ISSN: 2456-043X
International Journal of Engineering Science and Generic Research (IJESAR)
Available Online at www.ijesar.in
Journal Index In ICI World of Journals - ICV 2016 – 68.35
Volume 10; Issue 2; 2024; Page No. 08-15

Cardiovascular Disease (Myocardial Infarction)

Zarina Khalida, Rajesh Kumar, Ajeetpal Singh & Amarpal Singh, Meenakshi Malhotra

Department of Pharmaceutics, St.Soldier Institute of Pharmacy, Lidhran Campus Behind NIT(R.E.C) Jalandhar-Amritsar by Pass, Nh-1, Jalandhar-1440011, Punjab, India.

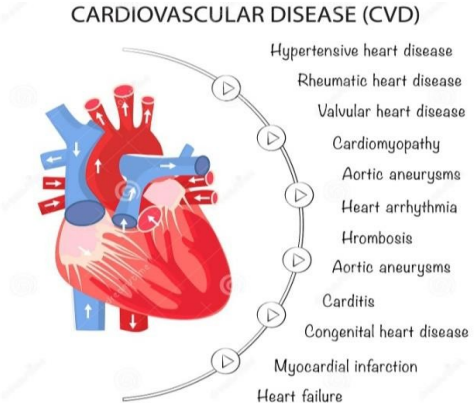
Abstract

Although myocardial infarction (MI) predominantly affects individuals over the age of 45, it can also impact young women and men, leading to substantial morbidity and imposing psychological and financial strains on both the patient and their family members. The causes of MI in those under 45 can be classified into four categories: drug abuse-related MI, hypercoagulable conditions, atheromatous coronary artery disease (CAD), and non-atheromatous CAD. These categories often intersect. Risk factors for MI include elevated blood pressure, smoking, diabetes, obesity, high cholesterol, physical inactivity, an imbalanced diet, binge drinking alcohol, and related substances. The primary mechanism of MI typically involves the complete occlusion of a vessel due to the rupture of an atheromatous plaque. This article delves into research and addresses practical considerations concerning young adults with MI.

Keyboard: CAD, MI

Introduction

The leading cause of mortality in Western populations is coronary heart disease (CHD) [1-3]. A fatal manifestation of CHD is myocardial infarction (MI), often presenting as a sudden death. Although MI primarily affects individuals aged 45 and above, it can also occur in young men and women, albeit rarely [4]. When it strikes at a younger age, MI imposes significant morbidity, psychological distress, and financial strain on the patient and their family. The safeguarding of youth against this condition has been eroded by the escalating prevalence of CHD risk factors (RF) among young adults, such as smoking, obesity, and sedentary lifestyles. MI refers to the loss of cardiac muscle tissue (infarction) resulting from ischemic injury or oxygen deprivation to the myocardium. It falls under the category of acute coronary syndrome (ACS), characterized by sudden or transient changes in heart blood flow-related symptoms. In contrast to unstable angina, another form of ACS, MI involves cell death, which can be confirmed by biomarker blood tests like cardiac troponin



Cardiac vascular diseases (CVD) (1,2)

Cardiovascular disease (CVD) encompasses a range of conditions affecting the heart or blood vessels. This includes coronary artery diseases (CAD) such as angina and myocardial infarction, commonly referred to as a heart attack. Additionally, other CVDs comprise stroke, heart failure, hypertensive heart disease, rheumatic heart disease, cardiomyopathy, irregular heart rhythms, congenital heart disease, valvular heart disease, carditis, aortic aneurysms, peripheral artery disease, thromboembolic disease, and venous thrombosis.

Myocardial infarction:- (3,4,5,6)

Definition:- Myocardial infarction (MI), commonly referred to as a heart attack, occurs when there is a disruption in blood flow to the myocardium, leading to ischemia. This condition is a significant contributor to global mortality rates. The primary cause of MI is typically underlying coronary artery disease. When a coronary artery becomes blocked, the myocardium is deprived of oxygen. Prolonged lack of oxygen to the myocardium can result in the death and necrosis of myocardial cells. The majority of myocardial infarctions stem from underlying coronary artery disease, which is the primary cause of death in the United States. When a coronary artery becomes blocked, the myocardium is deprived of oxygen, leading to potential cell death and tissue necrosis.

