Transthoracic echocardiography may be useful for preoperative cardiac evaluation of gynaecological patients undergoing routine surgery

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ABSTRACT

Echocardiography has been an integral noninvasive tool for [preoperative] cardiac evaluation that provides with echocardiographic details which may also be useful to perioperative clinicians to tailor their anesthetic deliberation while dealing with preoperative patients. The objective of this study is preoperative evaluation of routine gynecological patients echocardiographically after being referred from respective internists or anesthesiologists. This was a prospective, nonrandomized study of elective 68 cases who underwent echocardiographic evaluation preoperatively from 15th July 2009 to 14th July 2012. The mean age of the patients was 52.1 ± 10.3 years with the age range of 30-79 years. Valvular heart disease was the most common echocardiographic finding (129.4 %) followed by left ventricular diastolic dysfunction, LVDD (48.5%) and left ventricular hypertrophy (22.1 %). Systolic dysfunction was detected in 2.9% of patients and pulmonary arterial hypertension in 2.9% patients. Amongst patients referred after preoperative anaesthetic evaluation, patients had different cardiac lesions echocardiographically. Preoperative echocardiographic evaluation may provide important cardiac informations and values which might be employed by perioperative physicians to tailor their treatment.

Keywords: Echocardiography, gynecological surgery, Nepal, preoperative anesthetic checkup.

INTRODUCTION

For any preoperative evaluation, a history and physical examination, focusing on risk factors for cardiac, pulmonary and infectious complications, and a determination of a patient's functional capacity are essential.[1] Evaluation of entire patient is necessary to provide optimal perioperative care.[2] Guidelines for Preoperative cardiac evaluation for noncardiac surgery has already been published by American College of Cardiology and American Heart Association.[3]

Preoperative cardiac evaluation for noncardiac surgery with 5 steps approach include establishing the urgency of surgery, assessment for active cardiac conditions, determination of the surgery specific risk, assessment of patients functional capacity and clinical risk factors has been proposed.[2]

Among these steps, for assessing active cardiac conditions and functional capacity, echocardiography based evaluation of left ventricular function would be very useful noninvasive investigation. With increasing number of elderly patients undergoing various surgery and many of them may be having systolic or diastolic dysfunction and valvular lesion, echocardiographic evaluation gives quantitative data which will determine anesthetic deliberation and post operative management. Here, we report our prospective study of transthoracic echocardiography based cardiac evaluation as a part of preoperative anaesthetic check up in gynaecological patients at Nepal Medical College Teaching Hospital (NMCTH).

PATIENTS/METHODS

During the prospective study period from 15th July 2009 to 14th July 2012, 68 routine gynaecological patients consecutive patients were referred to echocardiography lab of NMCTH and underwent transthoracic echocardiography as per the recommendation of consulting physicians and anesthesiologists during their preoperative evaluation after detecting some abnormalities such as murmur, dyspnoea, palpitation, chest pain, ECG changes or cardiomegaly in chest X ray. Technique of performing transthoracic echocardiography in adult was as per the recommendation of American Society of Echocardiography.[4-6] Liberal use of sub costal and suprasternal echo windows were used when deemed necessary. Echocardiography machine used for this study were LOGIQ 400 MD MR3 Version 4.31 (GE, USA) and Nemio XG (Toshiba, Japan).

Evaluation of left ventricular ejection fraction, valvular lesions, left ventricular diastolic dysfunction, left ventricular hypertrophy, estimated systolic pulmonary artery pressure were the parameters evaluated.[6-9] Calculation of left ventricular ejection fraction, LVEF was

Table-1: Echocardiographic findings in preoperative gynaecological patients

Findings	Number	Percentage (%)
Valvular heart disease (VHD)	88	129.4
Left ventricular diastolic dysfunction (LVDD)	33	48.5
Left ventricular hypertrophy (LVH)	15	22.1
Left ventrticular systolic dysfunction (LVSD)	2	2.9
Pulmonary arterial hypertension (PAH)	2	2.9
No abnormality detected (NAD)	9	13.2
Total lesions	149	
Total patients	68	
Lesions per patient	2.2	

done by Teichholz method[10] as per the local availability of this system in echocardiographic machines in NMCTH.[10] Left ventricular systolic dysfunction has been classified as per the reference values.[11] Data were presented in terms of mean ±SD, number and percentage.

