

the individual is lying, standing or sitting. The phrenic level (according to Holzkecht) is highest when the patient is recumbent, in which position the abdominal contents, acted on by gravity, push against the diaphragm. When standing the diaphragm is slightly lower than when lying down. The force here is the rigidity of the abdominal walls exerting pressure on the viscera, which force is partly counteracted by gravity pulling the abdominal contents away from the diaphragm. In the sitting position the diaphragm is lowest, for in this attitude the abdominal musculature is partly relaxed and the force of gravity acting on the abdominal contents less opposed sucks the diaphragm downward.

The diaphragm functionates in an analogous manner to the other muscles of the body. Its excursion is greatest when its points of origin and insertion are most widely separated, and it acts more forcibly against resistance than when acting unopposed. This has been beautifully shown by Holzkecht<sup>6</sup> on a patient lying in the lateral position (on his side). That half of the diaphragm nearest the table (i. e., the lower half) suffers most of the weight of the abdominal contents and consequently stands higher than the opposite or upper half.

But notwithstanding this pressure, its excursion is greater than the opposite unopposed half. This upper half, furthermore, acts very peculiarly. It stands comparatively low and instead of sweeping up and down with its fellow of the lower side, it remains almost motionless, swinging in a sort of pendulum fashion about an axis which runs through its middle point. In other words, its excursion is decreased because its points of origin and insertion are approximated and because its action is unopposed.

The accompanying outline sketches of original skiagrams were selected at random to illustrate the various phases of abnormal diaphragm relations.

The exposures were made with the patient in a sitting or standing posture, respiration suspended after a moderate inspiration, plate in front, tube behind, target at a distance of twenty inches from the plate. Time, five to fifteen seconds, eight to ten milliamperes of current traversing the tube.

## THE CHOICE OF A VASODILATOR AND THE INDICATIONS FOR VASODILATATION.\*

HENRY WIREMAN COOK, M.D.  
MINNEAPOLIS.

In several recent articles I have asked for greater attention to the use of sodium nitrite as a vasodilator in preference to nitroglycerin and amyl nitrite. The administration of the sodium salt during the past four years in numerous cases where arterial relaxation seemed indicated, and under the control of blood pressure determinations, has graphically demonstrated the efficiency and permanency with which proper doses of sodium nitrite will lower arterial tension. Comparative observations with amyl nitrite and nitroglycerin have invariably proved favorable to the sodium compound. I have made only a limited number of observations with erythrol tetranitrate, introduced by Prof. Bradbury of England, and could demonstrate no advantage over the sodium

salt. It is very expensive, a dozen tablets costing one dollar.

Accurate methods of observing changes in pulse tension applicable to clinical usage have done much toward introducing and establishing in medical practice many facts concerning the action of drugs on the heart and vessels which have long since been demonstrated in physiologic work. It is a difficult and tedious process for truths established by physiologic experimentation to supplant the firmly rooted fallacies of faulty clinical observation. Nitroglycerin and whisky are even yet lauded from time to time as heart stimulants, and preparations of the adrenal glands for pulmonary hemorrhage. When, however, the practitioner has the means of accurately following the effects of the drugs he administers, he can break away from the traditional legends which have been handed down to him, and can himself detect the fallacies in the recommendations of some, enthusiastic colleague or some enterprising concern.

Any one who had accurately followed the results of alcohol or an active preparation of nitroglycerin would no longer rely on them to raise blood pressure, even though the pulse might "feel" stronger, and a single observation of the powerful blood-pressure raising effect of adrenal preparations would give sufficient warning of their danger in internal hemorrhage or in weakened conditions of the heart muscles. In no instance have accurate clinical methods been of greater value than in defining and broadening the use of vasodilators. Medicinal means of dilating the arterioles and so lowering blood pressure have an important place in general therapy, for a high tension pulse accompanies many chronic diseases, induces severe symptoms, and may precipitate a fatal termination.

### THE SPHYGMOMANOMETER.

The use of vasodilators has been greatly broadened by the growing use of some form of sphygmomanometer, or instrument to measure blood pressure, so that the indication may be definite and the action accurately followed.

The first instrument made in the country for the measurement of blood pressure, suited to clinical usage, was my modification of the Riva-Rocci principle, devised from a modification which Dr. Cushing had brought from the Italian clinic to the Johns Hopkins Hospital. I have used the same instrument continually for three years with merely a change of rubber tubing, and believe it is the most practical and satisfactory for the general practitioner, as it is simple, and easier to use at the bedside than the later more complicated instruments. It is now made with an improved wide arm piece.

