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From a dissertation by Joseph Lister

Abstract

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ON THE MODE IN WHICH EXTERNAL APPLICATIONS ACT ON INTERNAL PARTS

FROM A DISSERTATION BY

JOSEPH LISTER

Lister joined the Royal Medical Society in 1854 and delivered this dissertation to the Society on 21st December 1855. In this dissertation he propounds the idea that there is "sympathy" between external and internal parts such that treatment of internal disease can be adequately treated by applications to the skin such as leeching, cautery and blistering. He illustrates conditions which may be treated by external applications, and attempts to describe the physiological basis of the treatment.

Many local therapeutic means are employed for the sake of a beneficial influence supposed to be exerted by them upon an organ or tissue placed at a greater or less depth below the surface to which they are applied; as when blood is taken by cupping from the integuments of the chest in pneumonia or when the pre-cordial region is blistered in cases of pericarditic effusion. In these days of theory, all are deeply impressed with the very just sentiment expressed by Virgil "*Felix sui potuit rerum cognoscere causas!*" We are no longer

content with the suspicion which satisfied our ancestors but desire to know the *modus operandi* of the remedies we use. And so far is this feeling carried that many are ready to give up without hesitation the most time honoured methods of treatment if they appear irreconcilable with our present knowledge of Anatomy and Physiology, while they are apt to look somewhat slightly at the experience by which such practice is supported.

Now it is by no means obvious how external applications act upon deeply seated parts: thus

in the former of the instances above named it is generally believed that the benefit derived from the local blood letting is greater than could be obtained by venesection of the same amount, which seems to imply that the blood is withdrawn in much larger proportion from the lung than from other parts of the body; yet it is manifestly preposterous to suppose that cupping glasses, applied over the integuments of the chest supplied by the intercostal and internal mammary arteries, branches of the aorta, can draw blood directly from the engorged ramifications of the pulmonary artery, connected with the other side of the heart. Accordingly some physicians have been led to doubt the special efficacy of local blood letting in inflammation of deep seated organs. Again in the latter instance, that of blistering the precordial region, none would nowadays be found to believe that the serum effused under the cuticle had before formed part of the pericardial accumulation, and it is generally supposed that the blistering, besides causing inflammation of the skin "excites the vessels" of the pericardium "to increased absorption" as it is said.

But the depth of the pericardium below the surface and the well known superficial action of cantharides forbid the supposition that the inflammation excited in the skin is in any measure or degree propagated by continuity of tissues to the membrane in question. Similar arguments apply to the case of pleuritic effusion, and an eminent London physician of my acquaintance, influenced I suspect by such considerations, questions the advantage of blistering in either affection. Such doubts cannot be regarded with indifference; if they be well founded it is most important for us to know them well and to do our part in relieving suffering humanity and charitable medical institutions from the useless annoyance and expense of leeches, blisters, etc. in cases of deep seated disease. If on the other hand leeching, blistering and other external means are really as valuable in these cases as our predecessors believed them, then truly it is of the utmost consequence that we should be aware of the fact both that our patients may have the benefit of their employment and that we ourselves instead of giving ourselves up to the spirit of scepticism which at present too generally pervades the study of our profession may have our tottering faith in medicine strengthened and our respect increased from the hard earned fruits of the labours of our ancestor. The latter is, I believe, the true state of the case; and the

many facts that bear upon this important question only need to be placed in a somewhat clearer light in order that we may all be convinced that it is so. The following paper has been written with the view of promoting, however imperfectly, this most desirable object.

The local means employed by the Physician in the treatment of deep seated inflammation are the same that all surgeons use with undoubting confidence in affections of parts more superficially placed, e.g. local blood letting, not to mention blistering and issues.

