COMMENTARY

Making collapsing pulse user-friendly

Thomas Puthiaparampil, MD

Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak

SUMMARY

Collapsing pulse is generally elicited by elevating the patient's arm. However, the pulse becoming stronger on arm elevation is a physiological phenomenon, which is bound to create confusion, if routine lifting of the arm in search of collapsing pulse is practiced. The name 'collapsing pulse' represents only the second component of this sign. It masks the more important first component - the slapping, bounding upstroke, characterised by its other name 'water-hammer pulse'. It is possible to elicit this sign by appreciating the slapping character on routine pulse examination. The insistence on arm lifting in medical school teaching is better avoided.

KEY WORDS:

Collapsing pulse; Arm lifting; Water hammer pulse

INTRODUCTION

Arterial pulse examination aims to determine the heart rate, rhythm, stroke volume and the pulse wave character. All of them could be performed at the radial artery. It is disturbing to note that the current teaching in medical schools appears to be to lift every patient's arm abruptly while feeling the pulse with the palm specifically to look for a collapsing pulse. Question arises, is this method necessary, and is it not rather misleading for the beginners? The author with his two decades' clinical teaching experience believes that this practice has become a crude step blindly followed by medical students as a necessary one in physical examination without understanding the mechanism of collapsing pulse. The author thinks that it would be less confusing, if the character of the pulse is appreciated during the routine pulse examination. Collapsing pulse is possible only in cases where there is a strong, bounding pulse due to the increased stroke volume in all conditions causing it.[1] Lifting of the arm of the patient may be needed, if at all, to confirm a collapsing pulse, when it is suspected to be present on routine examination. So, it is unnecessary to elevate the arm of the patient in search of a collapsing pulse in every case. The author believes that this very dramatic and useful clinical sign should not be unnecessarily glamourised but made user-friendly.

Does the name 'collapsing pulse' fully define this clinical sign? The character of the pulse in aortic regurgitation (AR) and other conditions causing collapsing pulse is high volume, bounding and slapping followed by its sudden disappearance – the collapse. The other name for collapsing pulse - water hammer pulse - brilliantly portrays the initial slap, but not its second component – the collapse. Water hammer an obsolete Victorian toy, an empty tube with some water but no air inside produces a pistol shot like sound, when it is inverted.[2,3] The sound produced by the water hammer and the slap felt on palpation of collapsing pulse are comparable in their abruptness and intensity.

The issue

The name "collapsing pulse" is not fully descriptive of the phenomenon it represents, as it refers only to the second component of this sign. Anything to collapse has to rise high first. The collapsing pulse also rises high before it collapses. The steep, abrupt surge caused by a large stroke volume pumped into a rather empty arterial tree that imparts the easily recognisable water-hammer character is missing in this name. The characteristic sudden high rise causes a slapping effect, which is better described by the terms cannonball pulse and water-hammer pulse.

True, raising the arm accentuates the collapsing character.[1,3,4] But, if looked for, it can be appreciated even without the arm raising. A survey among medical students revealed that, many of them believed that the collapse occurs only when the arm of the patient is raised, and that it is essential to do this manoeuvre routinely in all patients while examining the cardiovascular system. Probably, this is what they are taught in the medical school. There is also a general impression that the arm should be raised abruptly.[5] There is no viable explanation to why the arm lifting should be done abruptly. The mechanism of AR does not change whether the lifting is abrupt or gentle and holding it up longer also does not change the character of the pulse.

A study by Carole A Warnes, et.al. published in the American Journal of Cardiology in the year 1983 demonstrated that the elevation of the arm increases the arterial compliance and deflection of the pulse, while the mean pressure and pulse pressure are decreased. The same changes, though less pronounced, were demonstrated in normal subjects as well as in patients with AR.[4] This being a physiological phenomenon, the routine lifting of the arm of the patient in search of collapsing pulse is bound to over-diagnose this clinical sign, although it might not affect the final diagnosis. It would be rather embarrassing to the student to diagnose collapsing pulse on peripheral examination and find no murmur on precordial examination to corroborate it.

Views of students

In order to explore the understanding of our medical students about collapsing pulse, they were given the task of writing a short essay on collapsing pulse, including its definition, mechanism, method of elicitation, causes and associated signs. The compiled results are given in the Table I.

Corresponding Author: Dr. Thomas Puthiaparampil
Email: pthomas@unimas.my

Table I: The view of year-3 and year-5 medical students on the collapsing pulse

	Gathered from students' essays	Year-3	Year-5
1	It is present in AR	21 (78%)	35(88%)
2	Other causes of CP include	PDA, hyperthyroidism	Exercise, anaemia, hyperthyroidism, CO2 retention, pregnancy, hyperdynamic circulation, severe MR, PDA, Fever, beriberi, cirrhosis
3	In CP the stroke volume is increased	14 (52%)	8 (20%)
4	There is a sudden drop in volume after the rise	1 (4%)	1(3%)
5	There is a wide pulse pressure	3 (11%)	6 (17%)
6	It can be appreciated without lifting the arm	0	1(3%)
7	Sudden elevation of the arm is required to elicit it	19 (70%)	1(3%)
8	It is appreciated only on lifting the arm	6 (22%)	28(80%)
9	Use the palm to feel	12 (44%)	5 (14%)
10	The beat becomes stronger when arm is lifted	5 (19%)	1(3%)
11	The pulse becomes weaker when the arm is lifted	3 (11%)	2(6%)
12	The pulse is absent on lifting arm	2 (7%)	3(9%)
13	Accompanying pistol shot sounds	-	1(3%)
14	Also called water hammer pulse	-	8 (23%)
15	Mentioned slapping character of the pulse	-	1(3%)
16	Accompanying Corrigan sign	7 (26%)	2(6%)
17	Accompanying Quincke's sign	1 (4%)	2(6%)