In the large majority of cases where it is desirable to lower arterial tension, and where dietetic and general measures are inadequate or inapplicable, the desideratum is not to weaken the propelling force, but to lower the resistance. Hence cardiac depressants are not indicated but vasodilators. This is not true in a certain minority of cases, particularly in acute diseases in children where a run-away, overirritable heart needs repression, and aconite may be indicated. In some cases aconite may be used advantageously in conjunction with vasodilators, as especially recommended by Babcock.

Although this paper is devoted to the administration of drugs a word should be said of dietetic and general measures which have the same effects on arterial tension in certain cases as the vasodilator; that is, they tend to lower an abnormal hypertension. Where the

6. *Physiol. u. Pathol. d. Atmung*, p. 9.

\* Read by invitation before the Medical Club of Minneapolis, 1907.

same end can be accomplished by other means without the use of drugs, the latter are contraindicated, and undoubtedly, rest from business and worry, regulation of the amount of water ingested, restriction in amount of food, especially meats, moderate outdoor exercise, etc., will in many cases lower a chronic abnormally high tension. But in acute conditions and in many chronic ones, medicinal aid is valuable.

There are two particulars that we would inquire concerning, in making a selection of a vasodilator: First, its action on arterial tension; second, its general or systemic effects. I shall consider these points in succession.

#### ACTION OF SODIUM NITRITE ON ARTERIAL TENSION.

The action of sodium nitrite on arterial tension is shown by physiologic as well as by clinical observation to be invariably toward lowering the existing tension, which lowering, except in cases of organic changes such as arteriosclerosis or great hypertrophy of the vessel walls, seems to be in absolute amount inversely proportionate to the existing tension. That is, we would expect a tension of 180 mm. Hg to be lowered a greater number of millimeters by the same dose than a tension of 100 mm. Hg. Likewise the lowered ten-

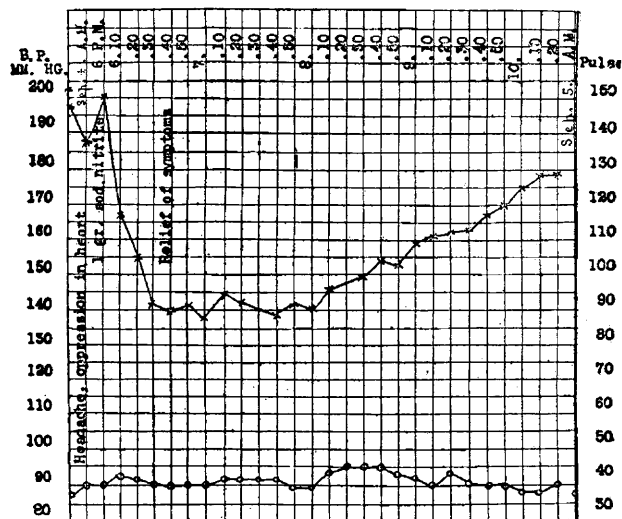


Fig. 1.—Chart illustrating relief of symptoms by vasodilation in a case of hypertension. Male, aged 60, with nocturnal cardiac asthma and cardiac hypertrophy; sounds clear. Urine specific gravity was from 1.015 to 1.020; no albumin at any time; an occasional hyaline cast.

sion is often maintained over a longer period in high tension cases than in low. This must be remembered in prescribing the intervals between doses. This point is illustrated by charts (Figs. 1 and 2) from a case of cardiac hypertrophy with hypertension and an case of pulmonary hemorrhage in phthisis with low tension. In both cases lower tension was desired.

The action of sodium nitrite usually comes in from three to five minutes when administered by mouth, and in about two minutes when given hypodermically, and maintained one to two and one-half hours, the return to previous level being accomplished in from two to three and one-half hours or more, the whole effect when charted being represented by an irregular curve with the convexity downward.

In this action on tension I have found sodium salt far preferable to amyl nitrite or nitroglycerin. The former has its uses undoubtedly in certain very acute conditions where immediate action is desired, as in angina pectoris, but its action is always uncertain in de-

gree, and extremely unreliable, and can never be depended on for effect lasting over one or two minutes. Thus in hemorrhage for instance, the rapid and uncertain changes in tension produced by amyl nitrite might readily do more harm than good, unless the action were continued by the sodium salt.