In the cases in which these modes of treatment are adopted by the surgeon, the parts affected are commonly within reach of sight or manipulation, and he is therefore able to trace their effects with precision. Hence the reason for the confidence with which these remedies are regarded in surgical complaints, while at the same time the proximity of the organ affected to the surface acted upon prevents the risk of the theoretical objection that may be raised against the use of the same means for disease of more deeply seated organs. Yet when these surgical cases are more strictly scrutinized we shall find that similar difficulties present themselves in explaining the *modus operandi* of local treatment, even when the affected organs are comparatively superficial. Thus when the testicle is fomented in cases of acute orchitis it appears at first sight as if the application were made directly to the affected organ. Yet on reflection it will appear that it is not the testicle itself that is warmed and moistened with a hot and wet flannel but only the superficial part of the integument. The cuticle no doubt has its temperature raised on each fresh application of the fomentation and also imbibes moisture and becomes swollen and opaque in doing so, but the free circulation of blood through the rich capillary network of the dermis must keep the most superficial parts of the cuticle at a temperature scarcely higher than that of the blood and also constantly rectify any material differences of chemical composition which the absorption of water into the intercapillary spaces would tend to produce. Still less can we suppose the subcutaneous tissue to be directly altered in temperature or humidity under the circumstances in question. Hence even in this apparent example of immediate application of fomentation to the affected part we see that its direct action upon the organ inflamed is out of the question and the very same difficulty meets us in the explaining of its mode of action as if the testicle had been placed some inches below the surface of the

body — and yet no practical surgeon will be found to question the beneficial influence of fomentation in orchitis. Again when a blister is applied on the knee in dropsy of the joint or chronic sinovitis we have no reason to suppose that the inflammation excited by it extends to the sinovial membrane. We know that if a blister is applied in the same situation for the remedy of enlarged bursa, the knee joint remains so far as can be judged quite unaffected, as inflammation even to a small degree excited in the synovial membrane would manifest itself by effusion into the joint which is not observed in these cases. Wherever a blister is applied upon the integument then this appears as a general rule the only part affected by it; the subcutaneous tissue retaining its usual lax character so that the skin can be moved freely backwards and forwards upon subjacent parts; still less reason is there for supposing that the inflammation excited by the blister passes still more deeply through the dense fibrous tissues intervening between the superficial fascia and the synovial membrane.

Here then the difficulty of explaining the absorption of the fluid in the joint under the influence of the blister is of exactly the same nature as that which should have alluded in the case of precorditic effusion. Yet nothing can be more certain than the fact that the absorption is so induced in the former case. A patient with "Hydrops articuli" may have been confined to bed for weeks with the part carefully bandaged without any diminution in the bulk of the fluid. In such a case the surgeon orders a blister with almost absolute certainty that the speedy removal of the liquid will be the result.

In this case as in that of the fomented testicle the surgeon has the affected part immediately under observation and no theoretical difficulties in explaining the *modus operandi* can possibly shake his faith in the efficacy of these means in such cases.

