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Review Article

A Strategic Approach to Global Maternal Cardiovascular Health Crisis: A Call for Dedicated Cardio-Obstetrics Subspecialty, Units and Clinics

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Abstract

This narrative review emphasizes the critical need for cardio-obstetrics subspecialties, structured training, specialized units, and clinics to combat the alarmingly high global rates of maternal cardiovascular (CV) morbidity and mortality. CV diseases are a leading cause of pregnancy-related deaths, posing significant risks to both mother and foetus. Conditions like peripartum cardiomyopathy, hypertensive disorders of pregnancy, congenital and valvular heart disease, venous thromboembolism, and pregnancy-related myocardial infarction contribute to poor maternal and foetal outcomes.

The prevalence of maternal cardiovascular disease is escalating, particularly in low and middle-income countries (LMICs) due to rising traditional risk factors, potentially exacerbated by poverty and undernutrition. Despite this, concrete action plans, especially in LMICs, are lacking, resulting in high healthcare costs and dismal prognoses. In this regard, a coordinated multidisciplinary approach integrating cardiology, obstetrics, and related specialties is crucial.

This review article calls for urgent establishment of cardio-obstetrics subspecialties, structured training programs, units, and clinics. These initiatives can revolutionize maternal CV health through preventive measures, treatment strategies, monitoring, counselling, and research. Such comprehensive care has the potential to significantly reduce the global burden of maternal CV disease, morbidity, mortality, and adverse foetal outcomes.

Keywords: Cardio-obstetrics; cardiovascular physiology in pregnancy; maternal cardiovascular disease; maternal death; pregnancy-related death

Introduction

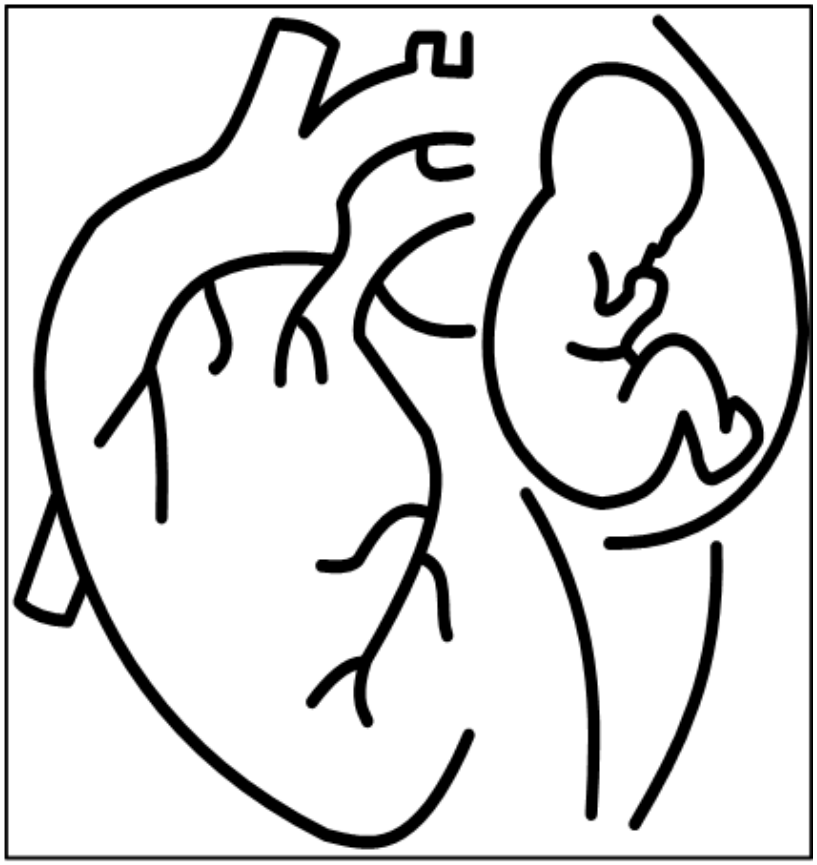

Figure 1: Depicting Cardio-Obstetrics Connection as Maternal Heart (left side) and Pregnancy with Foetus (Right side)

The above illustration depicts graphical abstract of cardio-obstetrics interactions as maternal heart-pregnancy-fetus [1]. Co-occurring cardiovascular disease and pregnancy is an exciting pathophysiological interaction that has led to the creation of new and evolving medical field cardio-obstetrics that is dedicated to caring for pregnant women with cardiovascular (CV) disease for improve maternal CV health and fetal outcome. This field comprises of cardiologists, obstetricians, and other relevant health care professionals. Pregnancy and the postpartum period introduce unique physiological changes that can unmask or exacerbate underlying cardiovascular diseases. The management of these co-occurring complex conditions requires specialized expertise that spans obstetrics, cardiology and related subspecialties. However, the current healthcare system often fails to provide this integrated care, leading to dismal outcomes for mothers and their babies especially in LMICs. The establishment of dedicated cardio-obstetrics subspecialty training program, units, and clinics has the potential to transform the landscape of maternal cardiovascular health. These specialized field, units and clinics would bring together obstetricians, cardiologists, feto-maternal medicine specialists, and other related healthcare providers to provide comprehensive and coordinated cardio-obstetrics care for women with established or suspected cardiovascular disease during pregnancy and the postpartum period. The presence of CV disease in pregnancy causes impaired quality of life, morbidity and death among childbearing women of HICs and LMICs [2,3,4,5,6], and their co-occurrence share complex bidirectional relationship [7], with dismal prognosis if not promptly identified and managed appropriately. The prevalence of maternal cardiovascular (CV) disease is increasing globally, driven by factors such as traditional cardiovascular risks, sex-specific cardiovascular risk factors [2,3], and poverty, and maternal undernutrition in LMICs. Despite this alarming trend, there is a lack of a concrete plan to address this public health threat, which leads to significant healthcare costs and poor outcomes, especially in LMICs. Health professionals, including cardiologists and obstetricians, are increasingly concerned about the rising incidence of maternal CV disease and related deaths in both high-income (HIC) and LMICs [2]. Many of these cases are preventable through effective measures during preconception, pregnancy, postpartum and beyond. Health care providers hold significant responsibility for delivering appropriate care to pregnant women with cardiovascular (CV) disease [2,3]. To effectively manage maternal CV conditions, professionals need a strong foundation in clinical knowledge, skills, and research related to cardio-obstetrics. This expertise can greatly impact the quality of life for these women and may be critical in life-and-death situations. Additionally, the field of cardio-obstetrics is evolving, and may be influenced by factors such as clinical observations, research developments, the complexities of feto-maternal care, healthcare delivery systems, and socio-economic and technological changes. The experiences and needs of pregnant women with CV disease also play a crucial role in shaping cardio-obstetrics care practices. In clinical practice, we noted that awareness of cardio-obstetrics among healthcare professionals, the public, health care administrators, policymakers, researchers, funders, and pregnant women with cardiovascular disease appears to be significantly low. Additionally, there is a concerning lack of healthcare practitioners who possess a solid understanding of cardio-obstetrics principles, which is insufficient to address the needs of pregnant women with cardiovascular diseases. To improve the quality of care in cardio-obstetrics and reduce maternal cardiovascular disease, as well as the associated economic burden, morbidity, and mortality, it is crucial for cardiologists, obstetricians, healthcare administrators, policymakers, midwives, nurses, and other relevant specialists to enhance their knowledge in this field. Achieving this requires a larger number of healthcare professionals equipped with adequate clinical knowledge, skills, competence, and a research-oriented approach to cardio-obstetrics. This review article provides a comprehensive overview of cardio-obstetrics, focusing on its fundamentals, related pathologies, maternal cardiovascular mortality, and risk stratification. The aim is to enhance clinician knowledge and advocate for the development of cardio-obstetrics, structured training programs, specialized units, and clinics in both HICs and LMICs. By doing so, it seeks to reduce the global burden of maternal cardiovascular diseases, as well as related morbidity, mortality, and adverse fetal outcomes.