The blockage in the arteries supplying blood to the heart is a common cause of myocardial infarction (MI), also known as a heart attack. If blood flow isn't promptly restored, a heart attack can result in permanent heart damage or even death. Regarding the epidemiology of myocardial infarction: Myocardial infarction is a frequent manifestation of coronary artery disease. According to the World Health Organization (WHO) estimate in 2004, approximately 12.2% of global deaths were attributed to ischemic heart disease, making it the primary cause of death in high- or middle-income countries and second only to lower respiratory infections in lower-income countries. Globally, there are over 3 million cases of ST-elevation myocardial infarctions (STEMIs) and 4 million cases of non-ST-elevation myocardial infarctions (NSTEMIs) annually. STEMIs occur approximately twice as frequently in men as in women. While death rates from ischemic heart disease (IHD) have slowed or declined in most high-income countries, cardiovascular disease still accounted for one in three deaths in the US in 2008. However, in contrast, IHD is increasingly becoming a common cause of death in the developing world. For instance, in India, IHD became the leading cause of death by 2004, accounting for 1.46 million deaths (14% of total deaths), and deaths attributable to IHD were expected to double between 1985 and 2015.

Causes of myocardial infarction (13,14)

There are various factors and conditions that can lead to a heart attack, including:

• Spasm of the artery: The muscles lining your blood vessels can sometimes twitch or spasm, causing them to narrow and restrict blood flow to the heart muscle.

• Rare medical conditions: Certain diseases can lead to abnormal narrowing of blood vessels, potentially increasing the risk of a heart attack.

• Trauma: Injuries such as tears or ruptures in the coronary arteries can obstruct blood flow to the heart, triggering a heart attack.

• Obstruction from elsewhere in the body: A blood clot or air bubble (embolism) originating from another part of the body can become lodged in a coronary artery, blocking blood flow and causing a heart attack. • Electrolyte imbalances: Imbalances in key minerals like potassium in the blood can disrupt normal heart function and increase the likelihood of a heart attack

Symptoms of myocardial infarction:

 Chest pain (angina). This symptom can be mild and feel like discomfort or heaviness, or it can be severe and feel like crushing pain. It may start in your chest and spread (or radiate) to other areas like your left arm (or both arms), shoulder, neck, jaw, back or down toward your waist. Shortness of breath or trouble breathing.

 Nausea or stomach discomfort. Heart attacks can often be mistaken for indigestion.
 Heart palpitations.
 Anxiety or a feeling of "impending doom."
 Sweating.
 Feeling lightheaded, dizzy or passing out.
 Chest pain, especially in the center of the chest.
 Discomfort that feels like indigestion
 Shortness of breath, fatigue and insomnia that started before the heart attack.
 Pain in the back, shoulders, neck, arms or abdomen.
 Nausea and vomiting.

Types of myocardial infarction:(15)

• Type 1 (spontaneous MI): Related to atherosclerotic plaque rupture, ulceration, fissuring, erosion, or dissection with intraluminal thrombus in one or more of the coronary arteries, leading to decreased myocardial blood flow or distal platelet emboli and thereby resulting in myocyte necrosis. The patient may or may not have underlying obstructive coronary artery disease (CAD).

• Type 2 (MI secondary to an ischemic imbalance): MI consequent to increased oxygen demand or a decreased supply (e.g., coronary endothelial dysfunction, coronary artery spasm, coronary artery embolus, tachyarryhthmias/bradyarrhythmias, anemia, respiratory failure, hypertension, or hypotension).

• Type 3 (MI resulting in death when biomarker values are unavailable): Sudden, unexpected cardiac death before blood samples for biomarkers could be drawn or before their appearance in the circulation.

• Type 4a (MI related to percutaneous coronary intervention [PCI]): Elevation of biomarker values (cTn is preferred) to more than 5 times the 99 th percentile of the URL in patients with normal baseline values (<99th percentile URL) or a rise of values over 20% if the baseline values are elevated but stable or falling. In addition, any of the following are required: (1) symptoms suggestive of myocardial ischemia; (2) new ischemic ECG changes or new BBB; (3) angiographic loss of patency of a major coronary artery or a side branch or persistent slow flow or no flow or embolization; or (4) demonstration of the new loss of viable myocardium or new regional wall motion abnormality by cardiac imaging.

• Type 4b (MI related to stent thrombosis): MI associated with stent thrombosis as detected by coronary angiography or autopsy in the setting of myocardial ischemia in combination with a rise and/or fall of cardiac biomarkers with at least one value above the 99 th percentile URL.

