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Guest Editorial

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'Autoflogulation' – a word to help students to be precise in explaining blood flow control

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I wish to share with my Physiology teaching colleagues a few common observations among students on the imprecise and loose way in which they sometime use key Physiology words.

The term 'autoregulation' generally means the ability of the body to respond to challenges and changing circumstances and maintain normal essential parameters. This broad meaning similar to the term homeostasis can then be used in sentences like 'plasma osmolarity is autoregulated or 'plasma potassium concentration is autoregulated'. In circulatory physiology however, the classical definition and use of 'autoregulation' describes a specific control mechanism in regional blood flow (2) (I will indicate this as italicized 'Autoregulation' to distinguish from the general idea of homeostatic feedback control as a hyphenated auto-regulation).

Most students are told that both the brain and the heart exhibit distinct 'Autoregulation' of their blood flow over a certain range of blood pressure fluctuations (70 – 150 mmHg). This intrinsic 'Autoregulation' phenomenon is able to sustain a relatively normal blood flow at rest in the cerebral and coronary circulations, independent of extrinsic neural or hormonal inputs (involving myogenic/vasodilator metabolite responses). This is indicated graphically as a plateau phase in the blood pressure/flow diagram.

For students who have not focused on this specific meaning of 'Autoregulation', I discovered quite frequently that they will agree with the two statements below

1. At rest, the coronary blood flow is autoregulated.
2. During exercise, the coronary blood flow is autoregulated.

For 1, these students thought about the intrinsic 'Autoregulation' that maintains a constant coronary blood flow. However, for 2. they are saying that the coronary blood flow Increases during greater cardiac work. The students are thinking about 'active hyperemia'. Presumably they have read the sentence 2 to mean "the heart is able to 'auto-matically' increase its blood flow during exercise". Thus the word 'autoregulation' in the two instances are used with two specific meanings, one to indicate maintaining a constant flow and the other to 'auto-matically' increase blood flow to match higher cardiac metabolism .

Is this a trivial matter in the use of physiological language? The concern is students understand accurately a unique physiological event, defined by a specific term and in turn correctly use it well to explain the mechanistic

responses (1). We should hope for less 'Humpty Dumpty's attitude "When I use a word, it just means what I choose it to mean".

Let me elaborate with further observations from time spent with students during tutorials. The arterial blood pressure is homeostatically auto-regulated. When the blood pressure drops, baro-reflex responses are activated with increased effector sympathetic activity to restore the blood pressure. The compensatory mechanisms include tachycardia, increased myocardial contractility and increased total peripheral resistance (TPR). Concurrently, the essential cerebral and coronary circulations are 'Autoregulated' in response to the hypotension to maintain adequate blood flow. Thus comparing the vascular resistance changes, on one hand the arterial blood pressure in auto-regulated by raising the TPR with selective sympathetic vasoconstriction in splanchnic/renal circulatures. At the same time, the local intrinsic 'Autoregulation' mechanisms vasodilate cerebral and coronary arterioles.

In this scenario , it is certainly important for students to discern and distinguish between the rapid baroreflex/sympathetic auto-regulation of systemic arterial blood pressure (bearing in mind the longterm auto-regulation of blood pressure by the kidneys also participates) from the local 'Autoregulation' of blood flow to the brain and the heart.

I have coined a word for my students to help them to be precise when using 'Autoregulation', to mean what they intend to mean. This is 'AutoFlogulation', the intrinsic vascular responses that maintain blood flow when the driving perfusion blood pressure fluctuates.

Consider now 'Autoregulation' of the renal blood flow. The sentence below always generates lot of discussion during small group sessions.

'The renal blood flow is autoregulated when the blood pressure falls to 80 mmHg'.

Most students usually say this is true, based on what they see in the blood pressure/blood flow 'Autoregulation' graph showing the effective 'Autoregulatory' range as from 70- 150 mmHg. In reality, the renal blood flow (RBF) is reduced even at blood pressure of 80 mmHg due to increased renal sympathetic vasoconstrictor activity as part of the general increase in sympathetic discharge when the baro-reflex are triggered by the hypotension.

The major difference between cerebral/coronary and renal 'Autoregulation' is that RBF 'Autoregulation' primarily does not serve a metabolic function but to maintain glomerular filtration rate. The renal sympathetic nerve has a major role in blood volume/pressure control and in hypotension, this increased neural input has homeostatic priority and overrides and masks the local renal 'Autoregulation'.

Thus, in the integrated cardio-renal picture, the arterial blood pressure is auto-regulated which includes the increased renal sympathetic constriction of renal arterioles (this contributes to TPR) that takes precedence over the intrinsic renal 'Autoregulation' mechanisms which would have instead vasodilated the renal arterioles when the pressure decreases to 80 mmHg.

I put up these three sentences again for the students to think over how 'Autoregulation' ('AutoFlogulation') ought to be precisely understood and described.

During exercise,

1. The cerebral blood flow Is 'Autoregulated'
2. The coronary blood flow is Not 'Autoregulated'
3. The renal blood flow is Not 'Autoregulated'

The higher arterial blood pressure during exercise will not increase the cerebral blood flow due to 'Autoregulation'. However, there will be 'active hyperemia' in the cardiac muscles. Conversely the renal blood flow can be decreased due to increased renal sympathetic activity in conjunction with a larger distribution of the cardiac output to the exercising skeletal muscles.

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