Methods

A comprehensive literature search was carried out on cardio-obstetrics in the data bases of Google Scholar, PubMed, Medline and Scopus. The use of search terms cardio-obstetrics, pregnancy heart team, physiological changes in pregnancy, cardiovascular diseases in pregnancy, cardiovascular risk stratification in pregnancy, maternal/pregnancy related CV morbidity and mortality were all analyzed. Abstracts and power-point presentation on cardio-obstetrics were also reviewed. Furthermore, full text of published papers and bibliographies of selected pertinent studies were thoroughly analyzed. All were analyzed and relevant information extracted

Review

Basics Cardio-obstetrics

Cardiovascular physiological changes during pregnancy

Pregnancy is associated with significant adaptive cardiovascular physiological changes to meet the increased metabolic demands of the mother and maintain adequate utero-placental circulation for fetal growth and development [8]. These adaptative changes begin early in pregnancy and continue throughout gestation. Increase in blood volume is among the earliest cardiovascular adaptive changes in pregnancy and by the end of the first trimester, blood volume has increased by about 45% [8]. This increased blood volume is achieved through increases in both plasma volume and red blood cell mass [8]. This adaptive increase is necessary for the provision of adequate blood flow to the uterus and placenta [8]. Correspondingly to the increase in blood volume, cardiac output also rises steadily throughout pregnancy, increasing by 30-50% by the end of the third trimester [9]. This is primarily achieved through an increase in stroke volume, as heart rate only increases modestly (10-20 bpm) [10]. The increase in cardiac output ensures sufficient blood flow to the uterus and other maternal organs [8,9,10]. In addition, systemic vascular resistance decreases by 20-30% during pregnancy [9]. This vasodilation is thought to be mediated by hormonal and mechanical factors, including increased levels of estrogen, progesterone, and local vasodilators like nitric oxide [10]. The decrease in vascular resistance offsets the increase in cardiac output, helping to maintain relatively stable blood pressure levels during pregnancy. Other notable cardiovascular changes in pregnancy include: (1) Decreased blood pressure, especially in the second trimester [11]; (2) Increased heart size and left ventricular mass [12]; (3) Increased venous capacitance and venous return [9]. These afore-mentioned adaptative physiological changes ensure adequate perfusion of the uteroplacental unit while also meeting the increased metabolic needs of the mother. Therefore, having very good understanding of the normal cardiovascular physiological changes in pregnancy is crucial to cardiologist, obstetricians and other related clinicians for identifying and managing cardiovascular complications that can arise during pregnancy and beyond.

Normal cardiovascular symptoms in pregnancy

Pregnancy induces significant adaptive physiological changes in a pregnant woman's cardiovascular system to meet her metabolic demand and that of developing fetus [8,9,10]. These adaptations often result in the experience of various cardiovascular symptoms that are considered normal during pregnancy. Therefore, understanding the spectrum of these typical cardiovascular changes and symptoms is important for clinicians to differentiate them from potential pathological conditions. Increased resting heart rate is one of the most common cardiovascular symptoms experienced by pregnant women [10,13]. Maternal heart rate can rise by 10-20 beats per minute due to the increased metabolic demands of pregnancy and the activation of the sympathetic nervous system [13]. This elevated heart rate is a normal adaptation and does not necessarily indicate an underlying disease. Pregnant women may also experience palpitations that are often benign and can be attributed to the increased cardiac output and sensitivity of the cardiovascular system during pregnancy [14]. However, persistent or worsening palpitations should be evaluated to rule out cardiac arrhythmias.

Orthostatic hypotension is another common symptom observed in pregnancy. This is caused by blood pooling in the lower extremities due to decreased vascular resistance and venous return associated with pregnancy [15]. Orthostatic hypotension is usually benign condition but in rare occasion may lead to dizziness, light-headedness, or fainting. Legs swelling, is another common symptom observed in pregnancy resulting from increased fluid retention and reduced venous return manifesting as bilateral pitting pedal edema especially in the lower extremities [16]. However, when the edema is excessive or unusual, may indicate underlying diseases such as preeclampsia, heart failure, peripartum cardiomyopathy, kidney diseases or chronic liver disease in pregnancy and if the swelling is unilateral with associated dyspnea, chest pain and tachypnea suspect venous thromboembolism. Other rare normal CV symptoms in pregnancy include dyspnoea on exertion, easy fatiguability and chest pain [17]. In summary, these afore-mentioned normal CV symptoms, are usually observed in pregnancy. Therefore, clinicians should be aware of these typical adaptative symptoms to avoid unnecessary treatment interventions and provide appropriate reassurance to pregnant women.