• Type 5 (MI related to coronary artery bypass grafting[CABG]): Elevation of cardiac biomarker values more than 10 times the99 th percentile URL in patients with normal baseline cTn values. In addition, either (1) new pathologic Q waves or new BBB, (2) angiographic-documented new graft or native coronary artery occlusion, or (3) evidence of new loss of viable myocardium or new regional wall motion abnormality by cardiac imaging is required.

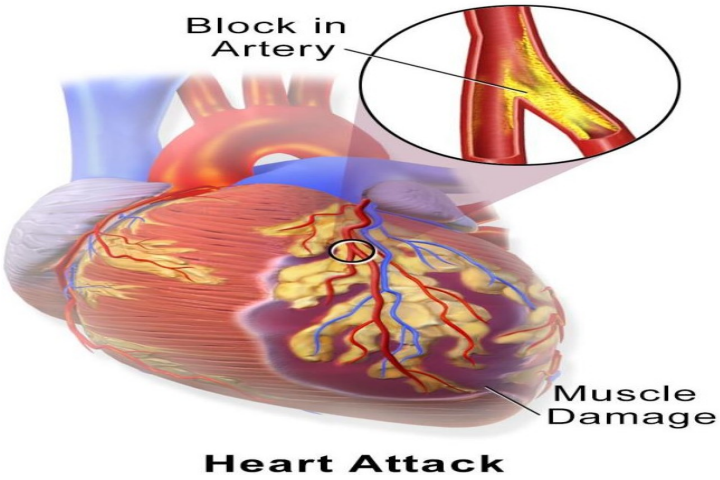
• Pathophysiology of MI:- (16-20)

The primary cause of a myocardial infarction (MI) often stems from the rupture of an atherosclerotic plaque located on an artery that supplies blood to the heart muscle. These plaques can become unstable over time, leading to rupture and the formation of a blood clot, which can block the artery within minutes. This blockage can result in tissue death in the area supplied by the affected artery. Notably, atherosclerotic plaques can develop silently over decades before causing symptoms.

Atherosclerosis is the gradual accumulation of cholesterol and fibrous tissue within the walls of the coronary arteries or other arteries, typically occurring over many years. This process involves progressive inflammation within the arterial walls, with inflammatory cells, particularly macrophages, infiltrating the affected areas. These cells become laden with cholesterol, particularly LDL, and transform into foam cells. As foam cells die, a cholesterol core forms within

the plaque. Additionally, smooth muscle and other cells move into the plaque in response to growth factors secreted by macrophages, stabilizing it.

While atherosclerotic disease is a common cause of myocardial infarction, other factors can exacerbate or contribute to its occurrence. These include conditions that lead to increased oxygen demands in a heart with limited blood supply, such as fever, tachycardia, hyperthyroidism, anemia, or hypotension. Additionally, damage or failure of interventions such as percutaneous coronary intervention or coronary artery bypass grafts can lead to myocardial infarction. Furthermore, coronary artery spasms, such as those seen in Prinzmetal's angina, can cause blockages and contribute to myocardial infarction.



Heart Attack

Diagnosis: (21)

Ideally, your physician should conduct routine screenings for risk factors associated with heart attacks during regular physical examinations. In an emergency setting where symptoms of a heart attack are present, you will typically undergo a thorough assessment. This includes an inquiry into your symptoms and measurements of vital signs such as blood pressure, pulse rate, and temperature. Additionally, you will be connected to a heart monitor to monitor your heart's activity, and various tests will be performed to determine whether a heart attack is occurring.

Tests to diagnose a heart attack include:

• Electrocardiogram (ECG). The initial test conducted to diagnose a heart attack is called an electrocardiogram (ECG). During this test, adhesive patches known as electrodes are placed on your chest and limbs. These electrodes capture and record the electrical signals produced by your heart as they travel through its chambers. The signals are then displayed as waves on a monitor or printed on paper.If there is damage to the heart muscle due to a heart attack, it may not conduct electrical impulses normally. As a result, abnormalities in the ECG tracing may indicate that a heart attack has occurred or is currently happening. These abnormalities can help healthcare professionals confirm the diagnosis of a heart attack and determine the appropriate course of treatment.