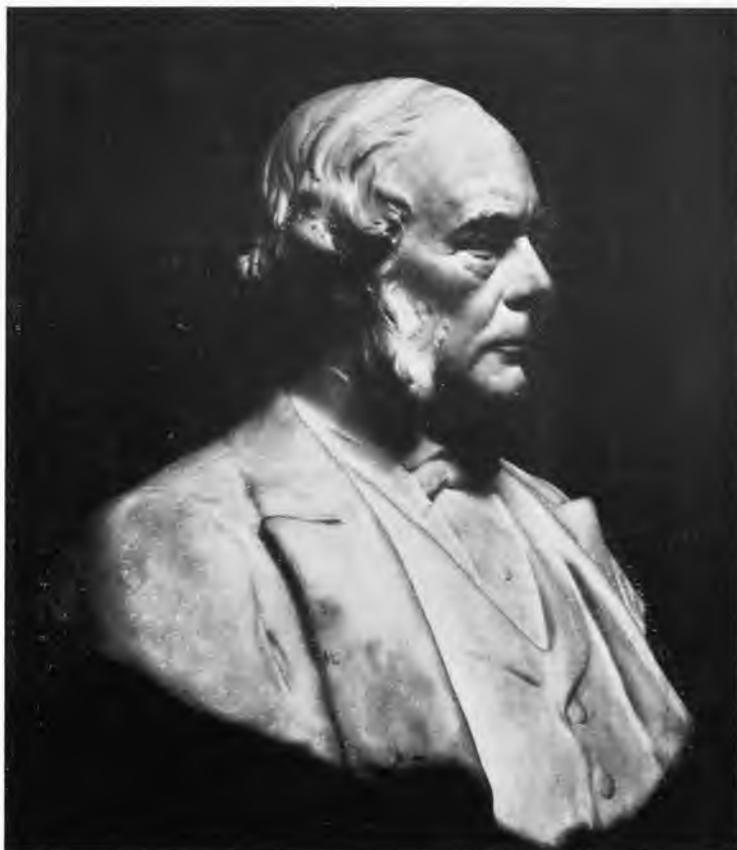
But the surgeon too has not infrequently to deal with disease more deeply seated, and therefore, no less than in the cases just mentioned, occasionally meets with facts quite conclusive in proof of the efficacy of local means. Few surgeons, I imagine, will doubt the beneficial influence so produced upon acute iritis by cupping the temples; yet the idea of direct withdrawal of blood from the inflamed organ as a mechanical consequence of the action of cupping glasses upon the integument is scarcely as absurd than in the case of pneumonia; the eye-ball, with the exception of the ocular con-

junctiva, being supplied by the ophthalmic artery a branch of the internal carotid, while the skin of the face receives its blood from branches of the external carotid. As this is a very illustrative case of local blood letting I may mention a striking example of it which on a patient under my own observation — a man of syphilitic diatheses under the care of Dr. Walsh of University College Hospital, London, imprudently left his bed in a season day similar to the present to look out of his window at a game of snowballing that was going on in the street, and in the course of a few hours the left eye was affected with severe inflammation. The iris became discoloured, greatly contracted and irregular; lymph appeared at the pupillary margin, the sclerotic was the seat of intense pink infection, the vision of that eye became misty and he experienced severe pain in the parts of the face surrounding the orbit. It fell to my lot as Dr. Walsh's assistant to deal with this very serious attack. As the man's general health was rather low I omitted general blood letting and proceeded to cup the temple. No sooner had the first glass been applied and had drawn up the yet unscarified integument as a red hemi-spherical mass, than the patient to my surprise exclaimed that his vision was much clearer and that his pain was greatly diminished; and though I could hardly believe my eyes the sclerotic infection appeared decidedly less. I proceeded to take a few ounces of blood as I had intended and from this time forth the inflammation which had before been so rapidly advancing steadily abated and in the course of the same afternoon the pupil became much larger and more regular. The patient also took calomel and opium to which the favourable progress of the case must still in part be attributed; but in the unequivocal effects of the first cupping glass in the deep parts of the eye we have an extremely striking instance of the beneficial influence of this method on the acute stage of inflammation in a part almost wholly unconnected as regards direct vascular communication with the integuments to which it was applied. The blood was drawn up in abundance into the soft parts included in the cupping glass; at the same time the sclerotic vessels grew comparatively pale, in other words came to contain less blood but, as before observed, anatomy forbids us to suppose that the blood was drawn mechanically from the sclerotic in so great a proportion as from any part supplied by the external carotid. There again the superior opportunities of the surgeon in having to deal with a disease which he could

see enabled him to combine objective with subjective symptoms as to exclude all doubt regarding the fact of the benefit derived from a means of treatment which the physician, less favoured in consequence of the obscure position of the parts he treats, may be led to doubt altogether.

As another instance of palpable advantage witnessed in surgical practice from the use of external application for disorders of deeply seated parts I would direct attention to the efficacy of the actual cautery of some severe cases of spinal disease: and I will select one

particularly striking case of which an account will be found in detail in the monthly Journal for August, 1854. A man, 27 years old, had been for 18 months affected with disease of the upper cervical vertebrae which had been steadily advancing in spite of treatment till his admission into the Royal Infirmary of the 20th of June 1854. "His countenance wore a peculiar expression of mingled suffering and apprehension" as Mr. Syme expressed it. He complained of severe pain in the head and neck, aggravated by any sudden movement so that this was a great constraint about all his actions.



