time of occurrence of extra systoles. Showers of extra systoles may produce marked irregularity of the pulse simulating auricular fibrillation which can be differentiated by the exercise test where the extra systoles disappear and the pulse becomes regular.

The effect of exercise is to increase the rate which tends to diminish the diastolic period. Hence it gives no opportunity for extra systoles to find a responsive state. Exercise thus constitutes a test by which one can differentiate extra systoles from other irregularities specially partial heart block in which condition on exercise the intermittance due to heart block persists whilst due to extra systoles disappear. If exercise is not feasible, other methods of increasing the heart rate are: injections of atrophine or inhalation of amyl-nitrite.

Cause:

What actually causes these extra systoles is not known. Physico-chemical processes which occur at the site of impulse formation are not understood. But there are predisposing conditions or certain occasions when these extra systoles are more prone to occur. They have been produced artificially by electrical stimulation in animals and recently at operations where hearts were exposed. They may occur during inspiration or expiration, after worry, anxiety, emotion or on changing posture, or on holding the

breath. They may be associated with constipation, meteorism or with a high diaphragm as met with in the last months of pregnancy, obesity or after large meals. They may occur as a result of infections or due to the toxic effects of certain drugs. Three important types of drugs produce extra systoles—1. Intravenous adrenaline, (2) Nicotine—nicotine of tobacco may give rise to extra systoles and I know a colleague of mine who would on smoking a cigarette evoke a number of extra systoles (3) Digitalis, an important drug in the use of cardiac disease produces extra systoles and helps also at times to abolish extra systoles. It is a double edged weapon. It is interesting to note the relation of extra systoles to digitalis. It is said that digitalis does not produce extra systoles in therapeutic doses in healthy hearts. If during digitalis administration extra systoles appear it may imply that the heart is not healthy. It is one of the signs of digitalis intoxication and specially when bigeminal rhythm occurs. Pulse bigeminus or the coupling of the pulse is well known as a sign of digitalis intoxication. It is said when these signs of intoxication appear it is an indication that digitalis has been given upto 75 per cent of the lethal dose.

In extra systoles of digitalis intoxication one must stop the administration of digitalis. In certain cases of congestive cardiac failure as a result of accumulation of metabolic products of oxygen deficiency, extra systoles may appear and it is to this type of extra systole that I wish to particularly refer. Digitalis administration by improving the myocardial state will remove these extra systoles. In a case of hypertensive left ventricular failure, digitalis had been stopped for 6 weeks with the result that the patient was having attacks of cardiac asthma with irregular pulse due to extra systoles. Digitalis had been purposely avoided because of the presence of the extra systoles, and of a fear of increasing them. On giving digitalis the pulse became regular. In these types of extra systoles of congestive cardiac failure, digitalis is the drug which will help to improve the condition and remove these extra systoles. In other words, digitalis is indicated in cases of extra systoles in the course of congestive heart failure, but when there is the slightest doubt that digitalis has produced extra systoles one may proceed with caution with further administration of digitalis.

Significance:

It has been said that extra systoles are merely "harmless nonsense of the heart" (Wenkebach). Some times they may be the first sign of serious disease. Extra systoles may occur in the auricles or in the auriculo-ventricular node or ventricles. It is very difficult to disagree the seat of origin clinically though some people stress the importance of the length of the compensatory pause to differentiate the auricular from the ventricular variety. The compensatory pause in the ventricular variety is longer and

the extra systole with its proceeding and following beat equals the time taken by two normal beats. In the auricular it takes lesser time. Clinically it is a difficult matter to detect the site, for which an electrocardiogram is necessary. Of the sites ventricular extra systoles are much more common than auricular, and the right ventricular extra systoles are much more common than the left. The right ventricular extra systole is the commonest type which occurs especially in the healthy heart. Extra systole occurs more commonly in a healthy heart than in a diseased heart but in the latter they are easily provoked. It is important to know the seat as it may sometimes help us to detect certain complications.

In the course of a case of rheumatic mitral stenosis the presence of auricular extra systoles may be the precursor of auricular fibrillation or in the course of coronary disease, left ventricular extra systoles may indicate ominous significance.

An occasional extra systole by itself does not produce any marked change in the cardiac dynamics. During the extra systole the cardiac output is diminished but the succeeding long compensatory pause throws out a larger amount of blood and does not produce any change in the cardiac output per minute. Thus by itself extra systole occurring in a completely healthy heart has no significance. It carries the prognosis of the underlying cardiac disease. If the heart is perfectly healthy extra systoles have no significance whilst in diseased heart the prognosis of the underlying condition is the concern. Extra systoles occur at every age and in all persons. They are rarely found in young children, but are more common in later stages of life. They may occur temporarily for seconds, minutes, or days, or they may be present off and on. No doubt a careful and complete cardiovascular examinations is the important consideration in assessing the significance of extra systoles.

Treatment:

When the underlying cause is detected for example, tobacco, digitalis intoxication, infections, congestive cardiac failure, appropriate treatment of the underlying cause is necessary. But sometimes it may happen that the clinical manifestations of extra systoles in healthy heart may be so disconcerting and discomforting that we must adopt measures to allay the fears of the patient. To start with, patient must be taken into confidence and assured that his heart is perfectly healthy and advised to go about as a normal person without any restriction of his activities. An assurance after a thorough medical examination goes a great way in relieving the anxiety of the patient. This may be helped by giving sedation as luminal or triple bromides which may help to diminish the sensitivity.

The correction of constipation, meteorism and administration of small meals may help to diminish the number. Digitalis is indicated in extra systoles in the course of congestive cardiac failure. Potassium acetate in large doses 30 grs. 4 hourly has been found useful in diminishing the extra systoles of digitalis intoxication. This drug is not well tolerated and may give rise to nausea, vomiting and diarrhoea. Lastly quinidine may be used. Wenkebach suggested the use of quinidine as he found that extra systoles disappeared whilst treating a malarial patient with quinine. Quinine sulphate may be substituted for quinidine which is not easily available. Quinidine is the better drug but more toxic which can be given alone or with digitalis and with due care. Wenkebach's formula consisted of:

Quinidine Sulphate	60 grs.
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Mft. 100 pills, 2 to 6 pills per day.

I have throughout the lecture avoided reference to an electrocardiographic examination as I intended to stress the clinical aspect. We must be able to diagnose extra systoles at the clinical bed side. An electrocardiographic examination is of importance in excluding any undiscovered symptomless myocardial disease. It helps to determine the site of an extra systole. Extra systoles of digitalis origin may be made out by the different shapes and forms of the complexes in the electrocardiogram suggestive of the presence of multiple foci.

I hope I have been able to impress upon the importance of this condition which one meets with very often in clinical practice.

Extracts.

THE TREATMENT OF SUPPURATIVE OTITIS MEDIA.

BY S. E. BIRDSALL, F.R.C.S.,

The Post-Graduate Medical Journal, May 1946.

Confronted with a patient who has a discharging ear, it is essential to know the origin of the discharge; is the diagnosis one of otitis externa or of otitis media? The distinction may be difficult. The following points may be helpful.

First:—In otitis externa, tenderness is marked, and pain may be slight. In otitis media pain may be very severe, and tenderness of the pinna is invariably absent. Mastoid tenderness may be present in either condition.

Secondly:—The character of the discharge affords valuable evidence. In amount, it is more copious in otitis media. All discharge must first be removed by mopping or syringing. If it rapidly



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re-appears, then we are probably dealing with otitis media, in which the secretion in the meatus is the overflow from an infected cavity lined with mucous membrane. In otitis externa, the secretion and is derived from the skin lining the meatus, and it will not be replaced in a shorter time than an hour. If the discharge contains mucus, then it must come from the middle ear, as there are no mucous glands in any skin. The discharge in otitis externa is often bright yellow, as though stained with flavine.

Thirdly:—The meatus is usually healthy in otitis media. In otitis externa there is usually some stenosis and the meatus may be very narrow owing to swelling of the lining skin, which either itches or is acutely tender.

Fourthly:—In a disease affecting the ear, no examination is complete unless the hearing be tested. It is essential first to clean the meatus of discharge. In otitis externa the hearing will be normal or but slightly diminished. In otitis media there must always be a considerable hearing loss.

THE ORIGIN OF OTORRHOEA.—It is essential to examine the disease from its onset. An acute otitis media leads to an empyema of the middle-ear. The increasing pressure of exudate leads to a bulging of the drum-membrane. At this stage a myringotomy should be performed. It shortens the duration of a painful illness, the membrane heals perfectly, the hearing is restored, and the discharge ceases in from one to ten days. It is very rarely that mastoiditis or chronic otorrhoea follows. Myringotomy at an early date is the most certain preventive measure against chronic otitis media. Failing myringotomy the membrane is spontaneously ruptured by pressure-necrosis, leading to an open fistula. The invariable additional factor leading to chronic otorrhoea is now facilitated—and this factor is secondary infection which is the prime cause of chronicity in all surgical diseases.

FACTORS CONDUCIVE TO SECONDARY INFECTION.—This cardinal factor of secondary infection is now reinforced by the treatment given. The meatus itself is the source of the secondary infection and it is obviously wrong to plug it with cotton-wool. It is also wrong to instil carbolic acid and glycerine, which will produce a chronic dermatitis and which cannot possibly have any therapeutic effect on the underlying middle-ear disease. There is no pyogenic infection in the body in which the application of 4 per cent phenol to the infected tissue would be regarded as anything but malpraxis. The use of hydrogen peroxide is also to be condemned, as it causes maceration of the skin of the deep meatus, and it cannot have any bactericidal value in the middle-ear, which it cannot reach.

RATIONAL TREATMENT.—In a case of acute suppurative otitis media before rupture of the drum-membrane has occurred, we are dealing with a pure infection due to streptococci or pneumococci in

the vast majority of cases. If we can prevent secondary infection, the disease will usually resolve in from one to ten days.

How are we to prevent secondary infection? The obvious answer is to keep the meatus surgically clean. This is done by preventing accumulation of discharge, and maintaining the health of its lining skin. The former is best attained by syringing with a sterile non-irritant fluid, such as biniodide of mercury 1 in 4,000. Mopping with sterile wool is open to the objection that it requires a skilled surgeon, and that even in his hands there is no means of removing secretions pushed in front of his cotton-wool pledget on each application. After the syringing, spirit drops are used at a strength of 25 per cent merely in order to dry the skin surface, and not with the object of killing bacteria.