• Blood tests. After experiencing a heart attack, certain heart proteins begin to gradually leak into the bloodstream. In the emergency room, doctors will collect samples of your blood to analyze for these proteins, which are also known as enzymes. The presence and levels of these cardiac enzymes in the blood provide crucial diagnostic information regarding the extent of heart muscle damage caused by the heart attack. Additional tests

• Chest X-ray. An X-ray image of your chest allows your doctor to check the size of your heart

and its blood vessels and to look for fluid in your lungs.

• Echocardiogram: An echocardiogram, which utilizes sound waves (ultrasound), generates images of the heart in motion. This diagnostic test enables your doctor to observe how your heart's chambers and valves are functioning, including the pumping action of blood through the heart. By examining these images, an echocardiogram can detect any areas of the heart that may have been damaged, providing valuable information about the extent and location of heart muscle injury, such as that caused by a heart attack.

• Coronary catheterization (angiogram). During a cardiac catheterization procedure, a liquid dye is injected into the arteries of your heart through a long, thin tube known as a catheter. This catheter is typically inserted into an artery, often in your leg or groin, and then advanced through the blood vessels until it reaches the arteries of your heart. The injected dye contains a contrast agent that makes the arteries visible on X-ray images.

• Cardiac CT or MRI. Cardiac CT scans utilize X-rays to create images of the heart. During the procedure, you lie on a table that slides inside a long tubelike machine. X-ray beams are directed through your body to create cross-sectional images of your heart and chest. These images can help identify blockages in the coronary arteries, assess heart function, and detect other cardiac abnormalities. Treatment (21) In a hospital setting, treatment for a heart attack typically involves administering medications. Medications prescribed to address a heart attack may include:

• Aspirin. In a hospital environment, the standard approach to treating a heart attack involves the administration of medications. Every moment is vital, as prompt medical intervention can greatly influence the final outcome.

• Thrombolytic. Common medications prescribed to manage a heart attack include thrombolytic drugs. Also known as clotbusters, these medications aid in dissolving blood clots that obstruct blood flow to the heart. The sooner you receive a thrombolytic drug after a heart attack, the higher the likelihood of survival and reduced heart damage.

• Antiplatelet agents. Emergency room doctors may also administer other medications called platelet aggregation inhibitors to help prevent the formation of new blood clots and prevent existing clots from enlarging.

• Other blood-thinning medications. Additional medications, such as heparin, are often prescribed to reduce the "stickiness" of your blood and lower the likelihood of clot formation. Heparin is typically administered intravenously or via injection under the skin.

• Pain relievers. You may receive a pain reliever such as morphine to help alleviate discomfort.

• Nitroglycerin. This medication, commonly used to treat chest pain (angina), works by dilating the blood vessels, thereby improving blood flow to the heart.

• Beta blockers. These medications aid in relaxing your heart muscle, reducing your heartbeat rate, and lowering blood pressure, thus easing the workload on your heart. Beta blockers can also mitigate heart muscle damage and mitigate the risk of future heart attacks.

• ACE inhibitors. These medications effectively decrease blood pressure and alleviate stress on the heart. In addition to medications, you may undergo one of the following procedures to treat your heart attack: • Coronary artery bypass surgery. In some instances, emergency bypass surgery may be performed during a heart attack. However, if feasible, bypass surgery is typically scheduled after your heart has had time to recover from the heart attack, usually about three to seven days. During bypass surgery, veins or arteries are surgically attached beyond a blocked or narrowed coronary artery, allowing blood flow to bypass the narrowed section and reach the heart. Following surgery, you'll likely remain in the hospital for several days until blood flow to your heart is restored and your condition stabilizes. Lifestyle and home remedies 21 To improve your heart health, take the following steps:

• Avoid smoking. The most crucial step you can take to enhance your heart's health is to abstain

from smoking. Additionally, it's essential to steer clear of secondhand smoke exposure. If you're struggling to quit smoking, don't hesitate to seek assistance from your doctor.

• Control your blood pressure and cholesterol levels. If either your blood pressure or cholesterol levels are high, your doctor can recommend dietary adjustments and prescribe medications as needed.

• Get regular medical checkups. Some of the significant risk factors for a heart attack, such as high blood cholesterol, high blood pressure, and diabetes, may not exhibit symptoms in the early stages. Your doctor can conduct tests to diagnose these conditions and provide appropriate management strategies if necessary.