RESULTS:

Mean age was 52.1 ±10.3 yrs with a range 33 to 75 years in this prospective study.

Echocardiographic findings in preoperative gynaecological patients was shown in Table-1. Out

Table-3: Details of valvular lesions detected in preoperative gynaecological patients

Findings	Number	Percentage (%)
Aortic regurgitation, AR	9	10.2
AR Trivial	3	
AR Mild	5	
AR Moderate	1	
Mitral regurgitation, MR	31	35.2
MR Trivial	16	
MR Mild	14	
MR Moderate	1	
Mitral stenosis, MS Mild	1	1.1
Tricuspid regurgitation, TR	35	39.8
TR Trivial	8	
TR Mild	27	
Pulmonary regurgitation, PR	12	13.7
PR Trivial	6	
PR Mild	5	
PR Moderate	1	
Total	88	100%

Table-2: Distribution of valvular heart diseases, VHD in preoperative gynaecological patients

Age group	Number of patients	(%)	Number of valvular lesions	(%)
30-39	3	6.4	5	5.7
40-49	11	23.4	16	18.2
50-59	15	31.9	27	30.7
60-69	12	25.5	27	30.7
70-79	6	12.8	13	14.7
Total	**47**	**100**	**88**	**100**

of total echocardiographic lesions (total number of lesions, n= 149, total number of patients, N= 68), valvular heart disease (VHD) was the most common echo finding (88,129.4 %) followed by left ventricular diastolic dysfunction (LVDD) (33, 48.5%) and left ventricular hypertrophy (LVH) (15, 22.1 %). Approximately three percent (2.9%) of patients had mild systolic dysfunction and 2.9% had pulmonary arterial hypertension (PAH). More than one tenth (9, 13.2%) had normal echocardiographic findings.

Distribution of valvular heart diseases, VHD in preoperative gynecological patients was shown in Table-2. Maximal number of valvular heart diseases were seen in the age group 50-59 (31.9%) and 60-69 years (25.5%).

Details of valvular lesions detected in preoperative gynaecological patients was shown in Table-3. Large number of patients had Tricuspid regurgitation, TR (39.8%) and mitral regurgitation, MR (35.2%).

Distribution of left ventricular diastolic dysfunction, LVDD in **preoperative gynecological patients** was shown in Table-4. Maximum number of patients in the age group 50-59 years had LVDD (10, 30.3%).

Distribution of left ventricular hypertrophy, LVH in **preoperative gynecological patients** was shown in Table-5. Among the patients with LVH, largest number was found in the age group of 50-59 years of age group (5, 33.3%).

Age group-wise distribution of preoperative gynecological patients with normal echocardiographic findings was shown in Table-6. Maximal number of

Table-4: Distribution of left ventricular diastolic dysfunction, LVDD in preoperative gynecological patients

Age group	Number	%
< 40 yrs	2	6.1
40-49	9	27.3
50-59	10	30.3
60-69	7	21.2
70-79	5	15.1
Total	33	100

Table-5: Distribution of left ventricular hypertrophy, LVH in preoperative gynecological patients

Age gr	Number	(%)
30-39	1	6.7
40-49	2	13.3
50-59	5	33.3
60-69	4	26.7
70-79	3	20
Total	15	100

Table-6: Age group-wise distribution of preoperative gynecological patients with normal echocardiographic findings

Age gr	Number	(%)
30-39	2	22.2
40-49	4	44.5
50-59	2	22.2
60-69	1	11.1
Total	9	100

normal echocardiographic findings were seen in the age group of 40-49 years. Normal patients below 50 years were about two third of total normal patients (66.7%).

DISCUSSION

Echocardiography has been used as a very useful noninvasive tool to evaluate valvular heart diseases, VHD.[12,13] Echocardiography based findings (Table-1, 3) showed VHD as the most common lesion (129.4%). Out of them, tricuspid regurgitation, TR and mitral regurgitation, MR were common regurgitant lesions detected echocardiographically in these patients (Table-3). Finding lesions like regurgitant valvular lesions and LVSD (Table-1) may contribute in better patient management by avoiding excessive saline infusions to prevent heart failure in these patients. Echocardiography was useful for aiding the management of preoperative anaesthetic evaluation wisely. However, one population based study[14] has reported patients undergoing preoperative echocardiography had minimal but significant mortality. Probably echocardiography was done in clinically symptomatic patients with worse comorbid diseases in clinically unstable patients in that study.