This treatment should be carried out at least twice daily and the meatus should be left free of any foreign body, however sterile. If in spite of this routine the discharge persists for three weeks, there must be a reason for the persistence.

Persistent otorrhœa.—If a case of acute suppurative otitis media be treated correctly, the discharge should cease within 14 days. If the otorrhœa be unchanged after this period, it is essential to discover the reason. The factor leading to non-resolution is often discovered on careful examination of the drum-membrane. It is often found that the region surrounding the perforation is occupied by a small bright-red polyp, which is a herniation of granulation-tissue or swollen mucous membrane, which acts as a ball-valve and interferes with drainage of mucus from the middle-ear. If this be removed or destroyed by the application of chronic acid on a probe, the otorrhœa may be cured dramatically in one or two days, even in cases where it has resisted treatment for months.

The discharge may be persistent and profuse, and it becomes obvious that its volume is greater than could possibly arise from the mucosa of the middle-ear alone. It is probable in such a case that the mastoid cells are infected and an X-ray examination will confirm the diagnosis. The correct procedure will be to obliterate the infected area by a simple cortical mastoid operation, which should be performed without delay, as it offers the only chance of healing of the drum-membrane and restoration of good or perfect hearing.

Persistent otorrhœa may be caused by an untreated neighbouring infected area, such as an antral empyema, infected adenoids or tonsils, or bad teeth. These must be sought, and, if found, eradicated.

Very rarely indeed, tuberculosis affects the middle-ear and leads to persistent discharge.

Chronic otorrhœa.—In a great number of cases, the institution of rational methods of treatment will have most dramatically favourable results.

It may, however, be impossible to promise a dry ear for this reason. There may be a large perforation which can never heal, much of the drum-membrane having been destroyed. In such a case we are really dealing with a fistula, connecting the naso-pharynx with the exterior, and it is obvious that a fistula leading to a cavity secreting mucus cannot be dry. If we can ensure that the discharge is one of mucus only, we must be content. If the discharge continue purulent and offensive, then we are dealing with an infection that involves not only mucous membrane, but also bone.

A radical mastoid operation will be indicated if the continued purulent discharge indicates a dangerous osteitis. The operation will have as its primary aim the eradication of bone disease that endangers life, and it is important to realise that it is not performed in order to terminate aural discharge.—*General Practitioner.*

PENICILLIN THERAPY COMPARED WITH SULPHONAMIDE THERAPY IN CEREBROSPINAL FEVER.

Vengsarker et al summarising their paper on "Penicillin Therapy Compared with Sulphonamide Therapy in Cerebrospinal Fever" come to the following conclusions:

(1) A series of 70 cases of meningococcal meningitis each were treated with penicillin and with sulphadiazine. The mortality among the penicillin series was 10 per cent and in the sulphadiazine series 4.2 per cent.

(2) No general or local toxic reactions of any significance were noticed in patients in the penicillin group, whereas in one case in the sulphadiazine group there was marked anaemia and granulo-cytopenia which responded to blood transfusion after an apparently ineffective course of liver, nicotinic acid and pentnucleotide.

(3) In both the groups there were a few resistant cases, some of which responded to substitution of the drug with that of the opposite group.

(4) The clinical and cerebrospinal fluid response to penicillin was slower than to sulphadiazine but the latter drug had to be continued in gradually diminishing doses after recovery, in order to prevent the cases passing into relapse or into chronic condition, especially in children.

(5) The addition of anti-meningococcal to the sulphadiazine treatment produced no particular benefit.

(6) The cost and the present requirement of frequent parenteral administration of the drug in its present form prohibits the use of penicillin except in hospitals.

(7) Combined treatment penicillin and sulphadiazine or sulphamerazine of the more acute cases not showing satisfactory response to either of these therapies alone is worth a trial.

Indian Med. Gazette (1946) March 3. p. 113.



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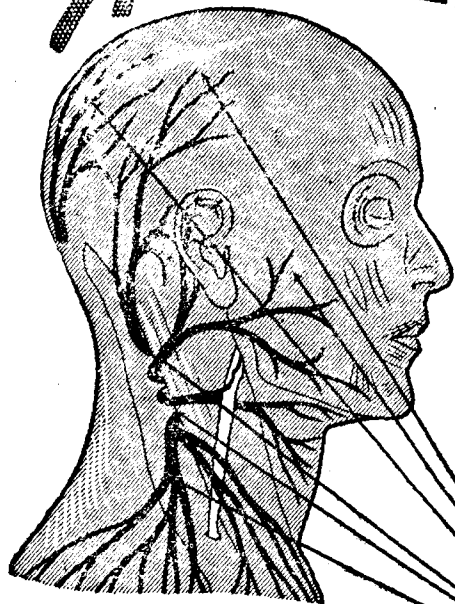
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THE EFFECTS OF WARS ON THE EVOLUTION OF SURGERY

Presidential Address delivered at the Eighth Annual Conference of the Surgical Association of India.

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President, Ladies and Gentlemen,

In asking me to preside and address you to-day at the 8th Annual Meeting of the All India Surgical Association, you have conferred on me a single honour for which I desire in the first place to thank you. Next, I have to thank on your behalf the distinguished Minister of Public Health, who has found time to open this Conference and address us with her mature ideas and experience. Thirdly, I have to thank those who have worked hard and made these excellent arrangements for holding this Conference in this historic and ancient city of India.

This Association represents the only postgraduate body of the practising surgeons in this country. We have come here with a desire to learn from others their experiences and at the same time make our own work known, maintain and tighten the bonds of unity, amity and esteem as members of one profession and of one nation at its great renaissance. This has been made possible due to our use of one common language as a medium of communication for our thoughts and ideas in social, political, economic and scientific atmospheres, not only in this country but also in the international world. Let us not be in a hurry to abandon this English language until we have developed our own Hindustani so that every person from Peshawar to Cape Comorin thinks it as essential to know Hindustani as it is now to know English. English is at present best suited for scientific expression of ideas in international world on account of its precision, terseness and richness of its vocabulary, the last of which, I consider, is not possessed at present by Hindustani. I also consider it somewhat ungrateful on our part to abandon in a hurry the help this language has given us and made us acquainted with world thoughts on Democracy, Socialism, Fascism, Nazism, Bolshevism and other 'isms' and their subtle differences. It is through this language that a Punjabi, Tamilian, or Maharastrian, has learnt to feel that our culture is the

same and as such our nationality should be the same. For advancement of science, again, it would be a retrograde step for the present to teach scientific subjects like Medicine, Surgery, Chemistry, Zoology, etc., in books translated in Hindustani with an altered nomenclature based on Sanskrit, Persian, or Arabic for current scientific words. It is the lawyer politicians who are ultra political but infra scientific who ask you to sing this hymn of hate against the English language. Even now, the Russians, English, French and Italians insist on their students to know thoroughly one of these languages in addition to that which is their mother tongue and why should we discourage its teaching in such a hurry. The late Justice Ranade had once remarked that it was providential dispensation that brought us in touch with the English people and their language ultimately to be of benefit for the people of this country, and he was right no doubt from what we are seeing at present. I will dilate no more on this subject except to say "Do not drop this pilot in a hurry as far as scientific progress of this country is concerned, and follow the Irish people on this point."

Leaving this question of language aside, I come to the question of wars which, as you are aware, are condemned by everybody. Are we Surgeons as men of science entitled to do so? Have these wars done nothing for the evolution of Surgery and thus become useful to humanity? Plato has wisely said that the world is really foolish in not understanding that men are always at war with each other. Montaigne states that wars are considered always the greatest and most magnificent of human actions. This is proved at the present time by surgeons, who have returned from the last war after performing some military duties, sticking to their military ranks as Captains, Majors, Colonels, and Commanders as if their important work consisted not in aiding humanity in their misfortunes by their kind attention as healers of wounds, but in holding certain ranks in fighting units of the army.

If they really abhorred wars, they would never have used their military ranks in civil life but would have considered a greater honour to be called merely "Doctors." They will never do that. The pomp and circumstances of wars have captivated the human mind so much so that its horrors are deliberately minimised, and conquests made after battles have more attention paid to them than those gained by Satyagriha and Ahimsa. Even accepting things as they are, man who dominates nature so much descends at times below the level of an animal to wage a relentless war on his own species as we find in Calcutta, Bihar, Noakali, Bombay and South Africa in preference to turning his immense knowledge gained from nature against the most potent of his enemies, viz., Bacteria, ignorance, bigotry and religious intolerance. These have caused more deaths than powder and bullets. This is due to the

savage instinct or virtue which comes to the top in case of disagreement to decide "Can I kill thee" or "Can you kill me". This makes wars necessary till we have conquered this savage beast in our own self, I must say we are still in the infancy of civilization.

Because of the lack of knowledge of an average surgeon in historical matters it seems appropriate to give you here a brief resume of the evolution of surgery due to war of different periods, advantages gained by humanity and the prestige the surgeon has acquired as observed from records of authentic history.

Surgery has been rightly called "the Queen of Medical Art" though a sub-committee of Association for alterations of the rules and regulations of this Association would like to call it a science of surgery and not an art. Its history is coeval with the history of mankind. The first surgical operation was probably that of extracting arrows received in combat and healing of wounds received in hunting wild animals. The term Dhanvantari in India probably meant a man proficient in curing people injured by *Dhanushya*. He represents Aesculapins of Indian Medicine.

There was a fair amount of surgery in ancient Egypt 5,000 years ago as found by researches carried out on Egyptian Mummies. In South America, a collection of Peruvian skulls shows distinct signs of their being trephined apparently for headaches also in pre-historic period with surgical instruments fashioned from stones. In Greece, Surgery found a fertile soil to flourish 2,000 years ago due to constant waging of wars there among the tiny local Governments and against Persia, when Greece became Imperialist and wanted to conquer the whole of Asia. Fifty years before the birth of Hippocrates, Surgery is said to have flourished in Greece. Hippocrates treated with success diseases of bones and joints, fistulas and trephined skulls and repaired defects left by nature in completing its job. He removed stones from bladders and treated hæmorrhoids. His achievements in surgery no less than in medicine placed medical science on sound basis. It is stated that Polemy was killed while being trephined after his fall from a horse on the battle field.