Normal cardiovascular physical examinations findings in pregnancy

Understanding the normal cardiovascular physical examination findings in pregnancy is essential for clinicians to accurately assess and monitor pregnant women. Tachycardia is very common in pregnancy and usually result from hormonal changes in pregnancy, physiological anemia and high output state [18]. Precordial palpation may reveal a laterally displaced and hyperdynamic apical impulse [19]. Cardiovascular auscultation may reveal loud first heart sound (S1) usually results from high output state and physiological anemia, while its exaggerated splitting result from early mitral valve closure [18]. Benign (physiological) ejection systolic flow murmur in about 90% of normal pregnancy, most often heard at the left sternal border [19]. Other rare murmurs in pregnancy include mammary Souffle a benign soft blowing, high-pitched systolic murmur of grade 1 to 2/6, and usually softer in upright position and best heard over the breast in young pregnant or lactating mother. Rare atrioventricular diastolic flow murmur is also observed in about 20% of normal pregnancy [18,20]. However, if present requires thorough evaluation to ensure is not organic murmur. Another rare auscultatory finding in pregnancy is venous hum [18,20]. Jugular venous distension may be observed, especially in the third trimester [19]. Pitting pedal edema, is common in pregnancy [19]. Pregnancy-induced cardiovascular physical examination findings are important to recognize during the physical examination of pregnant women. Clinicians should be familiar with the normal cardiovascular examination findings to distinguish them from potential pathological states.

Electrocardiographic changes in pregnancy

Pregnancy is a physiological state that is associated with significant alterations in the electrocardiogram (ECG). Understanding these ECG changes by the cardio-obstetrics specialist is important for the proper interpretation of ECG findings in pregnant women. The borderline electrocardiographic changes commonly observed in pregnancy include: Tachycardia with slight shortening of PR and QT interval [21,22], minor left or right QRS axis deviation due to rotation of the heart from elevated diaphragm from enlarging gravid uterus [23]. Additional changes observed in pregnancy include physiological Q wave in the inferior leads, non-specific ST-segment and T-wave changes most commonly observed in the left precordial leads [21]. Rare but abnormal ECG abnormalities in pregnancy include conduction abnormalities resulting from heart chambers dilation especially left atrial enlargement, supraventricular tachycardias (SVTs), and atrial/ventricular premature complexes [21] which, if persistent and associated with symptoms, require further evaluation and treatment.

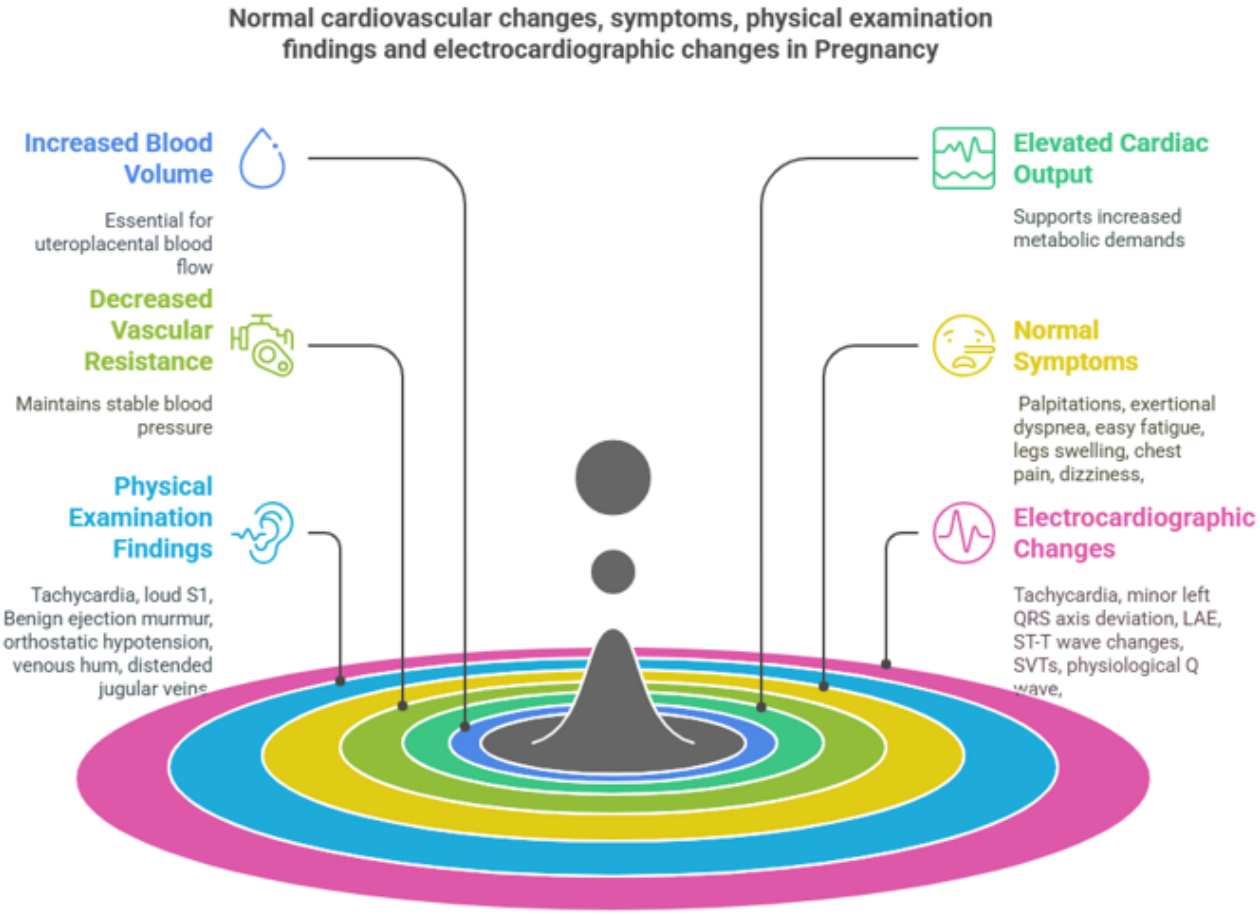

Figure 2: Showing Basics Cardio-obstetrics the normal physiological changes in pregnancy, symptoms, physical examination findings and electrocardiographic findings.

