

to swelling of the cervical veins in the manner described; a good instance of such a sequence of events is furnished by chronic vesicular emphysema of the lungs.

2. When the pressure on the venous trunks within the thorax (the *venæ cavæ*) is from pathological causes so augmented that they are no longer able to receive all the blood flowing towards them.

As in normal conditions the increase of the intrathoracic pressure which takes place during expiration checks the flow of the venous current,—an effect, however, which is neutralized and even more than compensated for by the accelerating influence of inspiration, and which, therefore, in health is never seen externally,—so also in pathological circumstances a persistent increase of the same intrathoracic pressure results in an equally persistent overloading of the veins of the neck; copious pericardial and pleuritic effusions, large mediastinal tumours and aneurisms of the aorta, pneumothorax, and the severer forms of pulmonary emphysema (in which expiration is much prolonged and usually effected only with the aid of the auxiliary muscles of respiration), are among the affections in which the phenomena under discussion are observed. In the more advanced stages of emphysema the swelling of the cervical veins (and also of those of the body generally) becomes a very striking symptom, because not only does the right ventricle act more feebly, as already pointed out, but the pulmonary capillaries are extensively atrophied and obliterated and the volume of blood permitted to circulate through the lungs thus greatly reduced.

In rare cases, particularly of fibrous mediastinitis, the reverse of these appearances may be seen, distension of the jugular veins with each inspiration: the fibrous cords developed in this affection exercise a certain amount of traction on the intrathoracic veins each time the chest is expanded in inspiration, and in that way lessen the lumen of the vessels in question (compare p. 244).—Congestion may also be limited to well-defined districts drained by particular veins, when it is probably due to some *local* cause, such as thrombus, obliteration, or compression of one of the larger venous trunks; of this nature are certain of the congestions of the veins of the neck, from compression by large goitrous tumours or swollen cervical glands.

The swelling of the veins of the neck is much more conspicuous while the patient is lying on his back than when standing or sitting, as in the former position the flow of blood

into the auricle is considerably retarded. The *respiratory movements*, also, have an important influence on the cervical veins with respect to their state of distension, an influence which is, further, more marked when decubitus is dorsal; in inspiration the veins tend to collapse, the blood they contain being rapidly drawn off, while in expiration they are speedily refilled and stand out on the surface as distinct bluish cords. Coughing renders the veins still more turgid, the sinus of the jugular vein then becoming especially prominent and appearing as a large bluish-coloured swelling. These effects of the different phases of respiration, however, are noticeable only in those pathological conditions in which the jugular veins are persistently dilated and overfilled. In the healthy subject engorgement of the veins of the neck (or of the facial veins, causing cyanotic discoloration) may be excited by repeated complete expiration, by fixing and for some time retaining the chest-walls in the position most favourable to expiration, or by prolonged and severe coughing.

MOVEMENTS IN THE VEINS OF THE NECK.

These consist occasionally of a rhythmical *dilatation* of the veins, determined by the movements of respiration; or they may be of an *undulating* character, taking the form of a continuous, but non-rhythmical succession of waves passing along the distended vessel, due jointly to the expansion and contraction of the chest in respiration and to the action of the heart; or, finally, they may be of the nature of a *pulsation*, dependent solely on the movements of the heart (venous pulse).

UNDULATION OF THE JUGULAR VEIN.

Undulatory movements, like the various degrees of congestion of the jugular veins coinciding with the different phases of respiration, indicate a state of engorgement of the pulmonary circulation. They, however, are also considerably modified by the action of the heart: an obstructed lesser circulation always leads to overloading of the right auricle, each systole of which throws a small quantity of blood back into the vena cava superior, engorgement of the latter ensues, the current of blood through the jugular vein becomes slower (or is possibly sometimes arrested for an instant), and local congestion is developed. This mass of

blood thus forced backwards into the vena cava by the contraction of the over-filled right auricle, on the one hand, and the simultaneous retardation of the outflow of blood from the jugular veins, on the other, combine to dilate these veins and communicate a distinct impulse to their contents; and as the veins once thrown into commotion do not immediately return to a state of quiescence, and as they are further also subjected to some disturbance and caused to swell up by the expiratory movements, the agitation of their walls, when the impediment to circulation through the lungs is of a serious character, becomes *undulatory* and almost continuous.

Undulation of the veins of the neck, therefore, which occasionally also extends to the smaller vessels opening into the jugulars, can arise only in those cases in which the cervical veins show a considerable amount of engorgement even during inspiration, when circumstances are most favourable to the rapid passage of the venous current.—*Expiratory distension* (not undulation) is observed in the superficial *brachial veins*, but only during severe attacks of coughing.—Of all the diseases which involve congestion of the veins of the neck it is in intense pulmonary emphysema and in stenosis of the left auriculo-ventricular orifice that undulation of these vessels occurs most frequently and in its most marked forms.

VENOUS PULSATION.