Arabs carried the torch of medical science during the period 800 A. D. to 1350 A. D. They translated the works of Hippocrates and Galen and made some original researches in drugs derived from mercury and sulphur. They built big hospitals in Baghdad, Damascus, Mansur hospital at Cairo and at Cardova in Spain. Albucacis in 1013 wrote a book on Surgery. Avazoor (1113 to 1193) found the cause of scabies. Paul of Agean was a surgeon who treated diseases and foreign bodies in ear, nose and throat and invented tracheotomy operation. In 1190, they were able to get permission to do dissections on dead bodies to learn Anatomy, one body being allowed to each physician every five years. Upto that time it was considered by Christians and Muslims both an unholy act to dissect a dead

human body. Dissection of animals was also considered to be a low occupation not to be followed by a respectable profession. Knowledge of Anatomy became more accurate due to the studies of one of Avano studying at Padua and Arnold of Villa Nova of Mantpelier Peter Universities, respectively, in 1250 A.D. Medeno of Bologna commenced his researches in finding drugs to cause sleep in patients before operation. Lucca made some additions to these drugs in 1258 A. D.

The science and art of surgery in India can be traced to the same period as that of Hippocrates, if not earlier. Atreya was a great physician at Taxilla University and Shushruta a surgeon at Kashipeeth or the ancient Benaras University. Both of them flourished before the 7th century B.C.; the Physician Charak was at the court of the Buddhist ruler Kanishk in 100 A.D. Shushruta long before had described the Anatomy of the human body as studied on human cadavers and has given a list of surgical instruments needed for major and minor surgical operations. Indian Medicine and surgery flourished till the 12th century A.D. when the chief surgeon at the court of Muhamad Ghori was a Hindu Physician, the father of Wachaspati, who had summarised all the medical and surgical literature existing at the time, i.e., 1250 A.D. The art of printing being not in existence the copies of such books were scarce.

Eye diseases were studied at Naland in Behar and ninety-four diseases of the eye have been described in the various Samhitas.

According to writer Arrain, Greek soldiers accompanying Alexander the Great in 327 B.C., thought very highly about the abilities of the physicians and surgeons in India at that time. But for all this it is a pity that these Unani and Ayurvedic methods of treatment of diseases based not on the knowledge of Anatomy, Physiology and Pathology, as we now understand, but based solely on emperical bases should be encouraged after a hibernating period of eight hundred years in this century, instead of leaving them for research by medical graduates for obtaining post-graduate degree and thus obtain for us all the useful knowledge to be found in those systems.

We owe to the Romans the foundation of ambulance work. It was the Roman General Labianus who made arrangements for his wounded to be carried in wagons drawn by swift horses to Admentium, a seaport, for surgical treatment in North African wars, with attendant male nurses.

We also read that Saladin, the Muslim conqueror, after his conquest of Jerusalem, allowed the Christian Knights Templars to look after the wounded Crusaders about the year 1200 A.D. The wounded used to be looked after first by women and then by the surgeons. This was the real beginning of the St. John Ambulance

service. Arabs were at the height of their scientific attainments at this period.

Due credit for the proper establishment of the ambulance service goes to a lady Queen Isabella, the Catholic Queen of Spain, who established ambulance and military hospitals on modern lines in the years 1483 to 1487 in Spanish wars against the Moors. Tent hospitals for the sick and wounded furnished with attendants and medicines were established by her at her own expense. There were 400 ambulance wagons with her when the victorious Spanish troops entered Granada. Four large hospital tents with careful provision of all kinds was a sight worth seeing. Wounded as well as the diseased were taken care of and the order, diligence and supply of all articles necessary and useful were as complete as in the best hospitals of Milan at that period.

The Queen herself went round the hospitals to talk to the patients and when advised to keep away from them said "let me go to them for they have no mothers. It will soothe them in their pains and weakness to find that they are not uncared for." Here, we find an example for ladies of our country to visit hospitals more frequently after calamities causing serious injuries resulting in deaths more frequently. Improvement in military hospitals and ambulance service, continued as one war succeeded another, as the number of fighting men increased from thousands to millions, As the quality of brutality, maiming and mutilation got more and more refined, thanks to the advance of science in war, the surgeons also became more and more efficient in the treatment of such cases with the help of the same progress in science.

An International Agreement was signed by several European powers in 1863 where it was agreed to treat medical personnel and severely wounded cases as neutral due mainly to the efforts of a Swiss gentleman, Henri Dunant, who had seen the good work of Florence Nightingale and had visited the battle fields of Crimea and Salferino, where the wounded were left on the battle-field unattended for several days without food or water. Dunant lost his whole fortune working for 25 years in this philanthropic work and had to live in obscurity from 1867 to 1901 when his merit was recognised. He received the Nobel Prize and further honours. To honour the country whose national flag was a white cross on a red ground the red cross flag was instituted with a red cross on a white ground. This is the origin of the Red Cross movement. I am unable to state why the red crescent was adopted for such work. Conditions as regards treatment of the wounded before this time were very bad, indeed, during the Napoleonic wars. We read about this from the account written by the great surgeon Ambrose Pare. He went to a stable in Milan after the French entered that city to keep his horses and found there, four dead soldiers, and three dying

propped up against a wall on grass strewed on the floor. They neither saw, heard or spoke. Their clothes were smouldering where gun powder had burnt them. While Pare was observing this, an old soldier comrade walked in and asked if there was any hope of saving them. When he heard that there was no hope, the soldier went and gently cut their throats. When remonstrated he replied I hope I will find some kind person to do the same to me under similar circumstances. It seems these stables were more safe to the wounded than the military hospitals, which were not free from enemy attacks in those days, though no fire could be lit there to keep the place warm on account of grass lying on the floor.

Non-existence of any trained personnel to look after the wounded in the armies of the Indian States with their wars with the British and the French must have been one of the causes of the wholesale desertion of the soldiers after a crash on the battle-field resulting in their defeats, though their armies always out-numbered those of the British and the French.

In my opinion, these constant wars among the nations of Europe and the experience gained there has been the main spring for the improvement of health and morale of the population there. The people there have improved physically and mentally. We have equally degenerated being robbed of our initiative, manhood and pride of race. It will be a great day for this country if we gain experience by military training in all our schools, for the want of which much irregularity, indiscipline and want of team work are noticed at present in all our activities.

With this training, one can be of greatest use to humanity, in places where large gatherings of populations such as *jatras*, *melas*, *uruses* take place and where sanitary arrangements, supply of food and clean water and preventive methods, such as vaccinations, inoculations and first-aid measures after accidents, are to be carried out. The efficiency of all these depends upon the regulated experience made on disciplined material mobilized for wars or some other similar purposes.

To resume our subject, *viz.*, the evolution of Surgery. After Hippocrates comes the names of Galen of Alexandria. His contribution to surgery consisted in ligaturing of arteries, suturing of nerves and other operations on brain and spinal cord which were made all in the wars of the time. He also wrote a book on Human Anatomy.

Bruno de Langoburg helped to clarify the meaning of the term surgery in his book *Chirurgica Magna* in 1252 A.D. He stated that the essentials of Surgery consisted in bringing separated parts together, separate those that had gone united together and extirpate those which have got superfluous.

Lanfrance was also a surgeon of the 13th century. He was for abolishing distinction between medicine and surgery.

Henri de Modeville was his pupil. He was not at all satisfied with the surgery of his time. He said that surgeons of his time know how to cause suppuration than how to heal a wound.

Taglia Cozzi made rhinoplasty operations for repairing noses popular. They were often cut off by the order of the Pope for sins considered to be mortal in this period of ignorance and religious intolerance.

Guy de Chaliac was the first in those days who started using extension apparatus for fractures in addition to splints. He also used moulding by bandages soaked in the white of egg as a hardening agent where we now use plaster of Paris.

Ambrose Pare was a great surgeon at the time of Napoleon. His experience was gained at Hotel Dieu in Paris and, as a military surgeon, he treated with success wounds caused by swords, pistols and firearms of the time. He described different varieties of fractures including those of skull. He was the inventor of artery forceps, artificial eye and various other surgical instruments. He first drew attention of the relation between syphilis and aneurism. He introduced ligatures instead of boiling oil to stop hæmorrhage after amputations and this saved many valuable lives.

William Salicets is another name to be honoured. He distinguished between arterial and venous hæmorrhages. He tapped hydrocephalus by cautery points and made other researches.

Wars have been of benefit to the progress of surgery but I do not mean surgery would not have progressed and remained stagnant without wars. The discovery of æther as a general anæsthetic by the dentist Morton in 1846 was not made under war conditions. This year is the centenary year of this great discovery and æther is still holding its own as a general anæsthetic. For 500 years previous to this discovery, a powder made from mandigora opium hyocymus and camphor was used for inhalation when soaked on wet sponge. Hugh of Luce was its inventor. He insisted cleanliness in surgery. Pre-Listerian surgery advanced due to the discovery of æther as an anæsthetic but it was characterised by the presence of Pyæmia, Septicæmia, Erysipelass and Hospital gangrene.

Researches of Pasteur leading to the discovery of the cause of fermentation made Lister think that a similar phenomenon by minute organisms was the cause of suppuration. His studies to prevent the growth of such organisms in tissues in cases of compound fractures at Glasgow made possible the use of carbolic acid for dressing compound fractures and resulted in diminishing sepsis from the wards of that hospital. He was able to convince the great men of surgery of that period of the efficiency of his method.

Thiersch and Volkman from Germany, Billroth from Vienna and Lucas Championere from Paris were impressed with his results and the position of antiseptics in surgery was thoroughly established.