• Exercise. Regular exercise is beneficial for improving heart muscle function after a heart attack and reducing the risk of experiencing one. This level of physical activity promotes heart health and overall well-being.

• Maintain a healthy weight. Carrying excess weight places strain on your heart and can contribute to the development of conditions such as high cholesterol, high blood pressure, and diabetes. Maintaining a healthy weight through proper diet and regular exercise is essential for reducing the risk of these conditions and promoting overall heart health.

 Association between myocardial infarction and covid-19: There is significant evidence indicating a correlation between cardiovascular disease (CVD) risk factors such as hypertension, diabetes, prior coronary artery disease (CAD), and the risk as well as the severity of COVID-19 infection.

 Patients with pre-existing cardiovascular disease, hypertension, obesity, and diabetes are at an elevated risk of experiencing a poor prognosis if they contract COVID-19. Furthermore, individuals with myocardial injury, regardless of the underlying cause, tend to have a worse prognosis. ASSOCIATION BETWEEN BASELINE CVD AND COVID-19 (23-26) Yes, indeed. There is mounting evidence suggesting a correlation between certain cardiovascular disease (CVD) risk factors such as hypertension, diabetes, prior coronary artery disease (CAD), and the risk as well as the severity of COVID-19 infection. Individuals with pre-existing cardiovascular conditions or risk factors tend to experience more severe outcomes if they contract COVID-19.

• Certainly, observational studies provide valuable insights into the relationship between cardiovascular disease (CVD) risk factors and the severity of COVID-19 infection. Here are two examples that illustrate this relationship:

• The information you provided from the Chinese Center for Disease Control and Prevention and other reports highlights the significant impact of cardiovascular risk factors such as coronary heart disease (CHD), diabetes, and hypertension on the severity and mortality of COVID-19 infection.

References:

1. Shanthi M, Pekka P, Norrving B (2011). Global Atlas on Cardiovascular Disease Prevention and Control (PDF). World Health Organization in collaboration with the World Heart Federation and the World Stroke Organization. pp. 3–18. ISBN 978-92-4-156437-3. Archived (PDF) from the original on 2014-08-17.
2. Naghavi M, Wang H, Lozano R, Davis A, Liang X, Zhou M, et al. (GBD 2013 Mortality and Causes of Death Collaborators) (January 2015). "Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013". Lancet. 385 (9963): 117–71. doi:10.1016/S0140-6736(14)61682-2. PMC 4340604. PMID 25530442
3. Ojha N, Dhamoon AS. Myocardial Infarction. InStatPearls [Internet] 2019 Dec 4. Thygesen K, Alpert JS, White HD, Joint ESC/ACCF/AHA/WHF Task Force for the Redefinition of Myocardial Infarction. Jaffe AS, Apple FS, Galvani M, Katus HA, Newby LK, Ravkilde J, Chaitman B, Clemmensen PM, Dellborg M, Hod H, Porela P,

Underwood R, Bax JJ, Beller GA, Bonow R, Van der Wall EE, Bassand JP, Wijns W, Ferguson TB, Steg PG, Uretsky BF, Williams DO, Armstrong PW, Antman EM, Fox KA, Hamm CW, Ohman EM, Simoons ML, Poole-Wilson PA, Gurfinkel EP, Lopez-Sendon JL, Pais P, Mendis S, Zhu JR, Wallentin LC, Fernández-Avilés F, Fox KM, Parkhomenko AN, Priori SG, Tendera M, Voipio-Pulkki LM, Vahanian A, Camm AJ, De Caterina R, Dean V, Dickstein K, Filippatos G, Funck-Brentano C, Hellemans I, Kristensen SD, McGregor K, Sechtem U, Silber S, Tendera M, Widimsky P, Zamorano JL, Morais J, Brener S, Harrington R, Morrow D, Lim M, Martinez-Rios MA, Steinhubl S, Levine GN, Gibler WB, Goff D, Tubaro M, Dudek D, Al-Attar N. Universal definition of myocardial infarction. Circulation. 2007 Nov 27;116(22):2634-53. [PubMed]