Cardio-obstetrics pathologies

Cardiovascular diseases (CVDs) in pregnancy are an important public health problem, as they are a leading cause of maternal and pregnancy-related morbidity and mortality worldwide [24]. The major risk factors that increase the chance of pregnant or childbearing women to develop cardiovascular diseases in pre-pregnancy, pregnancy and puerperium include: Hypertension obesity, diabetes mellitus, hyperlipidemia, pre-existing heart disease, metabolic syndrome, myocarditis, poverty, family history of heart disease, substance/drug abuse, smoking, connective tissue disease alcohol abuse and sedentary lifestyle [2,3]. Some maternal CV diseases present with diagnostic and treatment challenges, poor quality of life, high health care expenditure, with significant morbidity and mortality rates [2,3]. Furthermore, some cardiovascular diseases in pregnancy requires prompt recognition, screening, preventive strategies, health education promotion, CV risk stratification, and appropriate treatment intervention, especially by the cardio-obstetrics specialist, thus resulting in better feto-maternal outcome, and reduce cardiovascular disease burden in pregnancy [2,3]. Despite afore-going observations majority of maternal CV diseases are preventable with early detection and appropriate treatment interventions. Cardiovascular disease (CVD) in pregnancy is defined as a spectrum of congenital or acquired cardiovascular pathologies and cardiac arrhythmic disorders in pregnancy. These spectrum of CVDs in pregnancy includes both pre-existing conditions as well as those that arise during the gestational period. Understanding this spectrum is crucial for providing appropriate risk assessment, management, and monitoring of pregnant women with cardiovascular disease and complications.

The pre-existing CV disease in pregnancy include

Valvular heart disease in Pregnancy

Valvular heart disease (VHD) is a common cause of heart disease in pregnancy [25]. Pregnancy-induced hemodynamic changes [26], worsen valvular heart disease symptoms in pregnancy resulting in events such as decompensated heart failure, increased risk of arterial/venous thromboembolic events and life-threatening arrythmias all these pose diagnostic and treatment challenges to clinicians, especially in a resource constrained setting resulting in adverse feto-maternal outcome if not promptly identified and managed appropriately. In HICs, congenital heart disease is the leading cause of VHD in pregnancy [27], in contrast to LMICs, where rheumatic heart disease is still the leading cause of VHD in pregnancy [27]. Pregnancy is well tolerated in regurgitant valvular heart disease in contrast to stenotic valvular heart disease [28].

Congenital heart disease in pregnancy

Pregnant women with underlying congenital heart disease (CHD) are at increased risk of heart failure, acute pulmonary edema, symptomatic arrythmias, stroke and death triggered by failure of the cardiovascular system to adapt to physiological changes necessary to meet feto-maternal homeostatic and metabolic demands to maintain utero-placental circulation for fetal growth and development [29]. The risk, clinical presentation and outcome of pregnant women with CHD depend on the current hemodynamic status, lesion morphology, previous interventions, lesion associated cardiac structural changes, early identifications, cardio-obstetrics care, and health care financing [29]. Additional pre-existing CV disease in pregnancy include heart failure, cerebrovascular disease (stroke) and peripheral arterial disease (PAD) Preexisting CV diseases can significantly impact the course and outcomes of pregnancy, with increased risks of heart failure, arrhythmias, and maternal-fetal complications [2,3,29]. This groups of patients require thorough history-taking, meticulous physical examination, relevant focused investigations, risk stratification, counselling, close monitoring, optimization of cardiac status, appropriate treatment interventions. and multidisciplinary management are essential for these high-risk pregnancies. While pregnancy-induced cardiovascular diseases are spectrum of diseases that arise or unmasked during pregnancy this include:

Peripartum cardiomyopathy

Peripartum cardiomyopathy (PPCM) is a pregnancy related heart muscle disease. Globally, PPCM has ethnic and geographical variation in incidence and outcomes [30]. It appears to be a growing maternal health problem with myriads of challenges, especially in north-western Nigeria, which is the "hunting ground'' of this disease worldwide [30]. In this part of the world, PPCM appears to be a disease of poverty, resulting in significant re-hospitalization, health care cost, morbidity, and mortality rates [30]. Given these observations, PPCM in this region of sub-Saharan Africa, requires focused attention, disease awareness, prompts recognition and accessibility to appropriate guideline directed medical therapy to avert its devastating clinical consequences [30]. Regardless of these observations, it seems there is no concrete actionable plan to address this maternal health problem in sub-Saharan Africa in the near future. Clinically PPCM presents as heart failure (HF) syndrome in the last month of pregnancy or within 5-6 month or beyond of childbirth with a higher risk of cardiovascular events such as venous and systemic thrombo-embolism, atrial and ventricular arrhythmias and sudden cardiac death. The understanding of this disease continues to develop in the last 5 decades, and the paradigms use for understanding this disease have changed, but there are still with unresolved questions about the etiology and pari-passu the definition and diagnosis of PPCM, has undergone several modifications over the years, and the most recent definition was by the HF Association of European Society of Cardiology (ESC) working Group on PPCM [31]

Hypertensive disorders of pregnancy

Hypertensive disorders of pregnancy (HDP) are a spectrum of hypertensive states characterized by persistent and sustained elevation of blood pressure during pregnancy and shortly thereafter. Globally, HDP is a major cause of maternal morbidity and mortality [4,32]. The prevalence of HDP is escalating across the globe due to increasing prevalence of metabolic diseases among young women [33]. According to the World Health Organization (WHO), at least one woman dies every seven minutes from complications of HDP [5]. HDP complicates 5-10% of all pregnancies worldwide [34]., with pre-eclampsia increasing the risk of cardiovascular complications by four to twelve-fold increased risk of heart failure and two-fold increase risk of coronary artery disease, stroke, and cardiovascular death [35]. Hypertension in pregnancy primarily induces myocardial pathological structural remodeling with predominantly left ventricular dysfunction [36]. Clinically, the commonest complication of HDP is acute pulmonary edema, which is responsible for > 30% of maternal death worldwide [35]. Furthermore, HDP increases risk of perinatal morbidity and mortality [4].