Brain operations were tackled with more and more confidence. The first operation for removal of the Gasserian ganglion successfully was performed by Sir Victor Horsley using antiseptic technique. I have had the fortune of watching this great ambidextrous surgeon performing brain operations while a continual douche of antiseptic lotion was being used to keep the parts free from blood and now 10 per cent of brain tumors are found amenable to surgery. There were some tragedies on account of the overuse of antiseptics. They were used not only for dressing of wounds or for disinfection of materials used at operation but also for saturating the air of the atmosphere of the operation theatres with carbolic acid vapour with disastrous results. Lawson Tait came on the scene at this period. He performed ovariectomies and other abdominal operations under aseptic conditions with success. Rubber gloves for the use of surgeons came into general use in the beginning of the present century.

Though this advance and progress in surgery were not due to war conditions, the present period of war has made such progress that the medical history of future will have to say of the last two wars more than any of the preceding ones for giving surgery a powerful stimulus for its advancement as you will presently notice.

It was the South African war which opened our eyes to the fact that only 8,000 people were killed by bullet wounds, while 14,000 died from typhoid, dysentery and other bacillary diseases and the importance of inoculation and vaccination as a prophylactic was established due to the researches of Sir William Wright, Haffkine and other scientists.

In the Russo Japanese war, which took place soon after, the Japanese took full advantage of these discoveries. Inoculations against typhoid and tetanus were carried out resulting in the lowest death rate during that war by these diseases.

We now come to the first Great War of 1914-1918, where machines and mechanics of destruction were still more developed. There were hardly any cases of typhoid or tetanus in this great war worth making a special report for improvements in the treatment of these diseases.

A great deal of work by Crite and others was carried out in America regarding treatment of shock. Stress was laid on Anoci association and loss of fluid from general circulation. During this war, shock was treated with saline solutions and also with Gum acacia solutions given intravenously. Transfusion of blood was used though rarely and used of prepared plasma for transfusion was practically not known.



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Wounds commenced being treated with Dakin's solution given continuously by Carrel tubes inserted in the depths of wounds when very septic and Bipp paste was often used to pack wounds with, to keep them free from contamination and also for its antiseptic value with good results. In latter stages of the war, debridement of wounds with primary suture came into vogue, all with still improved results.

Injuries due to shrapnel, mines and bombs were extensive resulting in crippling of human beings. Sir Robert Jones recognised the number of such wounded disabled by compound or simple fractures and took it as a challenge given to surgeons to bring them back as useful members of society. With his exceptional skill and knowledge, combined with marvellous capacity and ability for organization, he met with successes which is well known. He established the first military hospital for orthopaedic surgery with 200 beds leading to 33,000 beds for such cases in England and America.

Plastic surgery for injuries to face and jaws with their hideous deformities were successfully dealt with by surgeons like Gillies and progress in this art now is phenomenal.

Coming to the present war, it is now possible with an air of finality to survey the progress in surgery and medicine during the last six years. Scientific progress made in war enabled patients being carried from India to England supplied with artificial breathing apparatus. Air transport for taking patients from the battlefield to hospitals across the sea was freely used. Problems, physiological and psychological in persons left in atmospheres they were not used to live have been attended to and solved.

The development of resuscitation therapy for the prevention and treatment of shock, replacement of fluid therapy for the maintenance of blood pressure in seriously wounded men, has also been an interesting chapter of this war. On the base of knowledge gained before the war, as regards the properties of blood plasma and serum in the prevention and treatment of shock, it was deemed advisable to select dry plasma as the agent of choice for use in resuscitation of the seriously wounded and hospitals were supplied by authorities with the necessary quantity of plasma for use in the beginning.

During the war, it was found that plasma, while valuable as a first-aid measure in combating shock, did not give favourable results, compared to those noted following the administration of whole blood in severely injured cases. This observation made the British organization feel the need of whole blood for transfusion. Units to provide adequate amount of whole blood were started actually in the theatres of war.

Americans soon arranged for blood banks in the different hospitals from donors on active service and supplied the needed amount of blood. By the middle of 1944 on account of the whole

blood as a therapeutic measure lead to the development of a programme which provided shipment by air of large quantities of whole blood from U. S. A. both to Europe and Pacific battle fronts in containers kept at 40° Fahr. of such blood. About 86,000 pints of blood were supplied to the Pacific region alone. I have no doubt, blood will be needed in large quantities and would be ready in the next war as plasma was kept ready in the last war unless some other fruitful discoveries are made to replace some other fluid instead of blood. The value of serum albumin and fibrin ferment products is a further development. Serum albumin has been found useful in severely burnt cases to reduce oedema after salines have given intravenously.

Only 25 grammes of serum albumin gave results corresponding to 1 unit of plasma, i.e. 300 c.c. Thus serum albumin was found to be superior to prepared plasma in such cases. Fibrin ferment form has been found useful for arresting hæmorrhage.

Sulphonamide and other sulphad drugs, though useful when given in adequate doses by mouth in preventing infection of wounds, seems to have very little influence in preventing sepsis when applied locally, notwithstanding that one hears glowing accounts concerning the value of sulphonamides thus used in preventing infection on such cases.

As regards Penicillin, not only the antibacterial quality of this drug discovered by the researches of Florey and Flemming has been confirmed by the extensive use made against the pathogenic bacteria and cocci of all varieties, but credit has to be given to the pharmaceutical chemical and distilling industries of America for producing this drug in quantities, which, in pre-war time, would have been thought fantastic and incredible.

Properties of Penicillin and similar products like Streptomycin in saving life and limb and its role in the care of wounded must be considered in conjunction with other adjuvants of surgical therapy such as Plasma Serum albumin, Amigen products, whole blood and sulphad drugs given intravenously.

The death-rate among the wounded in this war has been 4.4 per cent compared with 8.25 per cent in the war of 1914-18 among the Americans. It is interesting to know that the death-rate among the Germans wounded was 10 per cent in the first four years of war, while they were winning all their battles. This has been mainly due to pre-operative and post-operative improvements in the treatment of the wounded by the Americans and English surgeons.

To demonstrate how the ingenuity of surgeons assisted by researches in science has been able to cope with wounds of lower extremities involving the main blood supply, viz., the deep femoral or the popliteal artery. This resulted often in amputation of the limbs. All attempts to save the limbs by ligaturing the torn vessels

or by arteriorrhaphy failed due to firm oedema of the muscles rapidly causing structural alteration that was hard and unyielding. This prevented collateral circulation and generally ended in gangrene of the limb. Some success was obtained in the last war when the French surgeons used Tuffiers vaselined silver tubes to carry on the circulation and Germans did the same by end to end anastomosis by Carrel sutures or by bridging the gap by a venous graft.

Americans have contributed to this surgery devising venous lined sutureless Vitalium tubes. But these tubes are not always available in emergencies.

The following case reported in the *American Journal of Surgery* is interesting as to what could be attempted in such cases. The patient reported after injury to the deep femoral after a great loss of blood with blood pressure of 50 mm. mercury instead of 120 mm. 2500 c.c. of blood was given by transfusion. This raised his B.P. to 104 mm. and the injured ends of the divided vessels were tied. Lumber Sympathectomy was now carried out as the extremity still remained cold and gangrene was threatened. The result was that the B.P. came down again to 67 mm. from 104 mm. but the extremities remained warm. Another 1500 c.c. i.e., 50 ounces of blood was transfused. This resulted in establishment of the circulation and saved the life and limb as well of the patient. 4000 c.c. of blood i.e. 135 ounces or 6½ pints was needed for the purpose of this treatment for the want of which many of the early deaths in the hospitals due to exsanguination must have taken place. This treatment has come to stay and would be successful if blood banks have been established in hospitals all over the country.

A great deal was learnt in this war as regards the technique in the treatment of compound fractures and in cases suffering from burns avoiding discomfort to the patients by daily dressings. The horizon of work of the surgeons is enlarged due to experiences in treating results of destructive effects of explosive shells, fragmentation of bombs, torpedo attacks, buried ground mines and grenades. Attacks came from not only land but also from sea and air. The surgeons have thus gained experience in remedying and reducing the mortality caused by visceral wounds, besides wounds of extremities.

The early education of a surgeon is in character merely an apprenticeship which leads to some dogmatic views. The sharing of experiences with surgeons from other schools of thought from different continents, when working together in properly supervised theatres of war, has exerted a broadening influence on the intellectual growth of surgeons. Recognition of distinguishing qualities in persons not of their country or colour, when working on similar injuries and accidents or diseases moderates racial pride.

breeds tolerance and often creates esteem and respect for people of other nations and colour.

This list of the benefits rendered to the humanity by wars will be incomplete unless a statement is made in short of the other equally important benefits given to the civil population, now that the war is over, though surgery may be interested in them only indirectly. Dusting the bodies with D.D.T. powder for delousing purposes has made people so dusted immune from Typhus when living in the midst of a population suffering from Typhus epidemic. D.D.T. as a personal and environmental insecticide presents one of most advance preventive not only against Typhus but when used as a spray, it has been able to control flies, mosquitoes and their larvae which are destroyed by its use. Needless to say that it has prevented all diseases whose germs are spread by the mosquito agency, such as malaria and yellow fever.

The rat, despite all old methods, has multiplied and has become destructive all over the world and a constant menace to health. Two effective agents likely to replace all others have been developed during the five years of the war. One is known by Antu and the other Sodium fluoro acetate. Both are acceptable to rats and are rodenticides without causing injury to higher animals.

The discovery of quinacrine, a drug superior to quinine, was made by Germans due to monopoly of the Dutch Cartels, which controlled the world market of quinine. When Germans found difficulties to obtain sufficient quantity of quinine in the last world war they discovered chloroquin which causes abrupt termination of the clinical attacks of malaria in only a day or two. Further development gave us Atabrine or Quinacrine, Pamaquin and Paludrine.

The drug B.A.L. British Antileusite was also discovered during this war. It is a therapeutic agent against the local and systematic action of certain arsenical war gases and arsenical poisons. It is found useful in the treatment of dermatitis and Encephalitis caused by an overdose of maphersan.

Considerable quantity of Gamma Globulin is produced in the preparation of serum albumin. This globulin is found to be useful in ameliorating the attacks of measles and protects against infective hepatitis.

A formalized vaccine against influenza has also been discovered which confers immunity against this dreaded disease which carried away millions of people after the last war.