Nitroglycerin also acts quickly and rather uncertainly, and is of short duration. The uncertainty of its action has led me to make inquiry as to the probable decomposition products of nitroglycerin where the preparation is not perfectly fresh. A letter from the chemist of Wyeth Brothers on this subject is as follows:

As to the exact products of the slow decomposition of nitroglycerin, we believe them to be similar to products formed through spontaneous decomposition of this substance, such as glyceric acid, oxalic acid, hydrocyanic acid, nitric acid, ammonia and various other unidentified products which have been found to result from such decomposition, as contained in the reports of the British Association, 1856. Whether all of these are formed through the gradual decomposition of nitroglycerin in tablet form we do not know, but one or the other, no doubt, will be produced and may be of such a nature as to have toxic effects.

Authorities seem agreed that the sodium salt is more stable, and my own experience seems to me conclusive

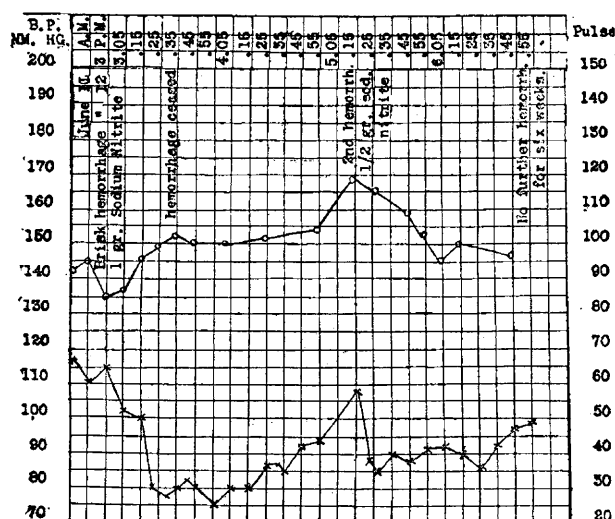


Fig. 2.—Chart illustrating control of hemorrhage in phthisis by vasodilation.

on this point. The duration of a therapeutic dose of nitroglycerin has not been noted by me to continue longer than one hour. The onset of the action is also sometimes sudden and occasionally alarming.

#### SYSTEMIC EFFECTS OF SODIUM NITRITE.

A great recommendation for the use of sodium nitrite is the almost entire absence of general effects when given in proper doses. The throbbing, dizziness, flushing, etc., which are often distressing with amyl nitrite and nitroglycerin, are slight or absent with sodium nitrite. This I think only in part arises from the more gradual action, for even when given hypodermically there is no distress. I have never noted the headaches which are not an infrequent accompaniment of continued use of nitroglycerin. I have a patient now under observation who has been taking sodium nitrite for three years off and on with no bad effects whatever. Some days this man, who has high tension and cardiac hypertrophy will not take any nitrite, being guided by his symptoms, but usually he will need one or two tablets of one-half grain each before he can get to sleep without shortness of

breath, etc., on lying down. I have found it most convenient to give sodium nitrite in triturates of one-half and one grain each. They may be given by mouth or hypodermically.

Although the observation of an abnormally elevated blood pressure may be the indication for the use of a vasodilator, this is not essential, for vasodilatation may be indicated with a normal or even a subnormal blood pressure, for instance in internal hemorrhage where the vessel can not be caught and tied. In such cases, as has been repeatedly observed, the hemorrhage will often stop spontaneously when the patient has become so greatly exsanguinated that the very low blood pressure allows a firm clot to form. The advantage to the patient is obvious when this result can be obtained by bleeding the patient into his own blood vessels instead of into the abdominal cavity or a pulmonary vomic. Where vasodilatation is produced and maintained until the danger from further hemorrhage is past the blood has been merely stored in the dilated vessels and can be restored promptly to the circulation by withdrawal of the drug.

In reviewing briefly the indication for the use of vasodilators, I shall group them under two main headings according as to whether they are associated with (1) low and normal tension; (2) high tension.

#### ASSOCIATED WITH LOW TENSION.

First, cases with low and normal tension where vasodilators are indicated: (a) Hemorrhage uncontrollable by ligature, compression, or local application. Under this would come ruptured extrauterine, postoperative, postpartum and traumatic hemorrhage where surgical methods of ligature, suture and packing may either not be applicable, or may not have controlled the flow entirely; hemorrhage from bowels in typhoid; hemorrhage from stomach as in ulcer or cirrhosis; aneurism; hemorrhage in phthisis. Here the hemorrhage is the indication for the vasodilator and not the blood pressure reading.

The blood pressure may be reduced as low as 70 or 75 mm. Hg without danger to the patient. With a pressure as low as 75 mm. Hg, however, I should not advise further reduction, as a blood pressure much below this point seems to cause respiratory distress through lack of circulation in the respiration center. However, in severe hemorrhages, as is well known, after the blood pressure has fallen below a point at which peripheral pulsation can be felt, the hemorrhage may stop before a fatal amount is lost, and such patients have rallied and recovered even after they had been pulseless.

