

PULSE

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PULSE

Primary Disciplinary Field(s): Physiology, Cardiology, Clinical Medicine

1. Core Definition

The pulse, scientifically referred to as the arterial pulse, constitutes the palpable manifestation of the cardiac cycle, specifically reflecting the pressure wave generated by the forceful expulsion of blood from the left ventricle into the aorta during systole. This hydraulic shockwave rapidly propagates through the arterial system, causing the elastic walls of the arteries to expand and subsequently recoil.

This rhythmic expansion and contraction of the arterial walls, which can be felt manually at various points on the body, provides a direct measure of the heart rate (the number of times the heart contracts per minute). Crucially, the pulse is not merely the flow of blood itself but the pressure wave that travels significantly faster than the blood flow. A normal, resting adult pulse rate typically falls between 60 and 100 beats per minute, defined as **normocardia**. Deviations from this range, such as **tachycardia** (a rate above 100 BPM) or **bradycardia** (a rate below 60 BPM), serve as immediate indicators of potential underlying physiological stress or pathology affecting cardiovascular stability.

Beyond simply quantifying the rate, the tactile assessment of the pulse yields vital qualitative data regarding the efficiency of cardiac output, the overall volume status of the patient, and the integrity of the peripheral vasculature. By evaluating parameters such as rhythm, volume, and contour, clinicians can instantaneously deduce critical information about the patient's systemic circulation, often guiding immediate diagnostic and therapeutic interventions.

2. Etymology and Historical Development

The clinical use of the pulse for diagnostic purposes dates back to antiquity, making it one of the most enduring and fundamental practices in medical history. The term "pulse" derives from the Latin *pulsus*, meaning "beat" or "stroke." Recognition of the pulse's connection to life and health was universal across early medical traditions.

In ancient Greece, physicians associated the pulse with the movement of vital spirits, and Galen, the prominent Roman physician, extensively documented and classified different pulse qualities, proposing that changes in the pulse reflected imbalances in the body's humors. His extensive work on sphygnology (the study of the pulse) remained authoritative in Western medicine for over a millennium. Simultaneously, sophisticated systems of pulse diagnosis were evolving in Traditional Chinese Medicine (TCM). TCM practitioners developed intricate methodologies, examining the pulse at three specific positions on the radial artery (cun, guan, and chi) and at superficial, middle,

and deep levels, with each combination corresponding to specific internal organs and diagnostic categories.

The scientific understanding of the pulse fundamentally shifted with the work of William Harvey in the 17th century, who described the circulatory system, definitively linking the arterial pulse to the mechanical action of the heart as a pump. While modern diagnostics now utilize advanced technologies like Doppler ultrasound and continuous electronic monitoring, the manual palpation of the pulse persists as an essential, foundational clinical skill, particularly valuable in rapid assessment where equipment is unavailable.

3. Key Characteristics and Measurement Techniques

When assessing the pulse, clinicians evaluate several key characteristics that reflect both cardiac function and systemic hemodynamic status. These characteristics are critical for determining whether blood flow is adequate or inadequate across various points in the body, as noted in the original clinical context.

Rate: This is the numerical measurement of beats per minute (BPM). Assessment of the rate confirms if the heart is beating within a normal physiological range appropriate for the patient's activity level, age, and physical condition. Significant deviations often necessitate immediate investigation into cardiac or metabolic causes.

Rhythm: Rhythm refers to the regularity of the beats. A pulse is described as regular if the interval between successive beats is constant. Irregularity, or **arrhythmia**, suggests potential underlying electrical conduction issues in the heart, such as atrial fibrillation or premature ventricular contractions.

Volume (Amplitude): Also known as strength or tension, the volume reflects the force exerted by the blood against the arterial wall. A strong, easily palpable pulse suggests high stroke volume and normal circulatory volume (a **bounding pulse**). Conversely, a weak, barely perceptible pulse (a **thready pulse**) indicates diminished cardiac output, potentially due to shock, dehydration, or severe heart failure.