Glycol vapour from 1 gramme of the drug has been found highly effective in sterilization of several hundred millions C.C.S. of air from pathogenic bacteria attacking respiratory passages and could be used in hospitals by a proper oiling of floor mixed with the drug and thus prevent the dreaded pneumonia and other respiratory diseases.

A new era of physical science has developed by the discovery that atom, hitherto believed to be indivisible, has proved to have a structure of electrical components held together by a complex force. It has an external electronic atmosphere and an internal nucleus which has been explored leading to modern knowledge of atomic energy.

With the electron microscope and ultra centrifuge hopes are maintained that significant information will be available regarding the ultimate constitution and fine structures of living matter and a new era for the ultimate control of life processes is not far off.

By strongly irradiating the germinating seeds by X-Rays a new type of tobacco plant with a 13 ft. long leaf has been produced. Ovums thus irradiated are likely to have great alteration of some of the genni resulting in change of the biological character of the offspring of such a ovum.

Machines of a million of voltage are comparatively recent development. X-rays produced by machinery of lower voltage by their attacks on the cathodes have been used for 30 years for treatment of superficial cancers, but their penetrating power is low. Rays of a million voltage are to be used not for creating X-Rays by attacking the cathode of metal but by making diseased tissues of it as a cathode.

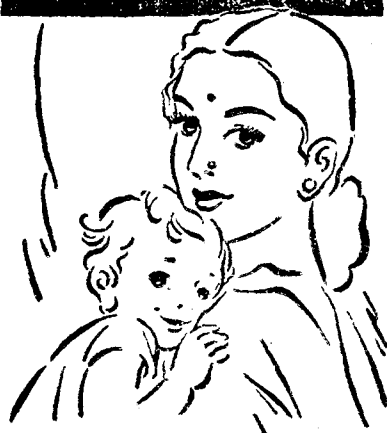
Cathode rays or electrons produced by five million volt machines are liable to penetrate the body when exposed to it to a depth of one inch, where they produce their maximum results. It is hoped that in electrons thus produced will be useful in treating deep seated cancers.

I have said nothing so far about the researches made by Russian scientists and surgeons in this war. They concerned mainly in grafting of tissues obtained from healthy soldiers recently killed in battles on other individuals deprived of the same most successfully. Eyesight is improved, contractures of limbs prevented and functions of organs have been restored by these researches.

The last two wars have been distinguished by more humane considerations for the rehabilitation of men of the fighting units. Nothing was done for them in the wars of early centuries except granting them a miserable pension.

The medical profession has always heartily assumed the responsibility placed upon it and in meeting which discoveries and advances have been made to maintain the humane objective of alleviation of pain and suffering and restoring men as rapidly as possible in order to retain their services as trained men. But no one can deny that the records of the success in providing assistance towards a satisfactory adjustment to civil life for those who are discharged for physical disabilities from the army are still very poor. No encouragement has been given to such men that though they are handicapped they are not disabled for life. In the past

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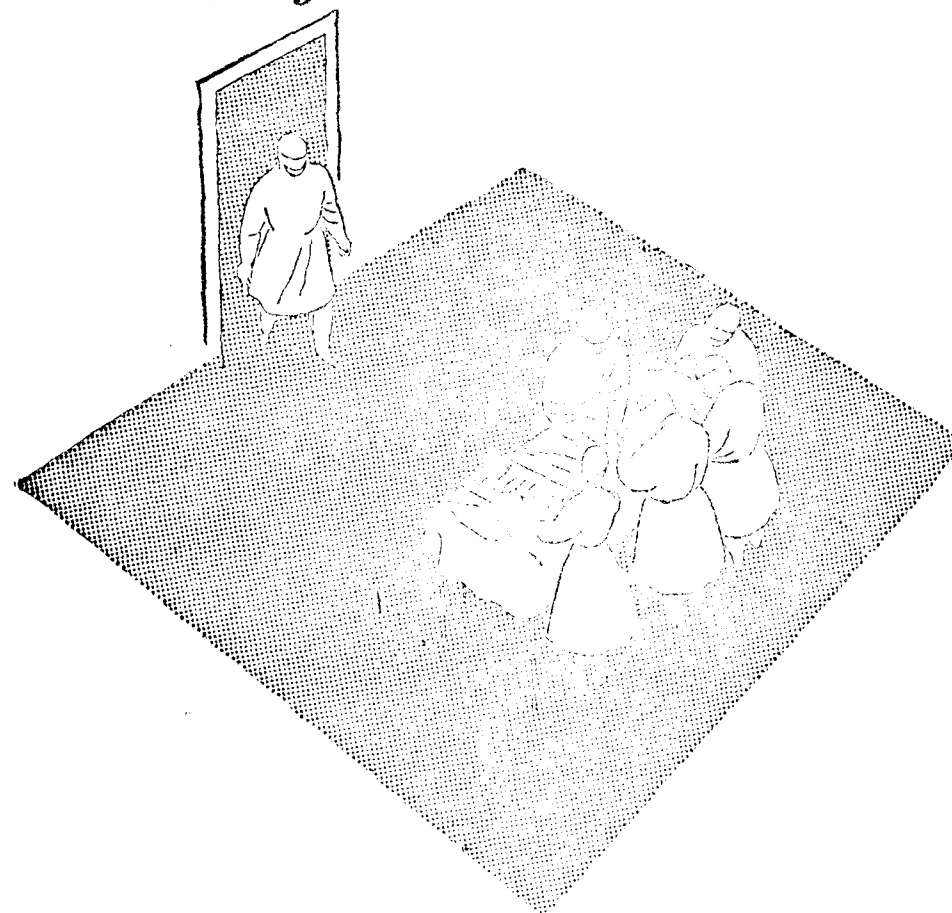
rehabilitation of such men was left to men themselves, but now the problem of readjustment of such men has been accepted by Governments of the various victorious countries. The rehabilitation starts while the patient is in the military hospital, while under treatment and is complete when he is ready to leave the hospital.

This programme consists of physical therapy, occupational therapy, physical training and vocational education useful in civil life in discharged men not able to carry on their original occupation and confidence is created in them that they can take a useful place in the community in which they live.

We can say after all these facts that wars have contributed nothing for the good of humanity or it is a wind that blows nothing but evil.

If I may be allowed to indulge here in a little politics I may make myself bold to say that these European Wars have awakened in us our national pride. It has made us think of the whole of India as one nation instead of a continent of so many Balkan States each forming a nationality according to the language in that province. We still need one common language though there may be many different linguistic provinces. Conditions which conduce to the thoughts that India is one country need besides one common language, one national head dress and one national anthem which will be sung by Hindus, Parsis, Muslims or by members of any religion and not listened to like a sermon in a church. With the help of our brain and brawn and brilliant tradition of bygone days in our mind we are sure to become one day a great nation.

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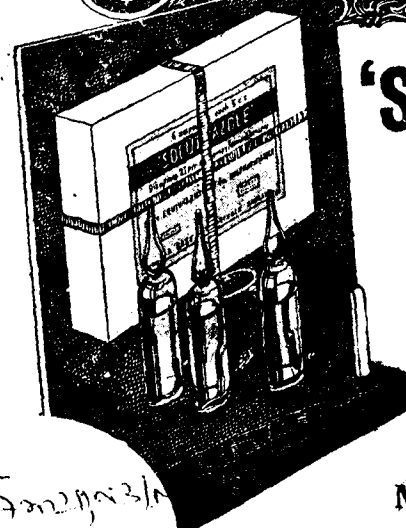
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VOL. XVI

MARCH 1947

NO. 3

PRECORDIAL PAIN

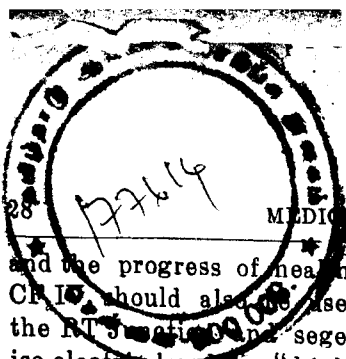
By CAPT. S. THAMBIAH, M.C., M.R.C.P., D.T.M., & H., F.D.S.,

Pain, slight or intense, wherever found, calls for speedy removal or considerable alleviation. To the lay-mind, pain over the heart region spells a grave prognosis and gives rise to great anxiety till a correct diagnosis is made and appropriate measures applied to deal with it. At present, improved methods of diagnosis have helped in clarifying nearly similar conditions though arising from different ætiological factors. Again new drugs and new procedures have changed our out-look in dealing with precordial pain. A correct diagnosis is a pre-requisite for a rational treatment.

Pain of myocardial infarction may be given "pride of place." The pain is mainly substernal with a spontaneous onset. The description given by patients carries an idea of constriction or compression. It may remain entirely substernal or follow closely the lines of radiation as in angina pectoris (anginal syndrome). Rest does not relieve the pain. When the pain is very severe, even morphia fails to give complete relief. Vasodilators have no place in relieving this pain and indeed are extremely harmful. The pain is soon followed by a fall in blood pressure and symptoms of shock in a few minutes or hours. The patient's face comes to assume an "ashen-pale" pallor. The patient becomes restless or will feel weak and unable to exert. Very often the medical attendant finds him bathed in profuse sweat and tossing about in bed trying to find relief from his pain and combat dyspnoea. The pain, if untreated, lasts for hours to 3 days.

By the second day confirmatory evidence of tissue destruction will appear, as fever, leucocytosis and increased sedimentation rate. Here again the height of fever, higher leucocytosis, more increased sedimentation rate will indicate extensive myocardial infarction. If the infarcted area rises to the pericardial surface, friction rub may be heard. On the mural endocardium of the ventricle, thrombus will deposit over the infarcted area, and broken fragments will give rise to embolisation in the lungs, brain, spleen, kidney and the extremities. The fall in blood pressure will lead to suppression of urine.

