subcutaneous node, and chorea—the subcutaneous node is the most “rheumatic” of all. The above figures are therefore, to say the least of it, significant.

REFERENCES.

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SOME EFFECTS OF WARM IMMERSION BATHS UPON THE CIRCULATION.*

BY

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SPA physicians are aware that some of their professional brethren are a little sceptical about the efficacy of bath treatments, and it is probably not generally realized what profound effects such a simple procedure as a warm immersion bath may exert on the bodily functions, and especially upon the circulation. Some of these effects can be quite accurately measured. First, and most obvious, is an alteration in the pulse rate. Secondly, variations in blood pressure, both systolic and diastolic. Thirdly, and beyond the scope of ordinary clinical observations, there is a change in the amount of blood flowing from the heart per minute, as well as in the stroke volume or output per beat. Fourthly come various less accurately measurable effects, such as sweating, cutaneous hyperaemia, etc.

The following observations were made during a series of experimental baths taken by three normal subjects with a view to ascertaining the effect of immersion baths on the circulation and to determine whether the consequent alterations in pulse rate and pulse pressure were in any close degree correlated with alterations in the heart's output. The effects on the circulation rate will be the subject of a separate paper, but I wish to draw attention to some rather striking effects on pulse rate and blood pressure revealed during these experiments. Typical examples are here shown in tabular form.

It is common knowledge that an increase in the body temperature is accompanied by a proportional increase in pulse rate. Our experiments show this effect, but, in addition, two other features appear. (1) When a normal subject is placed in a bath at a temperature of approximately 103° F. there is an immediate increase in the pulse rate long before any significant rise of body temperature occurs. This increase is so sudden that it would appear to be due to some reflex cause, and a subsequent greater rise is superimposed. (2) In certain of the experiments there was definite hyperpnoea and consequent alkalosis (excessive CO₂ elimination). This alkalosis was associated with still further increase in the pulse rate.

It is just thirty years since Edgcombe and Bain¹ published papers on the effect of baths, massage, and exercise on the blood pressure, and these papers are still regarded as classics. They contain no reference to diastolic arterial pressure, but they were written before present-day methods of measuring diastolic blood pressure had been devised. The writers do, however, state the effects on mean arterial pressure, which they define as the reading taken when the indicator of the haemodynamometer gives its maximum excursion. It is probable that this point of maximum excursion would approximate somewhat closely to the diastolic pressure.

Our own observations show that in normal persons entering a bath at 103° F. there is an immediate fall in both systolic and diastolic blood pressure, approximately 10 mm. of mercury in each case. This initial fall would appear to be due to simple hydrostatic causes. When the blood pressure is taken with the subject on a couch the arm is lying by the side. If the arm be elevated to an extent

such as occurs when taking the blood pressure of a patient immersed in a bath, a similar fall is observed. Subsequent to these immediate changes the systolic pressure may show a slight rise, which in none of our experiments exceeded 16 mm. of mercury, but was usually rather less. The most striking feature with regard to blood pressure was a marked fall in diastolic pressure, together with an alteration from the normal characters of the Korotkow sounds—that is, the sounds heard in the artery during decompression when determining blood pressure by the auscultatory method.

Wiggers² describes five phases in the Korotkow sounds:

“*First phase*: The sudden appearance of a clear sound, lasting for a fall of approximately 14 mm. of mercury. This has already been described as a criterion of systolic pressure.

“*Second phase*: The acquisition of a murmurish character, lasting while the pressure falls approximately 20 mm. of mercury more. It is attributed to the stenosis of the vessel produced under the cuff at this stage.

“*Third phase*: The replacement of the murmur by a sound becoming progressively louder and lasting during the next 25 mm. of pressure fall.

“*Fourth phase*: The muffling of the sounds, lasting while the pressure falls 5 to 6 mm. more. The cause of this muffling has been variously interpreted as due: (a) to the absence of diastolic collapse; (b) to the slowing of the stream under the cuff; (c) to the decreased resonance in the deflated cuff; (d) to a lack of flattening of the arterial wall.

“*Fifth phase*: The disappearance of all sound.”

The pressure in the cuff at the commencement of the fourth phase is generally accepted as being the diastolic pressure. We found that although normally at rest the transition from the third to the fourth phase was well defined, and gave a sharp reading of diastolic pressure, after a short time in a bath at 103° F. this was no longer so. Almost immediately the sounds during the third phase, instead of becoming progressively louder throughout the whole of the phase, became at first louder and then gradually softer, and during this period of diminuendo tailed off almost imperceptibly into the fourth phase. Hence it was not possible to recognize the usual clearly defined criterion of diastolic pressure. In addition, the fourth phase became prolonged, and, not infrequently, after the subject had been in the bath for thirty minutes or longer, the fourth phase was found to continue right down to zero pressure—that is to say, the fifth phase was absent altogether.