There was one patient with mild MS but no patients with moderate or severe stenotic lesions were noted in this study. Severe aortic stenosis, AS (Aortic valve area < 0.7 cm² or mean pressure gradient, >= 50 mm Hg) has been reported to be associated with an approximproximately 30% incidence of cardiac morbidity and mortality of approximately 10%. The risk of asymptomatic, moderate AS appears to be less, and surgery can be considered in this group with careful evaluation.[15] There were no patients with AS in this study.

Identifying regurgitant lesions in gynaecological patients may be useful to have preoperative chemoprophylaxis for infective endocarditis, IE as per old recommendations.[16-18] The American Heart Association, AHA made major revisions to their recommendation on antibiotic prophylaxis for IE in 2007.[3,19-21] The committee determined that only a few cases of IE would be prevented by antibiotic prophylaxis for dental procedures even if the prophylactic therapy were 100% effective.

Chemoprophylaxis against IE is not for recommended

for gastrointestinal or genitourinary procedures.[3] Vaginal hysterectomy is considered not recommended for prophylaxis against IE however, in patients at highest risk, physicians may elect to use prophylaxis for these procedures.[3,19-22]

Whether this change in chemoprophylaxis against IE is suitable in Nepalese context, is an open question. Due to poor dental hygiene for 4 or 5 decades, almost all elderly ladies who come for surgery for uterine prolapse may have few teeth with severe caries with retained, infected dental root remaining with terrible dental and gingival conditions. Whether this terrible situation should follow guidelines derived from western data with far better dental hygiene and treatment? Whether IE prophylaxis in regurgitant lesions, simple congenital heart disease such as ventricular septal defect, VSD, patent ductus arteriosus, PDA that are different from present guidelines, should be used or not used is an open debate. Many times, patient's management may need to be individualized with informed consent.[19]

When patient has low functional capacity or is undergoing high- risk surgical procedure, assessment of left ventricular function with echocardiography or radionuclide imaging is recommended. An echocardiography is not considered routinely necessary [2] especially when patient is asymptomatic and has good functional capacity. Finding murmurs on physical examination and when there is a need for assessment of left ventricular function with the concern for underlying CHF, performing echocardiography will be useful. Current guidelines recommend preoperative echocardiography in patients without known CHF with unexplained dyspnea and in patients with known CHF with clinical deterioration.[23] There were no patients with features of decompensated CHF, manifested by an elevated jugular venous pressure, an audible third heart sound, or evidence of pulmonary edema. Elective surgery is usually postponed in this condition until it can be evaluated and brought under control.

Evaluation of entire patient with a thorough history and physical examination, focusing on risk factors for cardiac, pulmonary, and infectious complications, and a determination of a patient's functional capacity, diabetes,

nutritional status and renal function are practiced in NMCTH. Standardized preoperative questionnaire that is used in NMCTH is similar to the format of University of Michigan Health System patient information report and partly modifed.[24]

Revised cardiac risk index and guidelines for perioperative cardiovascular evaluation for noncardiac surgery by American Heart Association and American College of Cardiology are followed at NMCTH as far as possible.[2,3,25-27] American College of Cardiology and American Heart Association recommendations for the assessment of cardiac risk in patients undergoing noncardiac surgery incorporate many of Goldman's risk factors but expand the assessment to include the risk associated with the particular surgical procedure as well as additional patient characteristics that influence perioperative cardiac risk.[3]

The most popular expression of global left ventricular function is the left ventricular ejection fraction, LVEF. It is a simple measure of how much of the end-diastolic volume is ejected or pumped out of the left ventricle with each contraction.[7] This simple measure has been found to be a strong predictor of clinical outcome in almost all major cardiac conditions and is used to select the optimal management strategy, including the implantation of an intracardiac defibrillator or biventricular pacing. [28-30] [16-18] Most frequently, LVEF is determined visually by 'eyeballing' 2D echocardiographic images of the LV. This visual assessment is reasonably reliable when performed by an experienced echocardiographer but has considerable interobserver variation.[16] Therefore, whenever possible, the LVEF should be measured more objectively by using volumetric measurements. Quantitatively, LVEF can be calculated from M-mode, 2D, and 3 D echocardiograms. We assess the compatibility of the values of LVEF by comparing it with 2'D' echo based qualitative global performance of left ventricle ('eye balling') as well. Occasional technical errors giving rise to strange LVEF may be checked by this technique.