E.C.G., can be of aid in the diagnosis within the first twenty-four hours of the infarction, and, when studied serially, may clear up the questionable cases. The site of infarction can be established



MEDICO-SURGICAL SUGGESTIONS

and the progress of healing followed. Precordial leads, at least C₁, C₂, C₃ should also be used. Early changes can be recognised in the R.T. segment being displaced upwards from the iso-electric level—a "high take off" or Pardee curve. As healing begins, the displaced wave begins to work back to normal. The Q, T, pattern may be produced in infarction of the anterior descending branch of the coronary with a large Q wave in lead I and a large S wave in lead III, and the precordial lead showing changes in R.T. junction and segment, and T waves are progressively altered as in lead I. In the same way changes in the E.C.G., occur in infarction of the posterior and diaphragmatic walls with Q, T, pattern—with a large Q wave in lead III. Here precordial lead gives rather inconstant changes. Ventricular complexes should be carefully studied. These are of low potential both in the Q.R.S. portion and in the T wave. Notching or splitting of the Q.R.S. wave with lengthening of interval to 1/10 second or over may be found revealing defect in the spread of impulses through the Purkinje system. BB Block, usually of the left branch may become evident.

Electro-cardiographic evidences must be correlated with the patient's history and clinical findings. Diagnosis of infarction should not be made on electro-cardiographic findings alone. Sedimentation rate and E.C.G., findings should be carried out at regular intervals as a clue to the progress of healing and prognosis. In fact these two factors go hand in hand with healing so that early convalescence is not ordered by the physician, if these are not normal.

The surgical conditions of rupture of the gall-bladder, perforation of a peptic ulcer and acute pancreatitis will be considered for a differential diagnosis when the painful reference is to the epigastrium. An experienced surgical colleague may help in arriving at conclusive diagnosis. If one of these surgical conditions exist, early operation is a life-saving measure. Comparable signs and symptoms may arise from a dissecting aneurysm. Due to involvement of the abdominal aorta and its main branches, the pain is in the lower abdomen and the lower extremities, and is of a very severe character. The above area may show variable changes. Pulsation in the femoral arteries may be reduced, or not felt at all.

The pain of anginal syndrome is variable as regards intensity and quality. It may range from a slight substernal discomfort or oppression to an excruciating pain with the attendant fear of impending death. The pain, in severe cases, lasts half to two minutes and rarely exceeds five minutes. This short period will seem an eternity to the sufferer. The physician, when summoned, rarely sees the individual in the attack, all being over, before his arrival. Certain factors will go a long way to show what was wrong with the patient. The patient will describe the attack with a

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certain amount of awe and respect. Even the stolid of men will be moved in describing this attack of pain. The attack leaves the patient demoralised. Close inquiry will show that there is a certain amount of soreness in the chest along with hyper-sensitive skin areas in the precordium. The pain of anginal syndrome has very often a tendency to radiate to the left shoulder, arm, innerside of arm and fore arm and, even to ring and little finger. Less often the pain may radiate upwards to the neck, angle of left jaw and teeth, and downwards to the epigastrium and back. There may be a reversal of the point of radiation. It may start in one of these areas before settling down finally on the anterior surface of the chest. A residual numbness can be made out in any of the areas of radiation, and often lasts long after the subsidence of soreness of the chest. Flatulence will be a prominent feature when the point of radiation is the epigastrium. Much speculation held the field as regards the pain of anginal syndrome. The American Heart Association has laid the matter at rest. The pain is due to ischaemia of the heart muscle and also irritation of the nerve endings in the heart either mechanically or chemically. Thus anginal syndrome is a physiological condition. As effort and stress bring about the attack and rest abolishes it, the precipitating factor is the enhanced demand on the circulation for more blood as in exertion, emotion, heavy meal or exposure. Jenner produced evidence, both clinical and postmortem, that coronary artery disease was somehow the basis of the anginal syndrome. This was nearly seven years after William Heberden described the disease condition and christened it "angina pectoris." Nothing more noteworthy appeared till Sir Clifford Allbutt, at the beginning of the nineteenth century, put forward the view that the pain was due to the stretching of a diseased aorta, very often syphilitic. About the same time Sir James MacKendie held the view that the pain resembled very much the cramp of intermittent claudication in the legs—a condition of myocardial insufficiency.

Anginal syndrome arises from organic or functional causes when the organic cause of the anoxæmia of the heart muscle is known, as syphilitic mesaortitis or coronary ostial stenosis then the name of the disease causing it should be indicated. Marked anæmia, and general anoxæmia by going to high altitudes, or being found in insufficiently ventilated rooms, may give rise to the Symptom-complex.

Chest pain may arise from conditions other than myocardial anoxæmia. Some very common condition will readily come up for notice as pleurisy, pericarditis, intercostal neuralgia or neuritis, arthritis of left shoulder, mediastinal tumour and sometimes gall-bladder disease. A thorough physical examination of the chest, X-Ray and a fluoroscopic investigation will clear up most of the

doubtful cases. Herpes zoster before the appearance of the grouped vesicles on an erythematous background along the area of distribution of 2 or 3 inter-costal nerves, will have to be kept in mind. In some cases, a clue to the diagnosis may be found in patches of erythema or hyper sensitive areas with a feeling of burning sensation. Tabes dorsalis may have a thoracic distribution of the pain in the so-called lightning pain stage. Two psychogenic states may be kept in mind, anxiety, hysteria and neurocirculatory asthenia. In both these, there is no structural heart disease and the pain is definitely precordial than substernal. In anxiety hysteria, the patient complains of extreme fatigue and careful enquiry will show personality changes. Neuro-circulatory asthenia may be spotted by evidences of vasomotor instability as flushing of the face, low blood pressure and profuse sweating without exertion. In very rare cases, the pain of *Trichinella spiralis* may put one off the track unless kept in remembrance. Chest pain of chronic cough in phthisical patients and those with chronic bronchitis may also be mentioned in passing.

So pain in the precordium in a patient after 40 years of age should not be lightly dismissed. A thorough examination of the patient with all the instrumental aids at our disposal has to be carried in fairness to the patient. Then definite therapy may be instituted to relieve or eradicate it.

(M.M.C. Magazine Jan. 1947).

COMPLICATIONS OF ARTIFICIAL PNEUMO-THORAX.

BY DR. S. KRISHNASWAMY, M.B.B.S., R.M.O.,

Government Tuberculosis Hospital, Royapettah.

Air embolism and pleural shock are the two most dramatic and serious complications of puncture of the pleural cavity, whether it is done for the induction and maintenance of a Pneumo-Thorax or for aspirating an effusion or for exploring the chest.

(I) Air Embolism

It is nearly always due to the needle penetrating the lung. It may puncture a pulmonary vein and bronchus as they lie side by side. If the vein is held open by fibrous tissue, air can pass from the bronchus into the vein and so to the left heart from where it is driven to the brain.

In some cases the needle enters the vein, the blood in which it is at negative pressure, and air is sucked out of the needle tube filter and manometer until the pressure within there is reduced to that in the vein. There is always the possibility of an air embolus occurring if high intrapleural pressures are produced, when the lung hold out at one point by an adhesion is torn and a vein opened.

It may also be produced by injection of gas into a network of veins under the parietal pleura.

(1) Nervous Symptoms

Symptoms.—They may be divided into two groups. They are extremely variable. Onset may be precipitous with immediate unconsciousness and death. Or it may be ushered in more gradually beginning with dizziness, faintness, local or general paraesthesias, aphasia and visual disturbances. More serious symptoms are hemiplegia or paraplegia, blindness, unequal and reactionless pupils and cheynestokes respiration. Death may occur at any time, which may be delayed even for a week in which case an unconscious state may predominate with periodic convulsions. In other cases, symptoms may begin to disappear gradually and the patient may recover. Rarely, the paralysis has been persistent.

(2) Cardio—Vascular Symptoms

They consist in pulse irregularities, asphyxial signs and evidences of gradual or sudden heart failure. These symptoms may be seen alone when the amount of air is much and there is no time for the development of nervous manifestations.

The fatal results of air embolism from pulmonary vein, are due to impairment of three vital functions:

(1) Cardiac activity by the obstruction of coronary arteries.

(2) Cerebral and medullary function by blockage of the arteries of brain.

(3) Blood circulation by blockage of pulmonary artery.

Death may be due to either the first or the second. Death from air embolism is rare. But if it does occur, it is usually quick. Recovery is the rule if the patient survives for half an hour.

(II) Pleural Shock.

It gives rise to a diversity of symptoms. Patient complains of severe pain. He becomes pallid with blue lips. Then he becomes unconscious. There is struggling. His hands and feet become cold. The pulse is thready and the respirations are hurried. After half to one hour, the symptoms disappear and the patient may recover. Or the patient's breathing becomes rapid, noisy and stertorous. His colour becomes more florid. He becomes unconscious with eyes rolled up. Subsequently he may recover. In other cases the patient may become tired. He later becomes unconscious with dilated pupils. Breathing becomes stertorous. The pulse may be fair and the skin warm. There may be epileptiform seizures. Barely the patient becomes immediately unconscious. Pulse becomes very feeble and breathing stertorous. Hands and feet become cold and the patient may die on the table.

Frequency.—It is rarely met with even in Hospital practice, about once in 500 to 700 A.P. injections.

Prophylaxis is of greater value than treatment. Pleural shock is guarded against by anaesthetising the parietal pleura thoroughly by novocaine solution before puncture and by waiting for five to ten minutes for the solution to act well. A preliminary injection of morphine $\frac{1}{4}$ gr. with atropine $\frac{1}{150}$ gr. is particularly advisable in nervous patients. Care should also be taken by avoiding sudden changes in intrapleural pressure or too great positive or negative pressures.

Air embolism is guarded against by constant radiological control which gives an accurate knowledge of the position of the partially collapsed lung in relation to the chest wall and the point of puncture as well as by taking into consideration that there is a distinct manometer swing before air is run into the pleural cavity.

(III) Pleural Effusions.

They are the commonest of all the complications. About a third of the A. P. cases are complicated by effusion at some time or other during the A. P. treatment. There is a steady increase in the probability of an effusion developing during the first three months of the treatment. But by twelve months the percentage may go up to 50 per cent. The more advanced and extensive the disease the greater is the likelihood of an effusion developing. It develops more frequently in those who are ambulatory than in those confined to bed. Some of the effusions are very transitory and are not repeated. Others start as an acute process and persist in a chronic form.

