THE NATURE OF DISCHARGES AND DOUCHES.*

BY WYATT WINGRAVE, M.D., LONDON,

PHYSICIAN AND PATHOLOGIST TO THE HOSPITAL.

DOUCHES AND IRRIGANTS.

Purposes.—A douche or irrigant may have for its object: (1) the mechanical removal of morbid secretions, accumulations, and foreign bodies; or it may be used (2) for antiseptic purposes; or (3) for diagnosis.

Essentials.—To effect satisfactorily these objects the douche or irrigant must conform to certain requirements which vary according to circumstances. 1. The solution employed should, when practicable, be a solvent of the substance to be removed. 2. The reagent should be itself readily soluble in water and form a clear solution. 3. It should be non-irritating to mucous membranes and sensitive surfaces. 4. To ensure thoroughness it should possess the power of penetrating the surface tissues. 5. It should be miscible—i. e., chemically compatible with the most effective antiseptics. 6. It should be economical in cost and readily available. Of these essentials perhaps the most important one is that of having the power to dissolve the discharge, since there are so many solutions in general use which not only have no such solvent action, but actually precipitate and harden the substances which they are intended to remove.

Nature and composition of discharges.—As a preliminary to choosing the materials for a douche it may be expedient to consider the nature and composition of the different discharges and accumulations which demand treatment. So far as our own field of work is concerned, they may thus be grouped: (1) catarrhal; (2) serous; (3) purulent; (4) cerumen and cholesteatomata; and (5) fibrinous and hemorrhagic.

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1. Catarrhal products as commonly met with in the nose and naso-pharynx and less frequently in the ear may be either viscid or inspissated to the extent of forming "crusts." Coming from mucous membrane the fluid consists chiefly of an alkaline solution of mucin, with globulin and serum albumin in proportions varying with the intensity and nature of the morbid process. Epithelial cells in varying degrees of mucoid degeneration and leucocytes, will be suspended in the fluid, together with varieties of bacteria. Of the organic constituents mucin is readily soluble in weak solutions of alkaline salts, such as bicarbonate of sodium (from 0.5 to 1 per cent.), but insoluble in acids, while cells and serum globulin are soluble in weak solutions of neutral salts, as also the nucleo-albumin of the cells, albumin being soluble in water.

2. Serous discharges rarely call for special removal except when localised. In them globulin occurs in greater proportion than mucin, therefore a neutral saline solution should be selected.

3. Pus will obviously vary considerably according to the conditions of its production and the duration of its retention. It may be thin, viscid, and even solid (caseous), sweet or fetid. According to Hoppe Seyler the proportions of organic solids in 100 parts of dried pus are: proteids, 13; nuclein, 34; fats and lecithin, 14; cholesterin; 7; cerebrin, 5; extractives, 4; and insoluble substances, 20. Halliburton gives nucleo-albumin, cell globulin, albumoses, and peptones as the chief constituents. In the fluid part or serum globulin with small quantities of serum albumin and albumoses will be found, while the organised solid or cell elements, such as leucocytes, connective tissue fragments, etc., will yield nucleo-albumin, cell globulin and nuclein, also fats, lecithin, cholesterin, etc., in varying degrees of fatty and other degeneration. All these are soluble in weak solutions of either neutral or alkaline salts respectively.

4. Cerumen may vary from a thin treacly consistence to that of a firm plug, more or less mixed with epidermal squames, hairs, parasites, dust and other foreign matter. Being fatty in nature it is readily soluble in alkaline salts. But as the duration of contact by an irrigant is so short and the plug oftentimes so dense softening by means of

a strong alkaline solution, preferably in glycerin, is often expedient as preliminary to the douche. Cholesteatomata consist of closely packed laminated squamous epithelium with fatty granules and cholesterin crystals. The cells will yield much keratin and nuclein, both of which with the fatty débris are soluble in alkalies. Sometimes, as in middle-ear suppuration, the epithelium is mixed with pus; if so the neutral salts also should be used in combination.

5. Plastic exudation consisting chiefly of filamentous fibrin entangling leucocytes in its meshes is extremely difficult of solution and rarely admits of more than a softening process by solutions of the neutral and alkaline salts, such as sodium sulphate, calcic hydrate, etc. The same applies to bloodclot, which is, however, less dense and consequently much more readily removed by similar irrigants.

Choice of material for douche.—Knowing the nature of the discharge and the solvents of its chief constituents there will be but little difficulty in selecting an efficient irrigant which shall act both chemically and mechanically. The appended table of reagents in frequent use will facilitate selection. On one side are grouped the solvents, on the other those which either actually precipitate, or at all events do not dissolve, the prevailing constituents of the discharge.