According to the 2019 American College of Obstetrics and Gynecologist (ACOG), hypertensive disorders of pregnancy are broadly classified into four groups [4]; (a) Chronic hypertension in pregnancy is an elevated blood pressure (systolic blood pressure ≥140mmHg and or diastolic blood pressure ≥ 90mmHg) that predates pregnancy, diagnosed within 20weeks of gestation or after 20 weeks of gestation but fail to resolve within 12weeks postpartum (b) Chronic hypertension with superimposed preeclampsia is the development of new onset proteinuria, thrombocytopenia or any of the features of pre-eclampsia in a woman with chronic hypertension. (c) Gestational hypertension also called pregnancy induced hypertension (PIH) is an elevated systolic blood pressure ≥ 140mmHg and or diastolic blood pressure ≥ 90mmHg in a previously normotensive woman at gestational age > 20weeks without significant proteinuria. 17% of women with PIH progress to develop preeclampsia (d) Preeclampsia is a systemic syndrome characterized by new onset hypertension (systolic ≥ 140mmHg and or diastolic ≥90mmHg) with significant proteinuria (urinary protein excretion ≥ 300mg/ 24hrs) after 20 weeks gestation. Severe pre-eclampsia is when systolic blood pressure ≥ 160mmHg or diastolic blood pressure ≥ 110mmHg on two occasions at least 6hours apart, while eclampsia is the severe form of pre-eclampsia characterized by neurologic involvement in the form of generalized tonic-clonic convulsion in the absent of any other cause of the seizures [4]

Cardiac arrythmias in pregnancy

Cardiac arrythmia is the most frequent cardiovascular disorders in pregnancy [37]. It is well documented that the risk of developing benign and life-threatening cardiac arrythmias increases in pregnancy and likewise their recurrence especially in women with past history of cardiac arrythmia [37]. The majority of cardiac arrythmias in pregnancy are benign; however, on rare occasions life-threatening arrythmias may be observed with diagnostic and treatment challenges. The mechanisms of cardiac arrythmias in pregnancy is usually triggered by pregnancy hormone induced adaptive cardiovascular hemodynamic changes and electrical remodeling resulting from atrio-ventricular structural remodeling, increased alpha adrenergic receptor, and autonomic nervous system changes [37].

Pregnancy-related Venous thrombo-embolism (VTE)

Pregnancy-related VTE is defined as the coexistence of deep vein thrombosis (DVT) and PE in pregnancy or puerperium [38,39]. The risk of postpartum VTE is fivefold compared to prepartum VTE [39]. Several factors were documented to increase risk of VTE in pregnancy and puerperium. These factors include gestational diabetes, preeclampsia, overweight, obesity, metabolic syndrome, prolonged immobilization, advancing age, prolonged labor, caesarean delivery, and postpartum infection [38,39,40]. The possible underlying aetio-pathophysiologic mechanisms for the development of VTE in pregnancy and postpartum include: (1) Hormonal changes inducing hypercoagulable and prothrombotic states in puerperium resulting in decreased fibrinolytic activity, increase fibrin generation, acquired resistance to activated protein C with decrease level of protein S and elevated level of coagulation factors II, VII, and X; all these hemostatic responses were to prevent excessive bleeding during childbirth [40,41]; (2) Hormone-mediated increase in venous tone and reduced flow [40]; (3) Childbirth- mediated pelvic veins endothelial damage [40,41] (4) Right common iliac artery-mediated anatomical compression of left common iliac vein, explaining why DVT in left lower extremity is commoner in (82%) of pregnancy and puerperium [42]. Clinically, pregnancy-related VTE presents as asymptomatic or symptomatic with classic or masquerading symptoms with high likelihood of misdiagnosis and for this reason, a high index of suspicion should always be entertained in any woman in pregnancy or puerperium with sudden onset of dyspnea, chest pain and easy fatigue with or without identifiable risk factors for VTE. Pregnancy-related VTE also present with devastating complications [38-42]. Given these observations, pregnancy-related VTE requires prompt recognition and rapid institution of guideline-directed medical therapy to avert dismal prognosis. Pregnant and postpartum women with a high risk of VTE require disease awareness, focused attention and thrombo-prophylaxis.

Pregnancy-related myocardial infarction

Although, in the general population atherosclerosis is the leading cause of coronary artery disease leading to myocardial infarction, this is in contrast to pregnancy-related myocardial infarction a very rare [43], life-threatening medical emergency, that is associated with variable etiology which includes spontaneous coronary artery dissection (SCAD) [44], atherosclerosis, thrombosis and coronary artery vasospasm. Pregnancy-related MI may present with diagnostic and treatment challenges especially in resource constrained settings with a consequently feto-maternal dismal prognosis. Given these observations, pregnancy-related MI requires prompt recognition, rapid institution of appropriate treatment intervention or urgent referral to health care center with adequate facilities and expertise in addition to control of identifiable risk factors to avert dismal feto-maternal outcomes. Additional pregnancy induced cardiovascular diseases include: venous thromboembolism, spontaneous coronary artery dissection, and aortic dissection [40,41,44,45]. These conditions require prompt diagnosis and specialized management to minimize the risk of adverse events. In conclusion, the spectrum of CVDs in pregnancy encompasses a wide range of pre-existing and pregnancy-related conditions, each with its unique challenges and management strategies. Comprehensive cardiovascular assessment, multidisciplinary care, and close follow-up are is essential to optimize the outcomes for pregnant women with cardiovascular disease and complications.