In operative procedures where control of bleeding is difficult, a lowered tension from nitrite will be found of great assistance. For instance in a Gasserian operation on a man with arteriosclerosis and high tension, the hemorrhage obscured the field and was alarming, but was easily controlled after reduction of the tension. Again in a complete hysterectomy operation as advised by Sampson for carcinoma, the bleeding, encountered deep in the pelvis, was uncontrollable until the tension was lowered nearly 50 per cent.

In the treatment of aneurism the formation of a clot is favored by a low tension, and where the sac is wired, an induced low tension tends to lessen the danger from embolus—as well as to hasten the formation of a clot. I should further advise the use of vasodilators in cases of venous thrombi as the lowered tension would also here lessen liability to embolus.

#### ASSOCIATED WITH HIGH TENSION.

Conditions accompanied by a high tension pulse are rapidly coming into greater prominence, and are more frequently brought to the notice of the practitioner. This increased prominence is, in my opinion, due to both an absolute increase in the frequency of the condition, as well as greater frequency of recognition due to improved methods of observation. The more general use of the sphygmomanometer has produced a more frequent recognition of the high tension pulse, but *pari passu* with the increasing strain of modern professional and business life, there is a simultaneous increase in physical strain, and this is particularly shown in the cardiovascular system by high tension pulse. As an example of a not infrequent condition I will cite the case of one of our great financiers who on the eve of a desperate attempt to corner the market, applied for \$1,000,000 insurance to cover some loans. At the medical examination, a high arterial tension and accentuated second sound were the cause of a rejection. This man wisely abandoned immediately his financial operations, and went to Europe for a complete rest for six months, and was offered on his return to America all the insurance he wished. The vast majority of cases never receive the warning until serious organic changes produce symptoms, and then rest and proper mode of life can not always effect a return to normal, and recourse must be had to medicinal means of averting a dangerously high tension, with an apoplexy or acute dilatation as a termination. It is here that a vasodilator must be employed.

#### INCREASE IN CARDIOVASCULAR DISEASE.

The three great cardiovascular diseases: Apoplexy, cardiac hypertrophy and dilatation, and chronic interstitial nephritis, which play so large a part in general mortality, are on the increase, and they are all accompanied by high arterial tension, and this high tension in a majority of the cases antedates the disease, and undoubtedly is an etiologic factor; so that high arterial tension when found without discoverable organic disease should be treated as a serious condition, and should also be recognized and corrected when it exists in connection with organic disease of heart, blood vessels or kidneys.

In heart and kidney cases, the mere reduction of an abnormally high tension will often produce the most striking and satisfactory results; that is, if the tension can be lowered, the dyspnea, sleeplessness, anxiety and cardiac pains are often greatly relieved or removed. The headache of kidney disease, often one of the most distressing symptoms, is alleviated, and in some cases the amount of albumin markedly reduced. There can be no doubt that a reduction of high tension in chronic heart or kidney cases is attended with greater relief and general improvement than follows any other single measure.

A word of warning, however, is timely here. This reduction, especially where there are severe renal changes, should not be accomplished too rapidly, nor be carried too far. It must be remembered that probably in certain sclerotic kidney cases the high pulse tension is a physiologic compensation on the part of the arterial system to offset the inability of the kidney to function except under pressure, and where the compensatory action is inhibited by arterial dilatation, the kidney is unable under lower tension to function, and the water may fill pleural or pericardial sacs or bronchial tubes, and the retained waste products may induce coma; so that

when there is severe kidney involvement the reduction should be slow and carefully watched, and accompanied by very free evacuation of bowels. One other word of warning: A lowered tension often brings with it a feeling of lassitude and weakness, which possibility should be explained to the patient, so that he may not misunderstand it and feel that he is worse because he does not feel as strong as when living with a dangerously high tension.

There is no indication, however, for vasodilatation merely because Bright's disease has been diagnosed from urinary findings, for this disease may exist without any increase in arterial tension; in spite of the extreme position of certain authors claiming hypertension as the causal factor in all cases of Bright's disease. The indications for vasodilatation in Bright's disease depend on the actual demonstration of high arterial tension by the sphygmomanometer, and the amount and frequency of the dose depend on the individual effect in each case.

No case of cardiac, arterial, or renal disease should be treated without the use of the sphygmomanometer, as to attempt to regulate arterial tension without any knowledge of its degree or its action under treatment, is to work in the dark. One-half grain of sodium nitrite is a safe initial dose in an untried case, and a three-hour interval between doses. The adjustment of dose and interval must be made in each case by use of the sphygmomanometer.