This presents itself as a rhythmical *elevation* of the walls of the *internal jugular vein*, coinciding with the systole of the heart or sometimes barely preceding it, always clearly perceptible to sight and touch,—most clearly when decubitus is dorsal. The vein pulsates either in its whole length, the impulse being always propagated from below upwards, or only its lower part, the sinus, partakes in the movement.

The venous pulse frequently consists of only a *single throb*, synchronous with the systole of the heart; at other times the wave is *double*, in which case the first part, that preceding the systole (presystolic), is the weaker, and the second, that coinciding with the systole, the stronger. When the systolic pulse is double the diastolic collapse of the veins is divided similarly into two distinct movements. A double systolic wave (Anadirotism) and a double diastolic subsidence of the walls of the vessel (Katadirotism) are usually readily detected by simple inspection and palpation; the reduplication may be more accurately demonstrated, however, by means of the sphygmograph.

The persistent distension to which a pulsating jugular vein is

subjected largely increases its calibre: in one case that was under my own care the breadth of the vessel was 1 ctm.—To mistake the venous pulse for that of the carotid artery is hardly possible; if it be suspected that the pulsation is *communicated* from that artery to the jugular vein such a source of error may easily be excluded by so altering the position of the head that these vessels are brought into less close relation to each other. If the pulsation be presystolic as well systolic, and somewhat feeble, it rather closely resembles simple undulation, from which, nevertheless, it may be at once distinguished by pressing upon the vein with the finger: *undulation disappears below the point at which pressure is made*, (that is, in the central part of the jugular vein, that nearest the heart), *while pulsation continues*, and is even intensified, by the proceeding described.

Venous pulsation is caused by the regurgitation of a wave of blood which, during the systole of the heart, passes upwards into the vena cava superior and through it into the innominate veins and the jugulars. Such regurgitation most commonly depends on insufficiency of the tricuspid valves; each contraction of the right ventricle drives a portion of its contents backwards through the right auricle into the superior cava and the innominate and jugular veins. The greater part of this backward wave reaches the *right jugular vein* through the *right innominate vein*, as the latter is continuous, in almost a direct line, with the vena cava superior, while the left innominate vein joins it at nearly a right angle. The venous pulse is therefore *more marked on the right side* than on the left; in the latter situation it may even be completely wanting.—In the early stages of the affection the upward progress of the impulse is checked by the closure of the valves with which the jugular veins are furnished, and *the pulse is thus confined to the lower part of the vessels, particularly to the sinus*, and coincides exactly with the systole of the heart; beyond the pulsating sinus *undulation* of the vein may be observed, the result partly of the shock which is transmitted through the whole length of the vein, and partly of the obstruction presented to the free outflow of blood. Gradually, however, the jugular valves are overcome by the persistent pressure from below, they lose their elasticity or are perforated or torn, and so become incompetent; the regurgitating wave then rises above

the valves, and pulsation is perceptible in the jugular vein as high even as the angle of the jaw. In cases of insufficiency of the tricuspid valve, besides the systolic pulsation just mentioned, there may be a distinct, though much feebler, presystolic pulsation, due to the regurgitation of blood which takes place on contraction of the overfilled right auricle. Presystolic and systolic pulsations of the jugular veins are thus always, without exception, pathognomonic of absolute or relative insufficiency of the tricuspid valve.

Absolute insufficiency of the tricuspid valve is the result of organic lesion, while *relative* insufficiency is caused by excessive dilatation of the right auriculo-ventricular orifice from the unduly large quantity of blood contained in the right heart, the valves themselves being intact. Relative insufficiency of the tricuspid valve occurs also with stenosis of the mitral orifice*: venous pulsation is set up therefore in these cases, the whole length of the jugular vein being involved when its valves are incompetent, or only its lower part so long as these structures continue to perform their office.—But venous pulsation may also be observed, independently of the existence of any relative insufficiency of the tricuspid valve, in cases of stenosis of the mitral orifice; this symptom, indeed, is comparatively common in the severer forms of this valvular lesion. It is produced by the contraction of the overloaded right auricle, (and is accordingly presystolic), is but feeble, and limited to the lower part of the jugular vein.—And finally, in certain rare cases venous pulse is developed in the absence of any affection of the heart, that is, without mitral lesion, from simple uncomplicated insufficiency of the valves of the jugular vein (Friedreich). In pathological conditions, (pulmonary emphysema for example), which give rise to persistent obstruction of the current of blood through these vessels, their valves yield gradually to the strain they have to bear in each expiration, they become relatively or really insufficient, and on the contraction of the right auricle a quantity of blood is

* This may occasionally arise even though the mitral valve be structurally unaffected, as in a case which I recently had an opportunity of observing, in which a considerable dilatation of the right ventricle appeared as one of the results of pulmonary phthisis; on *post mortem* examination the tricuspid valve was found to be normal, the orifice, however, being wide enough to admit three fingers, while the mitral valve and orifice showed no trace of morbid alteration. During life a systolic murmur was audible at the lower part of the sternum, and the extremely dilated jugular veins pulsated synchronously with the systole of the heart.

thrown back into the jugular vein; but a venous pulse generated in this way is necessarily very feeble.