Table of Solvents and Precipitants.

Solvents.	Precipitants.
Sodium sulphate (from 1 to 2 per cent.).	Water (except albumin).
Potassium sulphate (from 1 to 2 per cent.).	Mercury biniodid.
Magnesium sulphate (from 1 to 2 per cent.).	Mercury perchlorid.
Ammonium sulphate (from 1 to 2 per cent.).	Alum.
Sodium bicarbonate.	Zinc chlorid.
Sodium chlorid.	Zinc sulphate.
Sodium hydrate.	Zinc permanganate.
Sodium biborate.	Potassium permanganate

Sodium sulpho-carbolate.	Hydrogen peroxid.
Calcium chlorid.	Formalin.
Calcium hydrate.	Carbolic acid.
Potassium hydrate.	Boric acid.
Potassium carbonate.	Liquor sodii chlorinat.
Chinosol.	Liquor carbonis deter- gens.
	Izal.
	Alcohol (fatsexcepted).
	Sulphurous acid.

It will thus be seen that many of the solutions which we most usually employ are not those best adapted to their purposes, since some of them—e. g., the salts of mercury, phenol, boric acid, etc.—actually coagulate or form insoluble compounds with the chief constituents of the discharge, thereby preventing thorough irrigation. One must not ignore, however, the qualification that the duration of contact between the irrigant and the discharge is often so short that either complete solution or complete precipitation of the organic elements can scarcely be expected. Still, it will generally be quite sufficient for the purpose if the matrix is dissolved and diluted so as to facilitate the division and removal of the solid and organised matter—e. g., in the case of “crusts,” pus, cerumen, cholesteatomata, etc. This will obviously be more thorough when a solvent of that matrix is employed in preference to a fluid which can at the best act only mechanically. It is scarcely necessary to discuss each agent separately, yet several demand special notice.

Taking water first, this is by no means the most effective irrigant, whether employed as tap or distilled, warm or cold, since of the organic substances albumin is about the only one which it dissolves.

Next in importance are the neutral salts—sodium, potassium, magnesium and ammonium sulphates with sodium and calcium chlorids. These act as solvents of the globulin group, but vary in degree and according to the strength of solution employed. Sodium sulphate is by far the most useful, especially if employed in a strength of from 1 to 2 per cent., but if stronger—e. g., from 5 to 10 per cent. or more—it causes precipitation of proteids. It still further

has the property of penetrating organic tissues. This is well illustrated in the action of Müller's fluid (a solution of chromic salts and sodium sulphate) which not only hardens the tissue, but penetrates to its deepest part. Should the chromic parts be used alone, however, the hardening is only superficial. The quality is of the greatest value when dealing with a granulating surface and in economizing cocain.* Sodium sulphate still further has the valuable property of mixing readily with biniodid and other salts of mercury in efficient antiseptic strengths. Calcium chlorid, although not quite so good a solvent, is particularly useful as a hemostatic douche, since calcium salts play an indispensable part in the blood coagulation. Sodium carbonate is perhaps the best solvent of mucin, which forms by far the chief organic substance in catarrhal secretion; it is also a solvent of nucleo-albumins, fatty material, nuclein, keratin, etc.; its strength should be about 0.5 per cent. The same remarks apply to borax (sodium biborate), which salt has the additional advantage of possessing some antiseptic properties. Its strength should be from 0.5 to 1 per cent. Sodium, potassium, and calcium hydrate are valuable chiefly for their softening action upon the tissues and are not applicable as douches, except in very weak solutions since they form a glutinous compound with albumins known as Lieberkühn's jelly, familiar to us in the well-known "ropy" or "gelatinous" reaction between pus and liquor potasse. The first and second are useful when combined with glycerin for softening ceruminous and epidermal plugs as a preliminary to irrigation. Chinosol does not precipitate and mixes well with the neutral salts, but decomposition occurs when combined with alkalies. Distilled water is preferable to tap water.