In column three of the table the left-hand figure is, so far as could be ascertained, the transition from third to fourth phase. The right-hand figure, where only two are given, is the pressure at the end of the fourth phase—that is, disappearance of all sounds. Where this figure is zero it indicates that sounds were still present in the artery when the sphygmomanometer cuff was completely deflated. Where three figures are given, the front two show pressures at which clearly defined softening or muffling of the sounds occurred. So far we are unable to interpret these points with reference to Wiggers's phases, but it seems at least possible that in the later stages of a hot immersion bath the diastolic pressure falls very near to zero. These changes—namely, the fall in diastolic pressure and alteration of the Korotkow sounds—closely resemble those observed in severe cases of Graves's disease (hyperplastic exophthalmic goitre), and possibly also in cases of aortic incompetence and severe anaemias.

The significance of some of these observations is as yet obscure, but one point of interest may be briefly mentioned. It has generally been considered that an increase in pulse pressure associated with an increase in the pulse rate is indicative of an increase in the circulation rate. This has been shown to occur in exophthalmic goitre. Our observations on the circulation rate in baths have shown that, as a rule, no significant increase in circulation rate occurs even though both pulse rate and pulse pressure are increased. Indeed, in certain experiments the circulation rate under these conditions has been found to be actually lessened.

In the present communication it is impossible to give all the evidence in detail, but the most reasonable interpretation would be that there is constriction of the arteries and arterioles, together with a dilatation of the capillaries. This dilatation gives rise to diminished peripheral resistance, as well as a certain amount of peripheral stasis.

* A preliminary communication summarizing an address to the Yorkshire Branch of the British Medical Association at Harrogate on October 19th, 1929, and based on observations made in collaboration with Professor Whitridge Davies and a number of the senior students from the Leeds Medical School. The work was carried out at the Royal Baths and the Royal Bath Hospital, Harrogate.

The presence of peripheral stasis was further confirmed by the appearance in some experiments of a slight though quite appreciable cyanosis of the limbs. The normal, or sometimes diminished, general circulation rate, together with the increase in pulse rate, indicated an appreciable, and sometimes considerable, diminution in the output of the heart per beat.

Time.	Systolic Pressure.	Diastolic Pressure.	Pulse Rate.	Mouth Temp. °F.	Path Temp. °F.	Remarks.
p.m.						
3.30	123	80-74	68	98.1	—	Subject lying on couch before bath.
4.30	110	70-64	64	98.0	94.5	Readings immediately on entering bath.
4.40	108	62-58	64	98.0	94.5	(Plain water bath.)
4.50	109	65-58	68	97.9	94.0	
5.00	110	68-60	70	97.7	94.0	
5.07	110	66-60	64	97.2	93.5	
5.15	110	63-60	66	97.1	93.5	
5.20	—	—	—	—	103.0	Bath temperature raised to 103° F.
5.30	108	60-48	80	99.3	103.3	Perspiring.
5.40	110	54-44	84	99.9	102.8	
5.48	110	58-40	90	100.7	103.4	
5.58	120	64-44	100	101.3	103.2	Bath ended at 6 p.m.
6.15	110	75	76	99.7	—	After shower bath down to 65° F.
12.29	120	86	62	97.5	—	Subject lying on couch before bath.
12.37	—	—	—	—	—	Enters saline sulphur bath.
12.40	106	60	76	—	103.4	Temperature 103±1° F.
12.45	106	58-40	80	—	103.2	Sweating.
12.50	110	58-40	80	—	102.9	
12.55	110	60-40	90	—	103.2	
12.57	106	56-38	87	99.3	103.0	
1.01	112	58-0	90	100.0	103.1	
1.05	112	60-36-0	96	—	103.6	Loud sounds audible at zero.
1.09	110	60-38-0	96	100.2	—	
1.13	110	58-35-0	96	100.7	102.6	
1.18	120	50-30-0	93	—	102.4	
1.25	118	50-25-0	98	—	102.7	
1.28	120	40-15-0	—	—	102.9	
1.29	110	54-30-0	98	101.1	102.5	
1.35	120	60-20-0	100	—	—	
1.38	120	35-0	100	101.1	102.0	Loud sounds audible at zero.
1.39	—	—	—	—	—	Started cooling the bath.
1.41	108	50-0	—	—	87.0	
1.43	104	55-20	84	—	81.0	
1.46	100	50-35	70*	100.0	81.0	*Bigger wave at wrist. Marked cutaneous hyperaemia after bath.