In uncomplicated cases sufficient evidence is usually furnished by simple inspection of the venous pulse to enable us to tell whether it is caused by incompetency of the tricuspid valve; or, the latter being normal, by insufficiency of the valves of the jugular vein from prolonged distension of the right auricle: in the former case the throb is distinct, forcible, and systolic, in the latter case it is always presystolic; auscultation of the heart also shows that tricuspid insufficiency is marked by a loud systolic murmur, audible even in the jugular vein, while if the valvular apparatus in question be intact only a pure systolic heart-sound is heard. Whether, on the other hand, the pulsation arises from a real or only a relative incompetency of the tricuspid valve, can not be made out with confidence in every case, as in both conditions, in addition to the similarity of the appearances so far as the pulse itself is concerned, there is the same systolic murmur over the right heart, though in absolute insufficiency it is much louder than when the defect is merely relative. If in the later stages of tricuspid insufficiency the contractile power of the right ventricle is diminished the venous pulsation becomes feebler, and may even disappear entirely if the backward impulse do not travel so far peripherally as the jugular veins.

But it is not possible by means of inspection alone to determine with certainty in every case whether the pulsation is limited to the sinus of the jugular vein or extends also to a further point in the course of the vessel, a variable amount of undulation being generally added to the pulsatory movement, as the vein when agitated does not at once return to a state of rest. In such circumstances palpation offers more reliable information: thus, if the finger be placed on the pulsating jugular vein at the parts at which it is provided with valves there is felt a systolic thrill, which owes its existence to the regurgitation of blood through the incompetent valves, when the heart's action is sufficiently strong, and particularly during an attack of coughing. This phenomenon is naturally also appreciable to the ear as a more or less loud murmur. If, on the contrary, the jugular valves be competent this fremitus is wanting, and is often replaced by a clearer sound, the sound of the jugular valves (Bamberger), produced by the sudden tension of these parts from the impact of the regurgitant wave.

In general the retrograde impulse does not go beyond the internal jugular vein; in other cases, however, smaller vessels which join it also pulsate, relatively most frequently the external jugular and thyroid veins, more seldom the veins of the face. Should a portion of the wave pass from the innominate into the subclavian veins, the larger veins of the regions drained by these venous trunks, the axillary, brachial, and the superficial veins of the arms, exhibit similar pulsatory movements.

Occasionally the pulsation is propagated not only through the vena cava superior but also into the *inferior cava*; but it appears in the latter vessel and in those discharging into it, only when the force of the impulse is sufficiently great, and that occurs only in cases of absolute insufficiency of the tricuspid valve. If the wave be feeble it is lost before it penetrates any distance into the vena cava inferior. That a venous pulse should be so rare in the domain of the inferior cava is explained partly by the fact that the situation of the orifice by which that vessel opens into the right auricle is very unfavourable to the admission of a backward current of blood, and partly by the great length of the course of the vein before it becomes accessible to palpation in the abdominal cavity.

Not unfrequently the impulse traverses the vena cava inferior, reaching as far as the *hepatic veins*, when it gives rise to a rhythmical pulsation of the liver, following closely after the stroke of the heart. If the liver be also increased in size, as in such cases it generally is, from the congested state of all its veins, so as to form a more or less prominent tumour below the ribs, this pulsation is perceptible to the finger applied over any part of the organ, and is thus easily distinguished from the circumscribed elevation of the left lobe of the liver which is so often caused by the systolic expansion of the subjacent abdominal aorta.

Hepatic pulsation in cases of insufficiency of the tricuspid valve is partly, though not exclusively, due to the rhythmical dilatation of the vena cava inferior, which lies behind the liver: apart from the fact that the pulse of this vessel is too feeble to raise such a heavy organ to any marked extent, the feeling communicated to the hand is not merely that of uplifting of the liver as a whole, but at all points it is of the nature of a pulsation.—In certain cases the pulse of the hepatic veins is an earlier phenomenon than that of the jugular, the inferior cava not being provided with any valvular apparatus which might for a time stem the backward current of blood through it to the veins of the liver (Friedreich).

Pulsation of the femoral veins is sometimes, (though very rarely), observed as a result of insufficiency of the tricuspid valve, as the greater part of the blood regurgitating into the vena cava inferior enters the hepatic veins, only a very small portion of it going past the orifices of these vessels.

It may be here remarked that feeble *pulsation* sometimes also occurs as a *physiological* sign in the *superficial veins on the back of the*

hand and the dorsum of the foot, when the impulse generated by the contraction of the left heart is not abolished in the capillaries, but passes through the latter (giving rise to a capillary pulse, visible in the finger nails) into the veins. Quinke has directed special attention to this symptom, which, however, had been noticed by several earlier authors. It may appear in those who are in perfect health, but is most common in cases in which the pressure within the arteries is pathologically increased and suddenly diminished,—particularly, therefore, in aortic insufficiency, but also, as Quinke, and more recently Peter and Broadbent have shown, in various other conditions characterised by a certain degree of relaxation of the arteries.