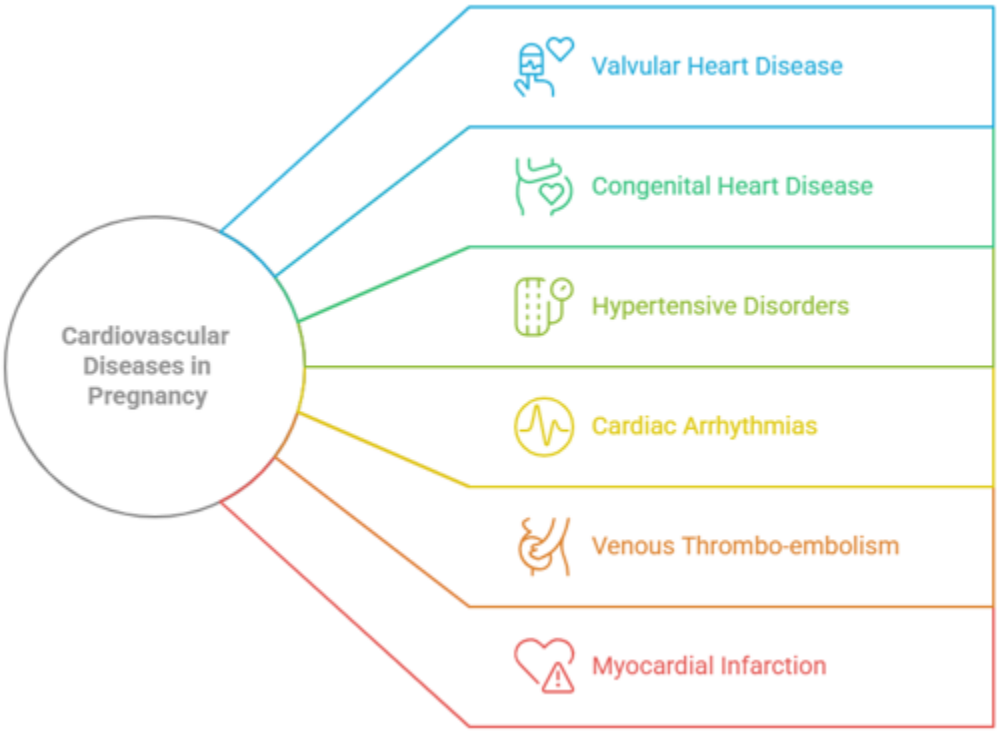

Figure 3: Showing spectrum of Cardio-obstetrics pathologies.

Cardio-obstetrics and Cardiovascular Morbidity and Mortality in Pregnancy

Cardio-obstetrics plays a critical role in mitigating maternal morbidity and mortality by addressing the complex interplay between pregnancy and cardiovascular disease, as these conditions significantly contribute to adverse outcomes for both mother and child. Pregnancy is a normal physiology; however, it places significant physiological stresses on the body and cardiovascular system [7], and for this reason it was nickname ''*nature stress test''* [7]. This physiological stress on pregnancy-related cardiovascular disease can lead to significant maternal morbidity and mortality. Therefore, understanding the epidemiology, physiology, risk factors, and management of cardiovascular disease in pregnancy is crucial for providing optimal care to this group of patients. Cardiovascular disease is a leading cause of maternal and pregnancy related mortality in both developed and developing countries [46,47]. Globally, maternal mortality rate has been rising, with maternal CV disease accounting for over one-third of these deaths [48]. The identifiable risk factors for cardiovascular morbidity and mortality in pregnancy include previous history of cardiovascular disease, obesity, advanced maternal age, hypertensive disorders in pregnancy and diabetes [49,50]. Pregnancy-related clinical conditions such as pregnancy induced hypertension, preeclampsia, and gestational diabetes also increase the risk of developing cardiovascular complications [51,52]. In this regard, cardio-obstetrics care involving obstetricians, cardiologists, and other specialists is essential for the optimal care of maternal CV disease [53]. This includes optimizing preconception maternal CV care, close monitoring during pregnancy, and appropriate interventions for cardiovascular disease or events [54]. Treatment, procedures, and timing of delivery must be carefully plan to balance the needs of the mother and the fetus [24]. Cardiovascular disease is a major contributor to maternal and pregnancy related morbidity and mortality. Therefore, identifying high-risk patients, implementing preventive measures, and providing comprehensive, specialized care are crucial for improving feto-maternal outcomes in this group of patients.

Cardio-obstetrics and Cardiovascular Risk Stratifications Tools in Pregnancy

Cardio-obstetrics necessitates the precise application of cardiovascular risk stratification tools to effectively manage the unique physiological demands of pregnancy in women with or at risk for heart disease. These tools enable clinicians to identify and quantify potential cardiovascular risks, allowing for tailored management plans that optimize maternal and fetal outcomes. Recent guidelines strongly recommended preconception and pregnancy counseling, CV risk stratification and focused diagnostic imaging in pregnant or childbearing women with VHD or CHD who desire for pregnancy. Pregnant women with pre-existing heart disease face significant risks, necessitating effective cardiovascular risk stratification tools. Various studies have explored these tools, focusing on their ability to predict adverse outcomes and guide for optimal cardio-obstetrics care, preventive strategies, diagnosis, treatment algorithm, prognostication and clinical decision-making [55,56]. This CV risk stratification tools include (1) The WHO classification system is commonly used to categorize cardiac disease severity and associated risks during pregnancy. This aids clinicians in close monitoring and treatment intervention required [24]. Recently, Modified World Health Organization (mWHO) Classification risk stratification tool was developed which refines the original WHO system by incorporating additional maternal factors, such as functional capacity and comorbidities, to enhance risk stratification [57]; (2) Cardiac Risk in Pregnancy (CARPREG) and a modified (CARPREG II) are specific risk scoring system developed for pregnant women with VHD or CHD, which includes both maternal and fetal factors has shown promise in predicting outcomes and can effectively stratify risk and guide clinical decisions [58]; (3) ZAHARA CV risk stratification in pregnancy derived from adult congenital heart disease (ACHD) population study [59].