The above figures are those obtained during two of the fourteen experimental baths on which the conclusions in the paper are based.

SUMMARY.

The following are the principal circulation effects noted during immersion baths at 103° F. in normal subjects:

1. Rise in pulse rate.
2. Maintenance, or increase, of systolic pressure, allowing for slight alterations in position of arm.
3. Fall in diastolic pressure.
4. Changes in pressure levels at which modifications of the Korotkow sounds occur.
5. Persistence of these sounds down to 0 mm. of mercury in certain readings.
6. Prompt return towards normal when the subject is cooled down on completion of bath.

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¹ Edgecombe and Bain: *Lancet*, 1899, vol. i, 1552; *Journ. of Physiol.*, March, 1899, p. 48. ² Wiggers: *Circulation in Health and Disease*, Philadelphia and New York, 1923.

Memoranda:

MEDICAL, SURGICAL, OBSTETRICAL.

FOREIGN BODY IN RIGHT BRONCHUS OF A BABY.

THE following case, in which a flower-spike of grass passed through the upper air passages and lung tissue to present beneath the chest wall, is of interest both from the mechanical aspect and on account of the fact that so little disturbance was caused.

The patient, a baby of 9 months, was admitted to the St. Albans and Mid Herts Hospital for observation on August 30th last. For two weeks the child had been fretful, with screaming attacks and occasional cough. On admission the temperature was 100°, pulse 120, and respirations 36. The general condition was fairly good, but screaming fits persisted. No abnormal physical signs could be detected except an impaired note over a limited area below the angle of the right scapula; adventitious sounds were absent and breath sounds were not appreciably altered. The temperature settled on the following day and screaming ceased. No further symptoms developed except an expiratory grunt, noticed especially at night. Chest signs remained unchanged. The child was discharged six days later apparently quite well.

On September 11th the mother noticed a "swelling on the back," and called in Dr. Ronald Wilson. He suspected a foreign body, and, on further questioning, obtained a history of a choking fit on August 12th—two and a half weeks before the first admission to hospital.

On readmission to hospital, on September 12th, the temperature was 99.8°, the pulse 136, and the respirations 34. The general condition remained fairly good. There was a tender swelling, two inches in diameter, extending downwards from the angle of the right scapula. It was fixed to the deep structures and had a small central red area but no fluctuation. Breath sounds were harsh in the neighbourhood of the swelling, but unchanged over the rest of the lung field.

On September 13th a radiogram showed thickening of the right ninth rib under the site of the swelling, with a cup-shaped area of rarefaction on its inferior margin and a well-defined opacity of lung field locally.

On September 14th, under a general anaesthetic, the tumour was aspirated, but no pus was found; incision revealed an inflammatory oedematous condition of the thoracic parietes, and no collection of pus. In the base of the wound a foreign body was exposed. This was withdrawn and found to be a flowering head of "wall barley," 1½ inches long (see photograph) with stalk end projecting outwards, and of slightly offensive odour. On passing a probe a sinus was found leading direct up into the right bronchus, reflex coughing being produced thereby. The wound was closed without drainage. A small superficial collection of pus formed, but rapidly cleared up, and the child had no further pyrexias or respiratory symptoms.

On September 23rd the patient was discharged with the wound completely healed. There was still a slight impairment of note, but no swelling, and breath sounds were good over the whole lung.

I am indebted to Mr. D. Morgan Jones, surgeon in charge of the case, for permission to publish this note.

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CHRONIC RHINITIS IN CHILDREN.

A FACTOR to be reckoned with in the treatment of chronic rhinitis in children is the large area of nasal mucous membrane involved. The area of the septum and lateral walls (not including any sinuses) in a small female subject in the dissecting-rooms of the Sheffield University was 225 square centimetres. As this mucous membrane is lying over immovable bone the removal of any excess of mucus must be dependent on (1) transmission along the surface by the action of the cilia, and (2) the expulsion of mucus by means of air currents.

By the reflex act of sneezing, which is an explosive form of expiration, an extra amount of secretion is poured out, which acts as a powerful cleansing force, loosening any debris collected there. If the sneeze is at once followed by a voluntary expiration through the nose (keeping the mouth shut and bending the head downwards) the old debris can be blown out of the nose. If the sneeze, or sudden involuntary expiration, is followed up by a short,