The overall prevalence of heart failure in the adult population in developed countries is 2% and follows an exponential pattern, rising with age, and affects 6-10% of people over age 65 years. Coronary artery disease is emerging as the single most common cause of heart

failure both in developed nations and economically emerging countries. Rheumatic heart disease remains a major cause of heart failure in Africa and Asia especially in young patients. Hypertension is an important cause of heart failure in the African and African- American populations. Diabetes accelerates atherosclerosis and often is associated with hypertension.[31]

Heart failure is a clinical syndrome in which either structural or functional abnormalities in the heart impair its ability to meet the metabolic demands of the body. It is a progressive disorder and is associated with extremely high morbidity and mortality. It may be due to abnormalities in myocardial contraction (systolic dysfunction), relaxation and filling (diastolic dysfunction) or both. Estimated 1- and 5- year mortality is 30% and 50%, respectively.[32]

Patients with compensated left ventricular dysfunction are at increased risk for cardiac complications. In a cohort of over 1000 vascular surgery patients who had preoperative echocardiography, asymptomatic left ventricular dysfunction (either systolic or diastolic) was associated with a two fold increase in cardiac complications. A history of symptomatic CHF was much more predictive, being associated with a sevenfold increase in risk. There were few patients (2.9%) with mild left ventricular systolic dysfunction, LVSD (Table-1). Avoiding excessive saline infusions were adequate to manage their systolic dysfunction. Use of echocardiography to evaluate LVSD was useful to aid the management of preoperative patients by restricting overaggressive saline infusions.

Inhaled anesthetics have predictable circulatory and respiratory effects, all decrease arterial pressure in a dose-dependent manner by reducing sympathetic tone, causing systemic vasodilation, myocardial depression, and decreased cardiac output. [26] Inhaled anesthetics also cause respiratory depression with diminished responses to both hypercapnia and hypoxemia in a dose-dependent manner.[26] Better analgesia, less risk of pneumonia, less respiratory failure and low risk of serious adverse consequences were noticed in neuraxial anaesthesia compared with general anesthesia.[33,34] Epidural analgesia was also found to protect against pneumonia following abdominal or thoracic surgery.[35]

Usefulness of detection and evaluation of LVSD in about one fifth of patients (20.6%) of clinically diagnosed cases of chronic obstructive pulmonary disease, COPD has been reported previously.[36] Our findings of presence of mild LVSD in a small number of patients (2.9%) is less than the prevalence of systolic dysfunction in other conditions such as COPD[23] and general patients.[8]

Echocardiography is a very useful noninvasive tool for evaluating estimated pulmonary artery hypertension.[8,37] Central physiologic abnormality of pulmonary arterial hypertension, PAH is increased right ventricular afterload with an elevated pulmonary vascular resistance. Chronically elevated right ventricular after load affects right ventricular contractility and cardiac output. Unlike the left ventricle, the right ventricle has limited ability to overcome high afterload. Initially, cardiac output diminishes during strenuous exercise. As PAH severity worsens, maximal cardiac output is achieved

at progressively lower work loads, ultimately resting cardiac output is reduced. The most common cause of death in patients with PAH is right heart failure.[38] [25]

Moreover patients with increased pulmonary vascular resistance have decreased right ventricular output or trying to maintain it at the expense of compensating mechanisms. Vasodilatation secondary to anesthesia, intraoperative bleeding or inadequate fluid therapy may be the cause of low right ventricular preload which may in turn, decrease the right ventricular output further more on the background of PAH.

Two patients had PAH echocardiographically (Table-1) and responded with oxygen inhalation alone. Patients with PAH demands special precaution perioperatively. They do not tolerate hypoxia. Adequate oxygenation is vital for decreasing pulmonary vascular resistance and reducing RV demands.[31] Oxygen supplementation helps alleviate dyspnea and RV ischemia.[39] Coexisting hypoxemia can impair the ability of the ventricle to compensate. [39]Preoperative identification of this condition is useful for perioperative management of patients with oxygen inhalation and nebulized bronchodilators if needed.