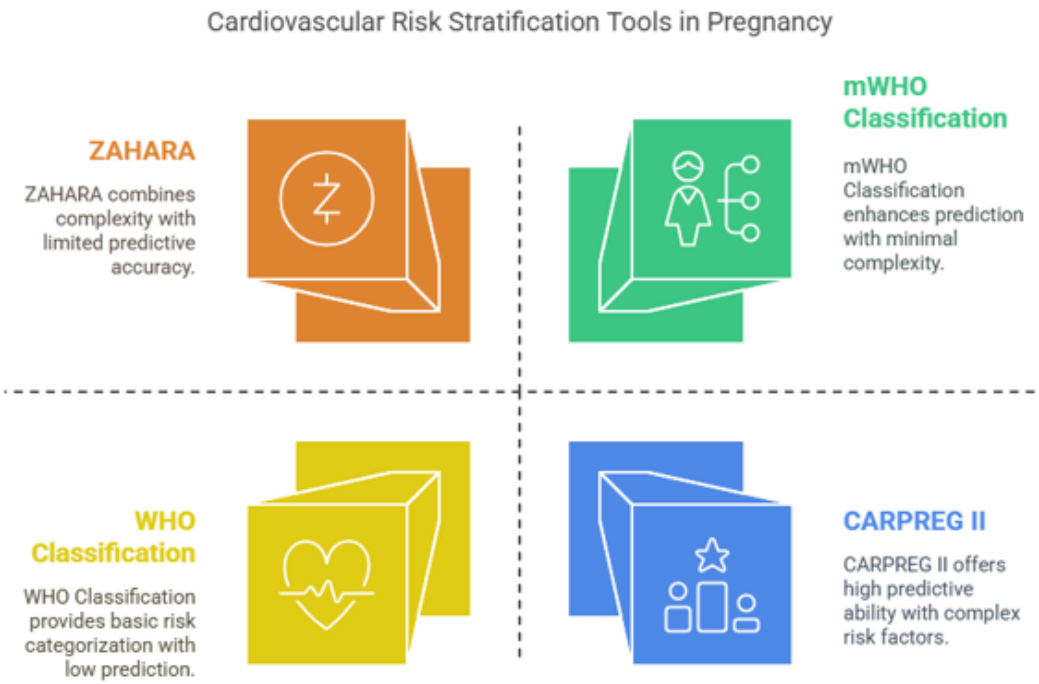

Figure 4: Showing most commonly use Cardiovascular Risk Stratifications Tools in Pregnancy

Other additional guideline and research for CV risk stratification in pregnant women with heart disease develop recently include: (1) Euro Heartcare Guidelines provide a framework for managing pregnant women with heart disease. They emphasize a multidisciplinary approach and the use of echocardiography to assess cardiac function and structure, which are critical for risk stratification [60]; (2) Recently biomarkers NT-Pro BNP was found to enhance risk stratification in women with heart failure risk and myocardial stress during pregnancy [61]; (3) Application of machine learning algorithms was also documented to improve risk prediction models of pregnant women with heart disease leading to more personalized care [62]. In conclusion, effective cardiovascular risk stratification in pregnant women with heart disease is critical for optimizing cardio-obstetrics care, maternal and fetal outcomes.

Why the need for Cardio-Obstetrics?

The prevalence of maternal cardiovascular disease is escalating, leading to significant maternal and pregnancy related morbidity and mortality globally. Better cardio-obstetrics care has been shown to reduce maternal CV morbidity, mortality and adverse fetal outcomes [2,3]. The world appears to be facing shortage of cardio-obstetrics care specialist especially in LMICs, likewise training centers/institutions for this subspecialty. In our clinical practice we observed wide knowledge gap of this new and evolving subspecialty in our region. Similarly, we also observed the awareness of this field among health care professionals, policymakers, administrators and general public appears to be extremely low. On the other hand, we also observed growing need for structured cardio-obstetrics training in health care institutions, likewise the strong need for all women with cardiovascular disease in pregnancy to be cared for by a cardio-obstetrics specialist during preconception, pregnancy and puerperium to prevent back sliding of WHO Sustainable development goal (SDG) 2030 of lowering maternal mortality [6]. In this regard, there is need to integrate cardio-obstetrics an important field for maternal CV healthcare with the potential to address the unique cardiovascular health needs of pregnant women and new born [2,3]. The key reasons why this specialized field is necessary in maternal CV health include: (1) Pregnancy induces significant physiological changes in the cardiovascular system, including increased blood volume, heart rate, and cardiac output [2,3]. These changes can exacerbate existing cardiovascular conditions or unmask previously undiagnosed heart problems [2,3]; (2) Pregnancy-related cardiovascular complications such as peripartum cardiomyopathy, hypertensive disorders in pregnancy, congenital heart disease, venous thromboembolism can develop during pregnancy and pose risks to the mother and the developing foetus. Therefore, cardio-obstetrics care of these clinical conditions in pregnancy are crucial to ensure the health and safety of both the mother and the baby [2,3,30]; (3) Women with underlying congenital heart diseases or who have undergone prior cardiac interventions may face increased risks of cardiac events during pregnancy, labor, and the postpartum period. Therefore, cardio-obstetrics care is required to manage these complex cases and ensure the best possible outcomes; (4) Postpartum period is a critical time when women face an increased risk of cardiovascular events, such as myocardial infarction, stroke, and venous thromboembolism [2,3,38-45]. Therefore, close cardio-obstetrics care during this time is essential to prevent and address these complications.