#### SUMMARY:

1. Sodium nitrite is the best vasodilator; it has the most enduring effects; is most stable and dependable; gives rise to fewest unpleasant symptoms.

2. Vasodilatation may be indicated with low or normal tension: *i. e.*, all uncontrollable hemorrhage, either: During operative manipulation; typhoid ulceration; gastric ulcer; pulmonary phthisis; other internal hemorrhage uncontrollable by surgical methods; aneurism; thrombus, etc.

3. High tension is abnormal, and is either the accompaniment of organic disease, or else presages its onset; in either case it demands treatment: first, by general hygienic measures; second, when necessary, by venesection or vasodilatation with drugs—preferably sodium nitrite.

### PROSTATIC CALCULI.

#### WITH THE REPORT OF TWO CASES.

G. L. ROHDENBURG, M.D.

House Physician, German Hospital.

NEW YORK CITY.

It is a well known fact that in some way altered prostatic secretion often forms concretions. According to Virchow, and to Morgagni before him, there is a proteid in the prostatic secretion which when present in excess is precipitated in the acini of the gland forming these concretions. The concretions in some instances start up an inflammation of low grade with an excess secretion of mucus. The epithelial detritus, together with the mucus and concretions, forms the nucleus for the deposit of mineral salts forming the calculi. They may be present in any or all parts of the gland. They may be single or multiple, and in a few cases the gland may be so filled with plates of calculi as to give the sensation of one stony shell. In size they vary from a millet seed to a peach pit. They are usually rounded, and when there are many in the one common sac they are often

facetted. At times they form regular stony plates as above stated.

A typical calculus is stony hard, without distinctive odor, and ranges from light brown to dark blue in color. At times calculi resemble porcelain because of their high polish. Sections through them show the larger ones to be formed of distinct lamellæ. Chemically they are composed chiefly of the phosphate and oxalate of lime, together with a nucleus of organic matter. The phosphate of ammonium and magnesium has also been found. In those passing into the bladder or lying in a sac in contact with urine the usual salts of vesical calculi are also found. The following are two quantitative analyses:

Lassaigne.....	{ Phosphate of lime.....	84.5
	{ Carbonate of lime.....	0.5
	{ Organic matter.....	15.0
Dupuytren.....	{ Phosphate of lime.....	60.
	{ Phosphate of ammonium and magnesium..	20.
	{ Carbonate of lime.....	20.

Dupuytren in 1820 was the first to give an accurate description of the condition. The symptoms of prostatic calculi are insidious in onset and the condition is not easy of diagnosis. The majority of the cases reported have been found accidentally. The symptoms are those of a composite picture of vesical calculi and hypertrophied prostate with points of differentiation. The true prostatic calculi occur almost entirely in the young adult, the ages of the cases reported averaging 28 and the extremes being 23 and 30. One may be able to obtain a history of gonorrhea in almost 40 per cent. of cases.

#### THE SYMPTOMS.

As a rule the first complaint of a patient is that of a sense of fulness in the perineum, together with a burning stinging pain at the end of micturition. Gradually the patient then notices a delay in starting the stream, which difficulty increases with the duration of the case. Shortly after this dribbling at the end of micturition, together with frequent urination, is noticed, and about the same time pus is found in the urine. Defecation becomes excessively painful and when the stool is hard causes sharp darting pains in the glans penis, and testes.

Often on violent effort to lift this same pain comes on, caused by the compression of the abdominal contents against the perineal floor. Priapism of several days' duration has been described in two cases. In several cases frequent emissions have been the sole complaint of the patient, the condition being discovered on physical examination. Temperature of 100 or 101 F. is often present, but uncomplicated cases do not develop septic temperatures or chills. If the case has any of the complications to be mentioned below the symptoms of the particular complication are of course added.

The objective symptoms are the ones on which the differential diagnosis is made. Rectal examination reveals a very much enlarged, exquisitely tender, stony-hard gland. Moderate, and sometimes light, pressure of the examining finger gives the sensation of crepitus and causes exquisite pain. Perineal examination may reveal a tender mass or not, according to the degree of enlargement. The urine is that of a cystitis—ammoniacal, full of pus and occasionally containing blood. Sounding the urethra reveals nothing until the prostatic portion is reached, when a sensation as if passing through a bed of gravel is experienced. The Roentgen rays may also be used as an aid to diagnosis. The cystoscope, aside from its use as a sound, reveals only the picture of a cystitis more or less acute.