Bust of Lord Lister, by Brock, in the Royal College of Surgeons of England. (by kind permission Guthrie, D. (1949), Lord Lister. Edinburgh: Livingstone).

He always kept his head bolt upright except when in bed and could neither lie down nor sit up without supporting his head with his hands; he never turned his head without the rest of his body. There was great swelling of the upper part of the neck, and he could only open his mouth a little way: deglutition was extremely difficult and a remarkable prominence of the bodies of the upper cervical vertebrae was to be felt in the pharynx. On the day after his admission Mr. Syme applied the actual cautery over the spinous processes of the upper cervical vertebrae. Next day he found less pain on moving the head and in 2 or 3 days his countenance assumed a cheerful aspect. "A steady improvement" says the report, "has since taken place in his symptoms and at the present time (July 15th) he has no pain whatever when he sits at rest and can also use strong and active exertion without uneasiness, and no longer requires to support his head in lying down or rising. He can turn his head round quite freely and look up at the ceiling and it is only in sudden movements of the neck that he feels any pain at all. The swelling in the neck has greatly subsided and he can open his jaws wide and swallow with comparative facility. The sore on the neck is almost healed and he talks of leaving the hospital in a few days as cured. When we consider how far removed the bodies of the cervical vertebrae are from the integuments of the back of the neck, and further that the actual cautery produces by its direct action only a very superficial effect, as complete proof as need be desired of the beneficial influence of an external agent upon severe organic disease in a part far beyond the range of its immediate action is obtained.

Facts scarcely less striking might be drawn from the practice of Physic but as we have seen the question of their *modus operandi* is essentially the same as in that of Surgery and I will for the present content myself with the illustrations already brought from the latter sources and proceed to the discussion, imperfect as it must be, of the Theory of the action of these external applications.

First I would remark that the consideration of the effects of cupping of the inflamed iris, not to mention other less conclusive instances, shows that the explanation of the action of this group of remedies must not be sought in the arrangement and connections of the blood vessels. If community of vascular supply were the cause of the influence of external agents over internal organs, we should expect to find this most strikingly illustrated in the case of

local abstraction of blood; but we have seen that in the iris, as in the lung, it is anatomically absurd to suppose that the withdrawal of blood from the surface to which cupping glasses or leeches are applied can produce any direct drain from the vessels in the affected part, inasmuch as the internal organs and the surface are supplied by branches of widely differing trunks. The only other great means of mutual functional connection between one part and another with which we are acquainted is the nervous system; and it is therefore to this source that we must look for the unravelling of the mystery we are considering.

Imperfect as our knowledge of the Anatomy and Physiology of the nervous system is, we yet know enough of its laws of action to see that it is through the medium of this great bond between the various component parts of the frame, that the effects in question are produced. And now I would wish to direct attention briefly to the sympathetic relations which exist through the agency of the nervous system between one part of the body and another; and more especially between internal organs and the surface placed over or in vicinity of them. This great law is manifested partly in sympathy of sensation; the external surface is richly supplied with sensory nerves while the internal organs have very little sensibility of their own. We see an obvious final cause for this. The surface is that part of the body which is brought into contact with the objects of the external world and requires sensibility to appreciate their presence and influences; and again any disturbances produced by these foreign bodies can be more readily rectified when the attention of the mind has been drawn to them. Hence both for the purpose of appreciating the qualities of these foreign bodies and rectifying the disturbances which they may create, acute sensibility is requisite in the integument. In both these respects however, the reverse obtains with internal organs. They are not, generally speaking, exposed to contact with the external world and also it is less necessary for the attention of the mind to be directed to their derangements because their inaccessible position makes it impossible to apply direct means to rectify such disorders. It would have been a cruelty, if it may be said with reverence, to have made the intestinal canal as sensible as the skin so that the mind should have been constantly conscious of irregularities of form or surfaces of the materials passing along it, perceiving sensations like those of painful friction or itchings of the skin, while at the same time the hand could