Most effusions start as clear serous exudates. Later, either on account of some fresh infections such as influenza or an acute re-activation of the tuberculous process, the character of the fluid changes. The fluid becomes opaque and richly cellular. A similar change is brought about by repeated aspirations. The clear fluid then becomes increasingly turbid and later viscid. The changes affect also the pleural membranes which increase in thickness and tend to unite. As a result there is a progressive obliterative pleurisy resulting in a harmful re-expansion of the lung and displacement of mediastinum.

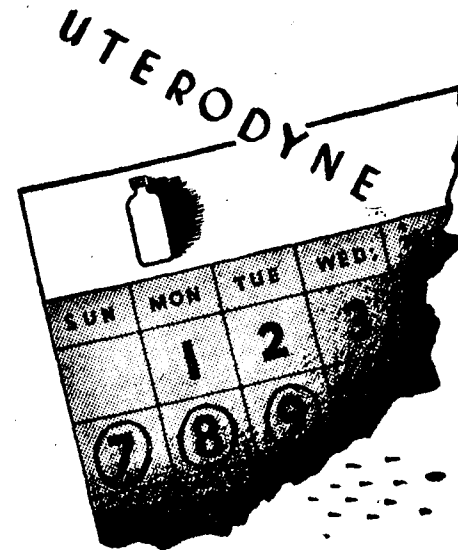
Etiology.

The slight transient effusions are transudative in origin as a result of injury to the pleura by the needle or of slight intrapleural bleeding.

The larger effusions as well as the persistent ones are almost invariably tuberculous. Effusions are more liable to occur when the lung is partly collapsed, when adhesions are present and when there is a positive intrapleural pressure.

Clinical Manifestations.

They vary greatly. The small transient effusions often pass unnoticed, were it not for routine radiological examinations. Occasionally they cause a rise of temperature of a few hours duration only accompanied by a general feeling of malaise.



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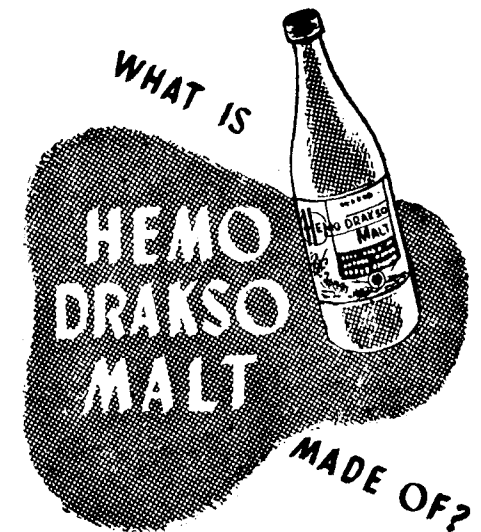
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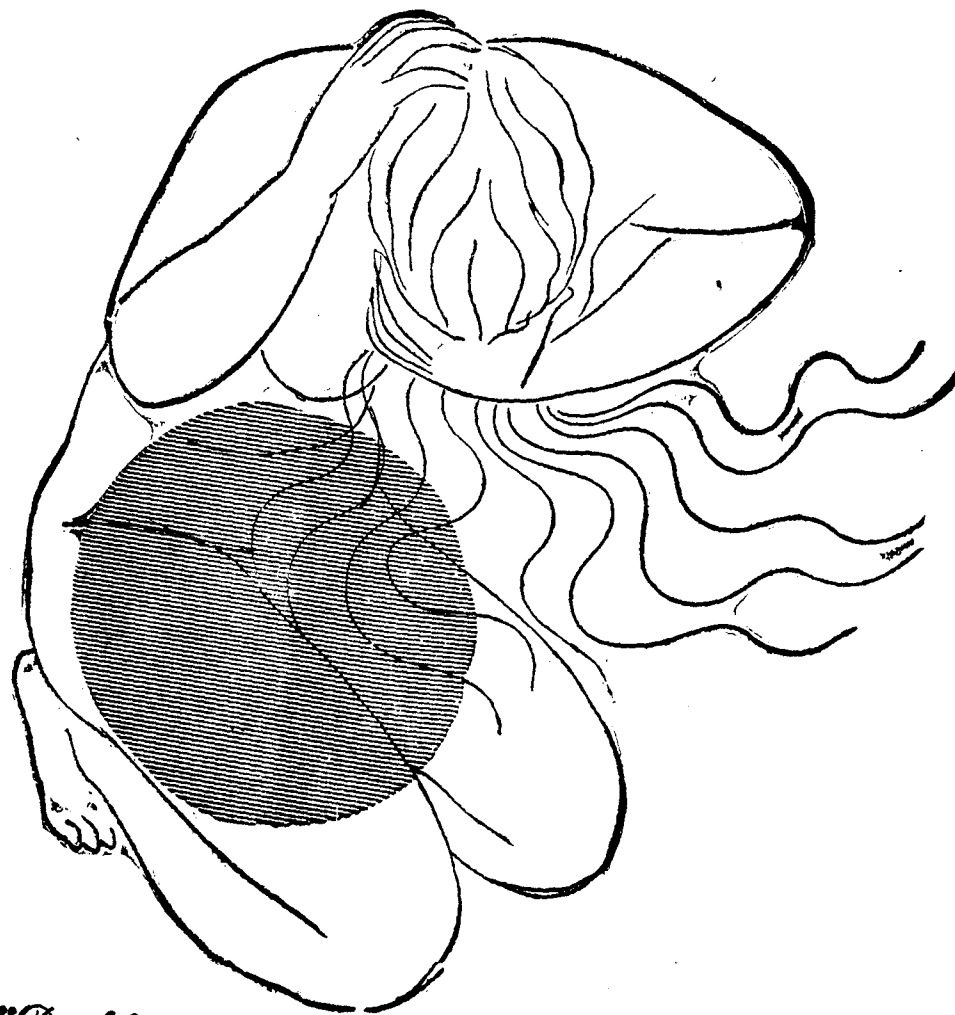
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The larger effusions and those due to a tuberculous infection, even when serous in character, almost invariably announce their advent by a rapid rise of temperature to 101 to 102° within 12-36 hours, which may drop down gradually or fluctuate at this level and then very slowly may reach its original height in the course of a few weeks. Associated with pyrexia there is pronounced malaise. The patient feels ill. There is increased pulse rate and loss of appetite. The patient may have a feeling of discomfort or actual pain on that side of the chest. Occasionally a hard dry irritating cough may develop. Dyspnoea may be present when the amount of fluid is such as to produce displacement of heart or mediastinum.

Treatment.

The fair principle is to leave the effusion alone as long as possible and always in the acute stage unless increasing pressure demands interference. Should the effusion persist and show no evidence of absorption, if the temperature is continuous or because of the fear of progressing adhesions, aspiration and replacement of air is indicated. If the effusion becomes purulent, it should be aspirated and the pleural cavity is washed out with Iodine lotion—a teaspoonful of Tr. Iodine to a pint of sterile water. If methods such as these fail, then a thoracoplasty operation must be done immediately, even when the general health of the patient is good.

(IV) Contralateral Pleurisy.

It is a rare complication of A. P. It is due possibly to excessive intrapleural pressure and displacement of mediastinum.

(V) Surgical Emphysema.

Emphysema of the tissues around the puncture wound, may be the result of coughing immediately after a refill of air at a positive pressure. It causes only a slight discomfort. Very occasionally the emphysema is more widespread and may even extend to the neck and limbs.

(VI) Pleural Hernia.

Mediastinal pleural hernia occurs more often in women than in men and especially in young adults. It is due to the weakness of the attachments of the reflection of pleura at those places where the membranes of the two sides of the chest come into closest apposition. These are in the anterior mediastinum between the first and third ribs or in the posterior mediastinum at the level of fifth to tenth dorsal vertebrae. It is more commonly met with at the front of the upper part of the mediastinum and is connected with a left sided pneumothorax. It is invariably associated with a flexible mediastinum. A pleural hernia is more often seen and is more pronounced when the intrapleural pressure is positive.

Diagnosis is extremely difficult unless it is by X-rays. It is one of the causes of dyspnoea occurring during pneumothorax treatment. Occasionally there is a slight pain felt usually on the right of sternum.

(VII) Spontaneous Pneumothorax.

Pleuro-pulmonary perforation with the addition of a spontaneous to an artificial pneumothorax is not uncommon.

It occurs most frequently within a few hours of a refill, due to the raised intrapleural pressure produced by the refill, greatly exaggerated probably by an act, of coughing, causes a tear in the lung at the point of attachment of an adhesion. The increase of the addition of gas, to the existing pneumothorax will be rapid if the tear is large and valvular or it may be slowly progressive.

The symptoms of dyspnoea, pain and distress develop rapidly and there is urgent need for treatment. The occurrence of a metallic ball sound in an artificial pneumothorax should always raise the suspicion of a spontaneous pneumothorax.



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(VIII) Contra-Lateral Spread.

There is danger to the contra-lateral lung of an excessively high intra-pleural pressure on the pneumothorax side, causing forcible displacement of a motile mediastinum and also of the sensitization of the patient by too big a refill or by another refill being given before the reaction caused by the previous one has had time to subside.

(IX) Pneumoperitoneum.

A rare accident is the introduction of the air into the peritoneal cavity producing a pneumoperitoneum. It can only occur if the puncture is made low down in the thorax.

(M. M. C. Magazine, Jan. 1947).

Extracts.

TOXIC REACTIONS ACCOMPANYING PENICILLIN THERAPY.

W. J. MORGINSON; J. A. M. A.; 132: 915: 1946.

The adverse symptoms produced by penicillin may be grouped according to its role as (1) direct toxin and primary irritant, (2) antigen, (3) therapeutic shock excitant and (4) indirect action on pathologic processes.

Direct Toxin and Primary Irritant:—For practical purposes the possibilities of penicillin as a direct toxic agent are negligible (Dawson and Hobby, 1944), except following its intrathecal use. Purification of penicillin apparently reduces toxicity. The toxic action in part depends on the cation radicle. Commercial penicillin is not a primary cutaneous irritant. Apparently there is no disturbance of the peripheral blood or hemopoietic system, and penicillin can be used in the presence of pronounced anaemia, leucopenia and agranulocytosis.