Symmetry: Comparison of the pulse strength and timing between corresponding sites (e.g., both radial arteries or both pedal arteries). Asymmetry can signal localized vascular obstruction, such as an arterial embolism, or conditions like aortic dissection, which requires urgent surgical attention.

4. Anatomical Sites for Palpation

The pulse can be measured wherever an artery runs close to the surface of the skin and overlies a bone or firm structure, allowing for compression against the structure to feel the pressure wave. The choice of site depends on the clinical necessity, ranging from routine monitoring to emergency

assessment of central circulation.

Radial Pulse: Located on the radial artery at the wrist, on the lateral side. This is the most common site for routine monitoring and calculating the heart rate due to its accessibility and convenience.

Carotid Pulse: Located on the carotid artery in the neck, lateral to the trachea. Due to its proximity to the heart, this site provides the strongest and most reliable pulse, making it the preferred site for checking circulation in an unconscious patient or during Cardiopulmonary Resuscitation (CPR).

Brachial Pulse: Located in the antecubital fossa (inner elbow), often used in infants for routine pulse checks and as the site for auscultating blood pressure measurements.

Femoral Pulse: Located deep in the groin area. The presence of a femoral pulse is critical for assessing central circulation and perfusion status in cases of profound shock.

Dorsalis Pedis and Posterior Tibial Pulses: Located on the top of the foot and behind the medial ankle bone, respectively. These are essential for evaluating **peripheral perfusion** and detecting peripheral artery disease (PAD) or vascular trauma in the lower extremities.

5. Significance and Clinical Applications

The clinical significance of the pulse extends far beyond simple rate determination; it is a critical component of the physical examination, providing rapid insight into overall hemodynamic stability and regional blood flow adequacy.

In acute care settings, the pulse is a primary vital sign. A sudden change in rate (e.g., severe tachycardia) or quality (e.g., a sudden loss of volume) often signals an emergent condition, such as internal hemorrhage, evolving shock, or a severe allergic reaction. The ability to measure the pulse tactilely allows medical professionals to monitor a patient's status continuously without the need for sophisticated equipment, enabling swift detection of deterioration.

Moreover, the assessment of pulse strength at peripheral sites is essential for diagnosing conditions that impede distal circulation. For example, diminished or absent pulses in the feet, when compared to a normal femoral pulse, are highly indicative of compromised arterial flow due to atherosclerosis or a clot. This differential pulse assessment is vital for monitoring patients with diabetes, trauma, or post-surgical interventions involving vascular repair, ensuring early detection of ischemia and preventing tissue necrosis or limb loss. Thus, the pulse acts as a direct, non-invasive barometer of the efficiency with which the heart is oxygenating and nourishing the peripheral tissues.

6. Debates and Criticisms

Despite its historical precedence and clinical utility, the manual assessment of the pulse is subject to inherent limitations, primarily revolving around subjectivity and potential inaccuracy, especially in

challenging clinical scenarios.

The qualitative characteristics of the pulse--such as volume, tension, and contour--are subjective measurements reliant on the examiner's experience and tactile sensitivity. Different clinicians may interpret the same pulse differently, leading to inter-observer variability. Furthermore, certain patient characteristics, including extreme obesity, severe peripheral edema, or profound vasoconstriction (often seen in hypothermic or shock states), can make manual palpation of the pulse extremely difficult or impossible, resulting in inaccurate rate counts or missed diagnoses of weak circulation.

In modern critical care, reliance on manual pulse checks has been partially superseded by continuous, objective monitoring technologies. Tools like pulse oximetry electronically calculate the heart rate based on arterial oxygen saturation waves, providing continuous and objective data. Continuous Electrocardiography (ECG) monitors provide precise rate and rhythm analysis, which is crucial for accurately diagnosing complex arrhythmias that might feel irregular but are difficult to categorize manually. While technology enhances precision, the manual pulse remains the fastest, most universal initial assessment tool available to healthcare providers worldwide.

Further Reading

Pulse (Physiology)

Heart Rate

Arterial Blood Pressure

Galen