not be applied to remove or diminish an unwieldy mass or to rub away the sense of itching. But though internal organs cannot, as a general rule, be reached directly by human means, yet it would appear as if the Creator had defined that their derangements should be, though but to a limited extent, under the control of treatment. As this can be effected only by indirect means it has been arranged that some part of the surface, generally that lying most nearly over it, shall be placed in sympathetic relations with the organ within so that agents acting on this portion of the integument may produce an influence upon the organ. And in order that mankind may be directed to this indirect mode of treatment it is so planned that the portion of the surface that is in sympathy with the organ for curative purposes shall also sympathise with it in sensation; shall, as it were, feel for it. Thus where the intestines are undergoing contraction beyond the limits of health, the hand is instinctively placed upon the surface of the abdomen. Who has not felt the soothing influence of the most superficial friction of the integument in intestinal colic?

In the same case Nature tells even the savage to apply warm applications to the skin of the abdomen and a correspondent from a Hospital in the Dardenelles tells me that there, where diarrhoea is very prevalent, the natives wind an astonishing number of yards of cloth round their bellies to counteract this tendency of the climate. Again to take the respiratory organs. How remarkable is the tenderness of the skin frequently present over the apex of a tuberculous lung! And how plainly does Nature tell us to avoid and guard against the exposure of the chest and throat when the lungs or bronchial tubes are inflamed. So too when the iris and sclerotic are attacked with inflammation it is not the eye but the integument of the face in its vicinity that is painful, and the headache which results from congestion or inflammation of the brain is commonly quite indistinguishable to the patient from the painful sensation produced by neuralgia of the nerves of the scalp. Lastly I would allude to the pain in the penis and perineum in cases of stones in the bladder. Were the pain felt in the organ that is the seat of the abnormal concretion it would be indistinguishable, at least to the non-professional man, from colic of parts of the intestines in the same situation; but as matters are arranged the infant affected with calculus at once draws the attention of his parents to the urinary organs by his energetic demonstrations of the uneasiness which he experiences in the external parts.

Along with this sympathy of sensation, we see frequent proof of sympathy of Physiological action.

In the case of the respiratory organs the whole integument is more or less in sympathy with them, but the anterior part of the thorax and the soles of the feet more especially and the deep inspiration that occurs when the body is plunged into cold water and the first breath excited in the newborn infant by contact of the surface of the body with the external air, are instances of this sympathetic physiological action. Another striking example of it is one familiar to every Accoucheur, who, if the uterus remains relaxed after labour producing hæmorrhage applies cold cloths to the vulva or lower part of the abdomen with the confident expectation that the uterus will at once contract into a firm globe. It is of course not necessary to point out that the cold applied to the vulva cannot possibly produce any reduction of temperature in the womb. I will content myself with one other instance of this sympathetic Physiological action, illustrative once more of the relations that exist between the integuments of the face and the iris, viz. the dilation of the pupil induced by extracts of Belladonna smeared upon the brow and lids. This dilation is clearly due to contraction of the dilating fibres of the pupil. When Belladonna acts unusually freely or when a strong solution of its active principle has been applied to the conjunctiva, the dilation far exceeds anything that could be accounted for by supposing the sphincter pupillæ relaxed. I remember seeing this effect very strikingly in a child with congenital cataract to whose eye I applied solution of sulphate of atropine preparatory to dividing the lens, with the effect of making the pupil almost equal in diameter to the cornea so that not only the whole exposed part of the anterior surface of the lens but the black inner margin of the ciliary body was brought into view. Wharton Jones has made the curious observation that while all other saline solutions tried by him produced in the arteries of the frogs web constriction followed after a few seconds by dilatation or else dilatation without any visible interval of constriction, solutions of atropine caused a gradual and permanent constriction of the arteries taking place in about the same time and lasting about as long as the dilatation of the iris when the solution is applied to the human eye. Hence it would appear probable that the Belladonna, when applied to the surface of the eyelids, not only causes contraction of the muscular fibres of the muscles of the skin,