Antigen:—Commercial penicillin and crystalline penicillin possess definite antigenic and allergic properties. Sensitivity to penicillin may be manifested as immediate reactions and delayed reactions. The *immediate reactions* usually occur in persons with a known history of penicillin sensitivity or at least previous exposure to penicillin. A small percentage of the population is primarily or spontaneously sensitive to penicillin. *Delayed or acquired sensitivity* may be produced by repeated intradermal injection of penicillin or by repeated local applications, and is analogous to drug or serum sensitivity. Sensitivity to penicillin may be of short duration or it may last for considerable periods, even months, or may be permanent. Toxic symptoms may not be noticed until several weeks following continuous injections. The antigenic potentialities may be latent, requiring lowering of allergic resistance and augmentation with other antigens to present symptoms. Penicillin sensitivity may be epidermal or dermal. If local applications can produce generalised sensitivity, as seems possible, a word

of caution should be made against the injudicious use of penicillin locally.

Allergic symptoms following penicillin therapy are usually mild, of low incidence and transient. Persistence of treatment after appearance of toxic symptoms might lead to severe, alarming and serious reactions. Severe angioneurotic edema and edema of the pharynx, larynx and lungs, known to accompany penicillin therapy, are serious and may be fatal complications. Each patient should be questioned regarding history of allergy, history of previous penicillin sensitivity and history of trichophytosis or other fungus infections. When a patient is sensitive to crystalline penicillin, continued therapy should be used with extreme caution, or only after desensitization, as severe reactions may be anticipated.

Reactions produced by antigen properties of penicillin may be:—(1) Erythema blotchy, diffuse, morbilliform, scarlatiniform flushing of face, dermatitis medicamentosa, exfoliating dermatitis. (2) Urticaria: sparse, mild diffuse, massive, transient, acute, chronic, pruritic. (3) Angioneurotic edema: localized, lips, eyes, tongue, uvula, pharynx, epiglottis, larynx, diffuse solid. (4) Erythema multiforme, erythema nodosum, edema of joints, polyarthritides, painful adenopathy, myalgia, (5) Malaise, headache, generalized aching, chills, fever, nausea and vomiting abdominal cramps. (6) Dyspnea, pulmonary edema, acute syncope, shock. (7) Dizziness, vertigo, muscular twitching, convulsions, loss of consciousness. (8) Euphoria and laughing, psychotic depression, agitation, confusion, nervousness. (9) Epistaxis, petichiae, purpura, regional angitis. (10) Eosinophilia, pseudoalbuminuria, haematuria, azotemia. (11) Tingling in testes, epididymitis. (12) Thrombophlebitis. (13) Exacerbation latent trichophytosis, trichophytids, dyshidrosis. (14) Photosensitization. (15) Drug and serum sickness-like syndrome. (16) Precipitated latent epilepsy.

Toxic reactions to penicillin produced by contact (epidermal) sensitivity are:—Dermatitis (venenata): erythematous, circumscribed; pruritic, mild, severe; vesicular, bullous, edematous, weeping, exfoliating; Cheilitis, Conjunctivitis, Scleritis, Blepharitis, Glossitis, Edema of the penis and scrotum.

Therapeutic Shock Reactions produced by penicillin may be focal or systemic. The focal reactions are:—exaggeration of cutaneous lesions; increased swelling, redness and discharge of chancres; enlarged regional adenopathy; precipitation of secondary lesions; increased pain in bones. The systemic reactions are:—malaise, chills, fever, nausea, vomiting; urticaria, erythema multiforme, morbilliform and scarlatiniform erythema; hoarseness, dyspnea, asphyxiation; myelitis, pseudocerebral syndromes, cranial nerve injuries, convulsions, coma; exaggeration of lightning pains; hallucinations, mania; cardiac embarrassment, ruptured aneurysm.

A Herxheimer reaction can be avoided by early reduced dosage of penicillin.

Indirect action on Pathologic Processes:—Divided and cautious early therapy with penicillin will permit some degree of physiologic adjustment.

Reactions following Intrathecal administration of penicillin are:—Listlessness, headache, nausea, vomiting, cold and clammy skin, vascular collapse, irregular respirations, cyanosis, no blood pressure, thready pulse, muscular twitching, clonic spasms, flaccid extremities, stiffness of neck, convulsions, comatose, unconsciousness, electroencephalogram changes, spinal fluid cell count, globulin, albumin increased in nonsyphilitic patients, positive Kernig sign, positive Brudzinski sign.

Penicillin has a direct irritating effect when applied to the central nervous system. All symptoms are reduced after diminished dosage and particularly with concomitant use of barbiturate sedatives. The convulsive effects of penicillin should not retract from its clinical intrathecal use when indicated, as the therapeutic dosage is usually below that which produces convulsions. Doses higher than 30,000 units are not recommended for diseases of the central nervous system.

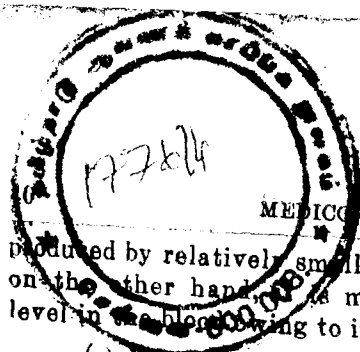
THE CHOICE OF SULFONAMIDES—F.

HAWKING: *Pract.*; 156: 72; 1946.

The choice of which sulfonamides to use in any particular case depends upon several different principles:—

(a) *Degree of activity against Bacteria*, usually measured *in vitro*. For all practical purposes, the difference between the sulfonamides is quantitative rather than qualitative, *i.e.*, some compounds are more active than others, but there is no specificity such that one organism, *e.g.*, staphylococcus, is sensitive to one compound and another organism to another one. The advantage of using certain compounds for certain infections depends rather upon the different distribution of the compounds in the body, so that, for example, sulfathiazole which is excreted rapidly in the urine is especially useful for the treatment of urinary infections. As measured in the test tube, sulfathiazole is probably the most active compound; sulfadiazine, sulfamezathine and sulfapyridine are almost as active; sulfanilamide, sulfacetamide and similar compounds are much less active, particularly against pneumococcal infections.

(b) *Height and duration of blood concentration reached with therapeutic doses*:—Sulfadiazine, sulfamezathine and sulfamerazine are advantageous in that persistently high blood concentrations can be



MEDICO-SURGICAL SUGGESTIONS

produced by relatively small, infrequent doses. With sulfathiazole, on the other hand, it is more difficult to maintain a satisfactory level in the blood owing to its rapid excretion.

(c) *Distribution in the body*:—Sulfaguanidine, succinylsulfathiazole, sulfasuxidine and phthalylsulfathiazole persist in the lumen of the intestine longer than others, and so are especially effective against dysentery. Sulfathiazole excreted rapidly in the urine and is useful for urinary infections.

(d) *Tendency to produce toxic reactions*:—Sulfadimethylpyrimidine and sulfanilamide are probably the least toxic. Sulfadiazine also causes a few toxic reactions, but occasionally it causes obstruction in the urinary passages, if the patient is not well supplied with fluids. Sulfathiazole is more apt than the others to produce sensitization, e.g. drug fever, rash, etc. Sulfapyridine is prone to cause vomiting.

(e) *Expense*:—Sulfanilamide is much the cheapest.

(f) *Supply*:—This has often been the deciding factor during war time.

The chief features of the sulfonamides in common use are as follows:—

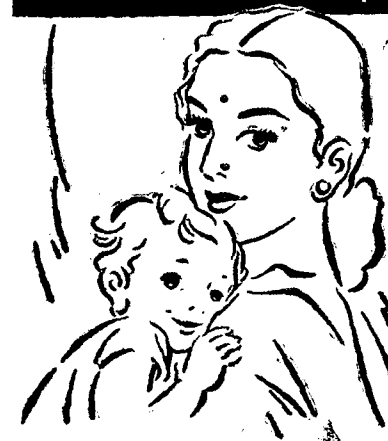
Sulfanilamide is cheap, plentiful and well tolerated. It is relatively soluble and is suitable for moderately severe infections by hemolytic streptococci; but for most other infections, more active compounds are preferable. It is not effective in pneumococcal pneumonia.

Sulfapyridine is plentiful and effective in most conditions which respond to sulfonamides. It often causes nausea and vomiting, and on this account its use is not recommended.

Sulfathiazole is one of the best compounds for general use if sulfadiazine is not available. It is highly active against all sulfonamide-sensitive infections, but owing to its rapid excretion large and frequent doses are required to maintain a satisfactory blood concentration. It has little tendency to cause nausea and vomiting, but it may occasionally cause obstruction in the urinary passages, and it is more liable than the other sulfonamides to cause sensitization reactions, such as drug fever, or rash. It is probably the best compound for local application to wounds to control streptococcal infections.

Sulfadiazine is highly active against bacteria and produces a high and persistent blood concentration on a moderate dosage. It is relatively non-toxic, although it may occasionally cause blockage of the urinary passages. It is possibly the best compound to use for all except mild infections.

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Sulfamezathine resembles sulfadiazine, but it is more soluble and does not cause blockage of the urinary passages. It is as good as, or better than, sulfadiazine.

Sulfamerazine also resembles sulfadiazine. The same blood concentration can be maintained with lower and less frequent dosage than is necessary for sulfadiazine.

Sulfaguanidine tends to remain in the intestine to a greater extent than the above compounds. Its anti-bacterial activity is only moderate. Its use should be restricted to the treatment of bacillary dysentery.

Succinylsulfathiazole breaks down in the intestine to liberate small amounts of sulfathiazole. It is most effective in suppressing coliform bacilli in the intestine, and is devoid of toxicity. Its use is restricted to the bacillary dysentery and to pre operative preparation of patients before surgical interference with the colon.

Phthalylsulfathiazole is a new similar compound which is said to be more active than succinyl sulfathiazole.



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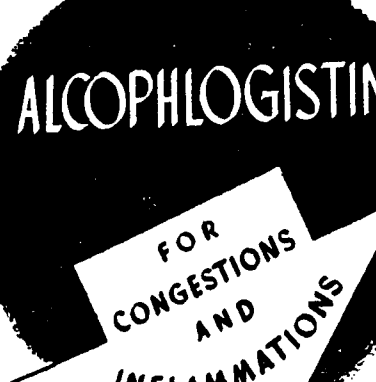
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