We will now consider the behaviour of the opposite group, which apart from their purely passive and mechanical action in very weak solutions are either actual precipitants or at all events do not dissolve the matter which they are employed to remove. As before mentioned, pure water precipitates the globulins and has no solvent action upon fats; used alone, therefore, it is not an entirely efficient douche. The salts of zinc—sulphate, chlo-

*The Lancet, Dec. 8th, 1900, p. 1679.

rid and sulpho-carbolate and permanganata—are chiefly used for their astringent properties, since they form insoluble compounds with the proteids and should only be used as astringents. The same applies to alum and to potassium permanganate. The latter salt may be mixed with sodium bicarbonate or biborate and forms an excellent douche for removing fetid crusts in the nose and nasopharynx. Boric acid is perhaps one of the most favored douche agents, probably owing to its supposed antiseptic qualities, but, unfortunately, it is not a solvent of proteids and therefore does not conform to our essentials. Carbolic acid (phenol) is a powerful precipitant of the proteids; it should therefore be mixed with solutions of sodium sulphate or carbonate, when it will prove a more efficient douche. Care must always be taken that the solution is complete, otherwise the phenol will be simply suspended and will obviously cause much irritation, even pain, especially when used as a nasal douche. Imperfect solution can be avoided by using the best preparations of phenol (absolute or No. 1 carbolic acid) by boiling, by using the above salts, or by diluting glycerin of carbolic acid (P. B.). Formalin is now very popular as a douche, but it is a very powerful precipitant. Peroxid of hydrogen, unless freely diluted, has the great disadvantage of causing rapid effervescence when mixed with pus. This is extremely awkward when irrigating a cavity, such as the maxillary sinus. Izal and liquor carbonis detergens are not only precipitants, but have the further disadvantage of being emulsions and opaque, so interfering with diagnostic evidence. They are also toxic and very irritating to the mucous membranes and require great care in their use. Finally, the inorganic salts of mercury—the perchlorid and biniodid—are most powerful precipitants, readily forming insoluble compound with abumins and globulins.

In addition to its purely mechanical use a douche may be required for antiseptic purposes. But our most valuable antiseptics are precipitants of proteids and therefore not thorough irrigants; consequently it is more often expedient to irrigate first with a solvent and use the antiseptic afterward, as in the case of suppurative middle-ear disease. This need not, however, always be done, since

biniodid of mercury, phenol, chinol, and many powerful antiseptics are not only miscible with pure sodium sulphate, but when mixed the solution do not precipitate proteids so readily as a plain solution of the antiseptic would. This is a property of no slight importance. In the use of potassium permanganate where there is much mucin, as in the crusts found in atrophic rhinitis, a combination with sodium bicarbonate or baborate will be found to afford a very efficient deodorant douche with or without sodium sulphate. Boric acid is so feeble an antiseptic, even by itself, that its combinations need no serious consideration. This, however, does not apply to chinol, which, mixed with sodium sulphate, affords not only a clear solution, but one having high solvent and antiseptic properties. Its great disadvantage is its cost. Sanitas also mixes well with the neutral salts and its efficiency is markedly increased.

It will thus be seen that few reliable antiseptics, when used by themselves, actually conform to the essentials of a perfect douche, but when combined with a neutral salt their efficiency is undoubtedly increased, this being due in a great measure to an increase in penetrative power.

A protesting word may here be not superfluous with regard to many popular formulæ combining thymol, eucalyptol, menthol, and other aromatics with various inappropriate salts which are employed as antiseptic douches. These are not only extremely irritating to the mucous membrane—especially the nasal—sometimes causing great discomfort, but they should only be recommended as deodorants and in those cases which demand stimulating as an adjuvant to the routine solvents—e. g., atrophic rhinitis. When available an economical and efficient douche in cases of atrophic and fetid rhinitis is to be found in sea water. It should be thoroughly well boiled, decanted and used at a temperature of about from 60° to 70° F. A pinch of sodium bicarbonate to the pint may be added when the crusts are very firmly adherent. When employed for diagnostic purposes the douche should be transparent and colorless, hence liquor carbonis detergens, creolin, izal, permanganates, etc., are to be avoided. Likewise, too, it is inadvisable to employ any precipitant such as mercuric chlorid for exploratory irrigation when the exit passage is

likely to be minute—e. g., per Lichtwitz cannula in the case of suspected maxillary sinus disease.

Although far from complete, the foregoing selection may be considered as fairly representative of the materials frequently employed as douches and, however true it may be that experience eventually leads us to select that which is most serviceable, the application of our knowledge of physiologic chemistry will doubtless not only facilitate that selection, but also guide us to still further improvements. While disclaiming any intention of suggesting a universal irrigant, experiments in the laboratory and clinical observation amply emphasize the fact that we have in the neutral salts, especially sodium sulphate, by far the most reliable basis for an irrigant, especially when pus predominates, but in many instances already referred to the addition of an alkaline salt will render it even more effective. Whatever formula be employed it must obviously be modified according to the clinical circumstances calling for its use and efficiency will be ensured by practically appreciating the teachings of the physiological laboratory.

The appended formulæ are based upon the foregoing principle, having all been thoroughly tested chemically and clinically, and although selected chiefly for use in connection with disease of the ear and upper respiratory tract they are equally applicable to general surgery.

Formulæ.