but at the same time contraction of the dilator pupillae by sympathy. This view of the phenomena is demonstrated by the beautiful experiment of Bernard upon the sympathetic nerve in the neck, the division of which (for instance in the cat) produces turgescence of the vessels of the ear and face generally, and contraction of the pupil of the side operated on; the dilator pupillae and the constricting fibres of the vessels of the integument being together relaxed so that the sphincter pupillae acts without antagonism and the relaxed arteries yield to the distending force of the heart; and that this explanation is the correct one is proved most striking by the converse experiment of stimulating the sympathetic by galvanism when the pupil becomes at once enormously dilated and the vessels of the ear, previously engorged, become invisible. The dilators pupillae and constricting fibres of the arteries are both together made to contract by the stimulus applied to the sympathetic, which is thus proved to have dominion over both, while the third cerebral nerve is known to preside over the sphincter pupillae.

I have dwelt thus fully upon this last example because the case of the iris is very illustrative in more ways than one. Thus :

1. The distribution of the blood vessels proves, as we have seen, that they are not the medium of sympathy between the surface of the face and the iris.

2. The temporal and supra- and infra-orbital pain of iritis shows that the soft parts of the face around the orbit sympathise in sensation with affections of the iris.

3. The action of Belladonna, as explained by the observations of Jones and the experiments of Bernard, show a sympathy in physiological action between the same parts and further appear to prove the important fact that this sympathy of Physiological action takes place through the medium of the sympathetic.

4. The effect of the cupping glass above detailed shows that along with the sympathy of sensation and physiological action is found a clear example of the influence produced upon an internal organ by one of the most disputed though most celebrated external therapeutic means.

Diseased action is but a modification of the process of health and accordingly, while an internal organ and the surface over it sympathise in physiological action there are no more striking examples of sympathy than those in which deeply seated parts become affected with disease in consequence of external applications.

Thus if a person sits long upon a cold stone he will very probably be attacked with inflammation in or around the prostate gland, or if the subject be a female an attack of endometritis may ensue, the latter case being strictly parallel with the physiological action lately attended to of the contraction of the uterus under the influence of cold applied to the same region. Again while the sudden application of cold to the chest or soles of the feet induces sighing inspiration, the same agent in long continued action on the same part of the surface is apt to induce inflammation of the mucous membrane of the bronchi. It is needless to multiply instances of facts so familiar and I would only now observe that where we see inflammation of an internal organ thus readily induced through the medium of the nervous system by the action of cold upon the surface over it, it appears but natural that agents of a different or opposite nature such as heat, may be effectual in curing inflammation where operating upon the same parts of the surface; in other words where the external surface sympathises with the internal organs in causing disease, so under other circumstances it may sympathise with it therapeutically. Accordingly there is no more effectual remedy for a bronchitis caused by exposure of the back to cold than a hot pediluvium while the hot hip bath is no less beneficial in prostatitis.

From these considerations of the laws of sympathy, we have no difficulty in understanding in a general way how external therapeutic means may produce an effect on parts deeply seated.

I cannot but feel that in this paper I have dealt very imperfectly with a subject which though intensely interesting is extremely difficult. For the accuracy of the facts mentioned I can vouch, and I feel also confident of the truth of the general theory that it is through sympathy, in other words through the nervous system, that the external therapeutic application, to which I have specially alluded produce their beneficial effects upon parts within. With regard to the more intimate application of this theory, to these several methods in particular, I express myself with greater hesitation, and feel that it is at present in but a crude form.

If however the object which I proposed to myself has been in any degree attained, if the facts bearing upon this important subject have been placed in a clearer light, and if the confidence of any of our members in the use of these means of treatment has been strengthened I shall feel myself deeply rewarded.