Legend: Year-5 (n=40) and Year-3 (n=27) medical students voluntarily participated in this study on 28/12/2017 and 5/01/2018 respectively. It was not a part of any assessment, and no marks were given. Their views were compiled in this table. The views expressed in students' essays are given with the number of students expressing them and their percentage in brackets. Abbreviations used: CP = collapsing pulse, AR = aortic regurgitation, MR = mitral regurgitation, PDA = patent ductus arteriosus

DISCUSSION

Textbooks varied substantially in the description of clinical signs of AR and the importance attributed to them.[7] Using the traditional technique without understanding the mechanism of collapsing pulse is evident in the responses of the medical students. Similar confusion is reflected in some online sites, which readily pop up on Google Search for collapsing pulse. Three of them are quoted here.[1] "The water hammer pulse will feel like a tapping impulse through the patient's forearm due to the rapid emptying of blood from the arm during diastole, with the help of gravity's effects".[3] 2. "Raise the arm above the head briskly. Feel for a tapping impulse through the muscle bulk of the arm as blood empties from the arm very quickly in diastole, resulting in the palpable sensation".[5] Is it rapid emptying of the blood from the artery or the rapid surge into the artery that causes the tapping impulse? 3. "Examine for a collapsing pulse by placing your fingers across the anterior aspect of patient's forearm and applying just enough pressure to occlude the radial pulse".[6] Should you occlude the artery or relax the grip enough to stop feeling the pulse while raising the arm? An article published in Annals of Internal Medicine in 2003 by Babu AN stated "The examiner palpates the patient's radial artery while elevating the wrist. If the pulse clearly increases in amplitude, then the sign is present".[7]

The author's repeated literature search did not discover more recent articles on the ancient clinical sign of collapsing pulse. Physical examination is rather a declining art in this era of quick diagnostic imaging investigations. However, collapsing pulse is still considered an essential physical examination in medical schools. The author would agree with Babu AN et al. who stated, "Prominent textbook support of the eponymous signs of aortic regurgitation is not matched by the literature. Clinicians and educators should update and improve the evidence for these signs to ensure their relevance in current medical practice".[7]

In all conditions known to cause collapsing pulse the arterial tree is in a collapsed state during diastole. In severe AR, the classical producer of collapsing pulse, the arterial tree is rather empty with a very low or near zero diastolic pressure due to the back leak of blood into the left ventricle and peripheral vasodilatation.[8] The giant pulse wave produced by the large stroke volume pumped into the collapsed arteries by a volume-overloaded left ventricle generates the water-hammer or cannon effect, which causes the characteristic slap that precedes the collapse in a collapsing pulse. It is the presumption of the author that the Korotkoff sound, which is generated by the sudden opening of the artery after being emptied by the inflated blood pressure cuff, and the sound produced by the water hammer have the same mechanism. The collapsed arterial tree could be compared with the empty interior of the water hammer toy.

A typical collapsing pulse is difficult to miss. It is clearly felt on a routine pulse examination. Its initial slap and abrupt collapse are remarkably characteristic. While the normal pulse rises and falls in a gentle manner, the collapsing pulse slaps and vanishes abruptly. The collapsing pulse is bounding and forceful, felt as a tapping impulse or slapping sensation.[1] It is so dramatic and magical that once its slap is experienced, like any slap, it is difficult to forget. If a normal radial pulse can be likened to a small 'o', the collapsing pulse could be likened to a capital 'A'. While the normal pulse has a gentle rise, a brief stay and a gentle fall, the collapsing pulse has a bounding upstroke, a sharp peak and an abrupt fall. There are many conditions, which can cause a collapsing pulse, but none of them is diagnosed by it. The most useful finding for ruling in AR is the presence of an early

diastolic murmur.[1] Most peripheral signs display poor sensitivity and specificity for AR, and so, might be useful only in severe cases.[7,9]

CONCLUSION

If collapsing pulse is diagnosed based on the physiological phenomenon of pulse becoming stronger on lifting the arm of the patient, its over diagnosis is bound to occur. Therefore, routinely lifting the arm while examining the pulse is better avoided. The need to look for the character of the pulse routinely in every patient should be stressed while training medical students. Manoeuvres are unnecessary when a sign can be appreciated even otherwise. A change in name of collapsing pulse to 'slapping pulse' or 'slapping-collapsing pulse' will be more self-explanatory and more practical.

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