Discussion

Cardio-obstetrics is a new, evolving and exciting field, with sole purpose of improving maternal CV health and fetal outcomes [2,3]. In our clinical practice, we observed that the awareness of this field among health care professionals, administrators and public in LMICs is very low. Interestingly, some obstetricians and cardiologist in tertiary health care institutions of LMICs are practicing cardio-obstetrics unconsciously via interdisciplinary care of women with CV disease in pregnancy. Similarly, we also observed greater imbalance between maternal cardiovascular disease burden and the number specialist with adequate knowledge, skills and competence on cardio-obstetrics. This imbalance may portend global maternal cardiovascular health crisis and adverse fetal outcome. In this context, cardio-obstetrics subspecialty, structure training program, units and clinics are to be recommended in health care institutions to mitigate maternal cardiovascular health crisis and adverse fetal outcomes in the near future [2,3]. The key benefits of cardio-obstetrics Subspecialty, training program, units and clinics is to offer improved maternal CV health through (1) Improved risk stratification of pregnant women with cardiovascular disease and preconception counseling by providing thorough cardiovascular assessment and risk stratification for women of reproductive age, enabling personalized preconception counseling and informed decision-making regarding pregnancy plans [2,3]; (2) Enhanced maternal CV disease close monitoring and management through dedicated multidisciplinary management of pregnant and postpartum women with cardiovascular disease, improving maternal and fetal outcomes [2,3]; (3)

Cardio-obstetrics streamlined seamless transitions of care between obstetric and cardiology teams, ensuring continuity of care and reducing the risk of fragmentation [2,3]; (4) Dedicated cardio-obstetrics units could serve in expanding cardio-obstetric research and education as well as hubs for clinical research, generating evidence-based guidelines and fostering interprofessional education to improve the overall quality of maternal cardiovascular health and care. To establish cardio-obstetrics subspecialty, units and clinics in any health care institution will require a coordinated effort among professional organizations, healthcare systems, health care administrators, postgraduate medical colleges, policymakers and funders and the key steps may include: (1) Promoting collaborative partnerships between obstetric and cardiology units and departments; (2) Developing standardized cardio-obstetrics training curricula and certification processes; (3) Advocating for the inclusion of cardio-obstetrics as a recognized subspecialty (4) Securing funding and resources to establish dedicated cardio-obstetrics subspecialty, units and clinics within healthcare institutions; (5) Implementing quality improvement initiatives and data collection to measure the impact of cardio-obstetrics care, units and clinics interventions in reducing maternal cardiovascular disease burden morbidity, mortality and adverse fetal outcomes. Pregnancy places significant stress on various body systems, particularly the cardiovascular (CV) system, which experiences substantial hemodynamic changes, including increased blood volume and cardiac output [7,8,9,10]. These changes can worsen existing cardiovascular conditions, negatively impacting both maternal and fetal health [7,8,9,10], if not recognized and treated promptly. Additionally, these physiological changes may obscure life-threatening cardiovascular emergencies, such as heart failure, peripartum cardiomyopathy, pulmonary embolism, and myocardial infarction [30,38,39,43,44], leading to diagnostic challenges and poor outcomes. Therefore, a solid understanding of cardio-obstetrics is crucial for clinicians to distinguish between normal CV changes during pregnancy and pathological conditions. Maternal cardiovascular (CV) disease is influenced by traditional risk factors and specific sex-related factors [2,3]. In low- and middle-income countries (LMICs), maternal undernutrition and poverty appears to be better predictors than traditional CV risks during pregnancy. Pregnancy can worsen existing maternal CV conditions, while some CV diseases may develop due to physiological and hormonal changes associated with pregnancy [25,27]. Maternal CV disease increases the likelihood of long-term disability and cardiovascular adverse events (CAEs), as well as maternal and pregnancy-related morbidity and mortality [25,27]. In LMICs, the primary causes of maternal heart disease include rheumatic heart disease (RHD), peripartum cardiomyopathy (PPCM), and CHD [25,27]. In high-income countries (HICs), congenital heart disease remains the leading cause [25,27], but the prognosis is generally better due to better cardio-obstetric care, in contrast to the poorer outcomes observed in LMICs, where care is less adequate. Awareness of cardiovascular risk scoring systems among healthcare practitioners for pregnant women with heart disease appears to be low, particularly in LMICs. Therefore, healthcare providers trained in cardio-obstetrics can significantly enhance cardiovascular risk assessment and management for these patients in both high-income HICs and LMICs. Their expertise will facilitate comprehensive evaluations, including detailed medical histories, thorough physical examinations, and targeted investigations. This approach allows for personalized, evidence-based treatment tailored to the specific needs of pregnant women with heart disease. Consequently, it is essential for healthcare providers to be well-versed in cardiovascular risk scoring systems and their application in managing high risk maternal cardiovascular diseases. The increasing prevalence of CV disease among pregnant women [2,3,6], poses significant risks, contributing to maternal and pregnancy-related mortality, which is primarily caused by CV diseases [6]. Peripartum cardiomyopathy, occurring shortly before to a year after childbirth, is a notable cause of pregnancy-related death. Various strategies have been recommended to reduce maternal mortality, including essential obstetric care, adequate antenatal care, and skilled birth attendance etc [63]. To effectively combat the high rates of maternal and pregnancy-related deaths due to CV disease, optimal cardio-obstetrics care is crucial. This requires training specialists in cardio-obstetrics and establishing dedicated units and clinics in health care institutions worldwide. In summary, enhancing cardio-obstetrics is vital for improving maternal cardiovascular health and fetal outcomes.

Conclusion

Pregnancy complicated by cardiovascular disease carries significant risks, potentially leading to lifelong disabilities and poor outcomes without timely and expert management by cardio-obstetrics specialists. To combat the global maternal cardiovascular crisis, a strategic, multidisciplinary (cardio-obstetrics) is essential. The development of dedicated cardio-obstetrics subspecialties, training programs, and specialized units will ensure the delivery of crucial, integrated care, ultimately improving maternal and fetal health.

Conflict of interest

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Patient consent

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Declarations

This manuscript is an original, unpublished piece. It has not been submitted for publication elsewhere.

Abbreviations

HICs: High income countries

LMICs: Low-middle income countries

VTE: Venous thromboembolism

PPCM: Peripartum cardiomyopathy

CHD: Congenital heart disease

HDP: Hypertensive disorder in pregnancy

PIH: Pregnancy induced hypertension

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