Landmark epidemiologic study 'Framingham study' has identified LVH, as an important risk factor for congestive heart failure,[40] stroke,[40] coronary artery disease, sudden cardiac death,[41] myocardial infarction and all cause mortality.[42] Echocardiography provides a more sensitive evaluation of left ventricular wall thickness. [7] Finding maximum number of left ventricular hypertrophy, LVH (Table-1, 5) in the age group 50-59 years may be related with presence of hypertension in this age group. Control of hypertension in Nepal as well as in other countries.[43-46]

On the basis of the registry data, one third to half of patients hospitalized with acute heart failure syndrome, have normal or nearly normal systolic function,[47-52] this condition is commonly referred to as HF with preserved ejection fraction.

Diastolic dysfunction refers to abnormality to the mechanical function of the heart during diastole or the relaxation phase of the cardiac cycle. Usually this involves elevated filling pressures and impairment of ventricular filling. Diastolic heart failure, a syndrome of heart failure in the presence of preserved systolic function, is most prevalent in elderly women, most of whom have hypertension and/ or diabetes and many also have coronary heart disease and or atrial fibrillation .[53]

Abnormalities in diastolic function are present in patients with both preserved and impaired systolic function. The impairment of the diastolic phase may be related to passive stiffness, abnormal active relaxation of the left ventricle, or both. Hypertension, tachycardia and myocardial ischemia can further impair diastolic function. Diastolic dysfunction alone may be insufficient to lead to AHF but it serves as the substrate on which other precipitating factors (such as atrial fibrillation, CAD or hypertension) lead to decompensation.[54] Thus ruling out of severity of diastolic dysfunction in operative patients warns anesthesiologists to modify their techniques to check flash pulmonary edema.

Diastolic dysfunction is an early consequence of hypertension-related heart disease and is exacerbated by left ventricular hypertrophy and ischemia. Cardiac catheterization provides the most accurate assessment of diastolic function. Alternatively, diastolic function can be evaluated by several noninvasive methods, including echocardiography and radionuclide angiography.[49]

In the current study, finding large number of LVDD (Table-1, 4) in the age group 50-59 years may be related with increased prevalence of hypertension and coronary artery disease in this age group. Diagnosing, LVDD is useful to identify high risk patients as they may go into flash pulmonary edema [55-57] if there is hypertensive crisis, sepsis, myocardial ischemia, arrhythmia and alteration in loading conditions[55-57] such as transfusion of excessive saline infusions. Control of tachycardia, acquisition of sinus rhythm controlling atrial fibrillation and judicious use of intravenous fluid are something anesthesiologists do come across during intraoperative period. Attention to these factors in patients with diastolic dysfunction holds significance. Half of the preoperative gynaecological patients who underwent echocardiography had LVDD.

A mitral inflow E/A ratio of 1.5 or more and deceleration time, DT of 140 milliseconds or less indicate increased filling pressures.[7,9] Pulsed wave Doppler sampled at the tip of mitral valve showing taller mitral A wave in comparison to mitral E wave has been interpreted as the diastolic dysfunction[6,7,9] however, it is considered grade 1 diastolic dysfunction and other grades (2-4) may appear different to this feature [6] but still have diastolic dysfunction. Though addition of pulmonary vein pulse wave Doppler study aids in diagnosing those grades of diastolic dysfunction especially pseudonormalization of mitral flow pattern. Further study with inclusion of pulmonary flow pulsed wave Doppler study is desirable however, it is challenging to evaluate atrial reversal A wave in pulmonary venous pulse Doppler study, measure its duration and comparison with mitral inflow A wave duration. Their precise measurement can be very difficult and challenging.[6] Doppler Tissue Imaging of mitral annulus may be used for the evaluation of diastolic function. We did not attempt such measurements in our lab with limited facilities. So real prevalence of LVDD in preoperative gynaecological patients may be

higher as some of normal looking pulsed mitral Doppler variables may be due to moderate diastolic dysfunction with pseudonormalized pattern. Further studies are necessary to include pulmonary vein Doppler studies to differentiate normal and pseudonormalized pattern of pulsed wave mitral velocity variables. Those diastolic dysfunctions may have been missed as other parameters, pulmonary vein flow, isovolumetric relaxation time have not been evaluated in this study. This may be an important limitation in the evaluation of diastolic dysfunction.

Finding maximal number of lesions in the age group 50-59 years (Table-2, 4,5) and more number of normal echo below 50 years (Table-6) may have important implications. Echocardiography may be liberally performed to detect such lesions in age group above 50 years in preoperative Nepalese female patients. Preoperative echocardiographic evaluation may provide important cardiac informations which might be employed by perioperative physicians to tailor the perioperative management of elective gynecological patients.

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