1. Sodium sulphate, from one and a half to three drams; water to one pint (20 fluid ounces), from 1 to 2 per cent.

2. Sodium sulphate, from one and a half to three drams; sodium bicarbonate, 40 grains; water to one pint.

3. Sodium sulphate, from one and a half to three drams; borax, 40 grains; water to one pint.

4. Sodium sulphate, from one and a half to three drams; sodium bicarbonate, 40 grains; glycerin of carbolic acid, 45 drops; water to one pint.

Not.—Instead of glycerin of carbolic, absolute phenol nine grains or No. 1 carbolic acid may be used. Heat to 155° F.

5. Borax, 40 grains; bicarbonate of soda, 40 grains; glycerin of carbolic acid, 45 drops; water to one pint (diluted Dobell's solution).

6. Sodium sulphate, one and a half drams; chinosol, 10 grains; water to one pint.

7. Sodium sulphate, one and a half drams; sanitas, three fluid drams; water to one pint.

8. Sodium sulphate, one and a half drams; perchlorid of mercury, two grains; water to one pint (1 in 5000).

9. Sodium sulphate, one and a half drams; red iodid of mercury, two grains; sodium iodid, two grains, water to one pint (1 in 5000).

10. Sodium sulphate, one and a half drams; potassium permanganate, two grains; water to one pint.

11. Sodium bicarbonate, 40 grains; potassium permanganate, two grains; water to one pint.

Note.—Borax (40 grains) may be used instead of sodium bicarbonate.

12. Solution of calcium chlorid (P. B.) six fluid drams; water to one pint.

Notes.—The pure exsiccated sulphate of sodium should always be used in preference to the ordinary crystalline salt. Bicarbonate is preferable to carbonate of sodium. Hot water whenever convenient should be employed to make the solutions. Solutions of phenol should be heated to 155 degrees. No. 1 as a simple irrigant for pus, Nos. 2 and 3 when mucus is present or when the discharge is inspissated, Nos. 4, 5, 10 and 11 for inspissated fetid mucus or "crusts," Nos. 6, 8 and 9 as antiseptics, and No. 7 and 10 as deodorants. No. 12 is chiefly employed for its hemostatic property.

METHODS OF EMPLOYMENT AND INSTRUMENTS.

The selection of an instrument will be guided, first, by the particular purpose for which the douche is to be employed; secondly, whether it is intended for the surgeon's or for the patient's sole use. This distinction is by no means unimportant, knowing how rarely the layman appreciates the possibility of infection and the importance of cleanliness. In this instance he is perhaps not entirely to blame, since this ordinary apparatus at his disposal—e.

g., the rubber ball, glass or metal syringes—are without doubt the most dangerous weapons ever employed. An ocular and olfactory, still more a bacterial, examination of the interior of any syringe which has been much used, will at once emphasise the truth of this statement. The cause of this is obvious: no apparatus that has to be filled by the aperture which comes in contact with the wound can escape contamination of its interior, except through special care which cannot be expected in its domestic employment. In the case of aural and nasal douches, the application to the nozzle of a short piece of rubber tubing, which can be renewed or removed and sterilized, greatly reduces the risk of infection or of injury during self-use. The ordinary form of hydrostatic douche is not liable to infection in this particular way, but it is a somewhat clumsy arrangement and not to be advised for delicate and deliberate work as in aural cleansing, since it admits of but slight variation in volume and pressure.

Dr. J. Dundas Grant's modification of the piston syringe is thoroughly efficient in guarding against septic infection, being fitted with a two-way tap which admits of filling through a separate channel (Fig. 1). This with the ordinary piston glass or metal form is, however, very difficult for the patient to use himself.

The writer's aseptic douche (Fig 2) will be found specially adapted to this purpose, since the patient not only has force, direction and volume of fluid directly under control, but by means of inlet and outlet valves, the irrigator can only be filled at the distal end like a Higginson's syringe, of which it is in fact a modification. It is very wide in its application, but is specially valuable in case of disease of the ear, requiring great care in auto-irrigation and those forms of rhinitis demanding a copious douche. The glass nasal douche (Fig. 3) is particularly useful when small quantities only are required.

It is as unnecessary to describe in detail all the numerous forms of apparatus adapted to special purposes as it is to enumerate and to condemn all those which do not conform to the most rudimentary principles of cleanliness, but it may not be unreasonable finally to emphasise that no apparatus can be safely employed in which one aperture serves both for filling and for emptying.

Fig. 1.
Two-way Syringe.

Fig. 2.
Aseptic Aural and Nasal Douche. Nozzle, showing valve.

Fig. 3.
Glass Nasal Douche.