4. Reimer KA, Jennings RB, Tatum AH. Pathobiology of acute myocardial ischemia: metabolic, functional and ultrastructural studies. Am J Cardiol. 1983 Jul 20;52(2):72A-81A.
5. Apple FS, Sandoval Y, Jaffe AS, Ordonez-Llanos J., IFCC Task Force on Clinical Applications of Cardiac Bio-Markers. Cardiac Troponin Assays: Guide to Understanding Analytical Characteristics and Their Impact on Clinical Care. Clin Chem. 2017 Jan;63(1):73-81. [PubMed]
6. White HD, Chew DP (August 2008). "Acute myocardial infarction". Lancet. 372 (9638): 570– 84. doi:10.1016/S0140-6736(08)61237-4. PMC 1931354. PMID 18707987
7. O'Gara PT, Kushner FG, Ascheim DD, Casey DE, Chung MK, de Lemos JA, et al. (January 2013). "2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines".
8. World Health Organization (2008). The Global Burden of Disease: 2004 Update. Geneva: World Health Organization. ISBN 978-92-4-156371-0.
9. Roger VL, Go AS, Lloyd-Jones DM, Benjamin EJ, Berry JD, Borden WB, et al. (American Heart Association Statistics Committee and Stroke Statistics Subcommittee) (January 2012). "Executive summary: heart disease and stroke statistics--2012 update: a report from the American Heart Association". Circulation. 125 (1): 188–97. doi:10.1161/CIR.0b013e3182456d46
10. Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, et al. (January 2015). "Heart disease and stroke statistics--2015 update: a report from the American Heart Association". Circulation. 131 (4): e29– 322. doi:10.1161/cir.0000000000000152. PMID 25520374. From 2001 to 2011, death rates attributable to CVD declined 30.8%.
11. Gupta R, Joshi P, Mohan V, Reddy KS, Yusuf S (January 2008). "Epidemiology and causation of coronary heart disease and stroke in India". Heart. 94 (1): 16– 26. doi:10.1136/hrt.2007.132951. PMID 18083949. S2CID 27117207 a.
12. Macintyre CR, Heywood AE, Kovoor P, et al. Ischaemic heart disease, influenza and influenza vaccination: a prospective case control study. Heart. 2013 Dec. 99 (24):1843-8. [Medline]. 1.
13. Kwong JC, Schwartz KL, Campitelli MA, et al. Acute myocardial infarction after laboratory-confirmed influenza infection. N Engl J Med. 2018 Jan 25. 378 (4):345-53. [Medline]. [Full Text].
14. Jaffe AS. Third universal definition of myocardial infarction. Clin Biochem. 2013 Jan. 46 (1- 2):1-4
15. Van de Werf F, Bax J, Betriu A, Blomstrom-Lundqvist C, Crea F, Falk V, et al. (December 2008). "Management of acute myocardial infarction in patients presenting

with persistent ST- segment elevation: the Task Force on the Management of ST-Segment Elevation Acute Myocardial Infarction of the European Society of Cardiology
16. Reed GW, Rossi JE, Cannon CP (January 2017). "Acute myocardial infarction". Lancet. 389 (10065): 197–210.
17. Colledge NR, Walker BR, Ralston SH, Davidson LS (2010). Davidson's principles and practice of medicine (21st ed.). Edinburgh: Churchill Livingstone/Elsevier. pp. 577–9.
18. Woollard KJ, Geissmann F (February 2010). "Monocytes in atherosclerosis: subsets and functions". Nature Reviews. Cardiology.
19. Janoudi A, Shamoun FE, Kalavakunta JK, Abela GS (July 2016). "Cholesterol crystal induced arterial inflammation and destabilization of atherosclerotic plaque"
20. https://www.mayoclinic.org/diseases-conditions/heart-attack/diagnosis-treatment/drc- 20373112
21. https://www.uptodate.com/contents/covid-19-myocardial-infarction-and-other-coronary-artery- disease-issues#H2335481072
22. Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet 2020; 395:1054.
23. Guan WJ, Ni ZY, Hu Y, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. N Engl J Med 2020; 382:1708.
24. Chow YW, Pietranico R, Mukerji A. Studies of oxygen binding energy to hemoglobin molecule. Biochem Biophys Res Commun 1975; 66:1424.
25. Guo T, Fan Y, Chen M, et al. Cardiovascular Implications of Fatal Outcomes of Patients With Coronavirus Disease 2019 (COVID-19). JAMA Cardiol 2020; 5:811.
26. Anupam sood , Akhilesh singh, Charauta gadhkari(CURES) [, Department of medicine , Jawaharlal medical college, Dalta meghe, Institute of Higher Education Education and Research Wardha