Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-8, Issue-3 | May-June 2022
DOI: 10.53339/aimdr.2022.8.3.11
Page no- 82-90 | Section- Research Article (Cardiology)

Prevalence of Cardiotoxicity Induced by Chemotherapy Measured by Dobutamine Stress Echocardiogram (DSE) in BSMMU

S M Ear-E-Mahabub[1], Happy[2]*, Nazir Uddin Mollah[3], Mahir Mubir[4]

[1]Assistant Professor, Department of Cardiology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. Email: smemahbub@gmail.com,
Orcid ID: 0000-0001-7782-8576
[2]Ex Head and Associate Professor, Department of Oncology, Holy Family Red Crescent Medical College and Hospital, Dhaka, Bangladesh.
Email: dr.happy.holy@gmail.com,
Orcid ID: 0000-0002-4278-8217
[3]Associate Professor, Department of Oncology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. Email: dr_nazir24@yahoo.com,
Orcid ID: 0000-0002-0996-862X
[4]Chief Medical Officer, Square Hospitals Ltd., Dhaka, Bangladesh. Email: dr.mmubir@gmail.com,
Orcid ID: 0000-0002-1392-9762.

*Corresponding author

Received: 18 January 2022
Revised: 16 March 2022
Accepted: 25 March 2022
Published: 22 April 2022

Abstract

Background: Cardiotoxicity related to cancer treatment is an alarming source of significant morbidity and mortality, and may differ from subclinical myocardial dysfunction to irreversible heart failure or even death. DSE is a safe, feasible, and accurate modality for finding of myocardial ischemia and prognostication in patients with known or suspected coronary artery disease, particularly when they have limited exercise capacity. **Materials & Methods:** This study is a cross-sectional observational study which was conducted at the department of Cardiology, in BSMMU, Dhaka from June 2019- December 2019. The sample size for this study was 50. **Results:** The mean age was 56±12 where 17(34%) of the respondents were <65 years and 33(66%) were >65 years. The male respondent was 35(70%) where female was 15(30%). Diabetes was found in 3(6%) cases and followed by Acute ischemia, Hypertension 6(12%), Coronary Artery Disease (CAD) 4(8%), ACE-inhibitors 5(10%), Beta-blockers 3(6%), Nitrates 3(6%). Acute leukemia was found in 13(26%). in M12-18 was 45±2 and followed by mean of LVESD (mm) was 27±4, 29±4, 29±4, 30±2, 30±3, 31±2. Mean of IVSd (mm) was 9±1, 9±1, 9±1, 9±2, 8±2, 8±3. Mean of Peak E (cm/s) was 80±10, 76±11, 74±16, 73±12, 66±9, 63±15 and the p-value was seen <0.001 which denotes a significant improvement in treatment (p<0.005). **Conclusions:** The early discovery of cardiotoxicity may ensure the improved chemotherapeutic process and timely management of the treatment of cardiomyopathy, such as beta-blockers and ACE inhibitors.

Keywords:- Cardiotoxicity, Chemotherapy, Dobutamine Stress Echocardiogram (DSE).

INTRODUCTION

Cardiotoxicity related to cancer treatment is an alarming source of significant morbidity and mortality, and may differ from subclinical myocardial dysfunction to irreversible heart failure or even death.[1] There are two treatment options such as: conventional therapies (i.e., chemotherapy and radiotherapy) which is characterized to have a significant effect on cancer cells without directed to them and newer molecular targeted therapies (i.e., trastuzumab), to recognize the specific cancer cell in order to save the normal

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-8, Issue-3 | May-June 2022
DOI: 10.53339/aimdr.2022.8.3.11
Page no- 82-90 | Section- Research Article (Cardiology)

cells.[2] Generally, chemotherapy is more likely given to those patients who are less than 75 years and have no history of heart failure or pulmonary disease.[3] But, sometimes normal cells and tissues also get affected by the chemotherapy which leads to several mild and severe adverse effects, like nausea and vomiting, bone marrow suppression, and cardiovascular side effects, hypotension, tachycardia, arrhythmias, and heart failure.[4] Besides, the risk of cardiotoxicity is more frequent in patients with hypertension, diabetes mellitus, liver disease, and those having previous cardiac diseases.[5] Moreover, a combination of potential cardiotoxic agents, paclitaxel or trastuzumab with anthracyclines, may severely increase the risk of cardiotoxicity that can lead to disastrous congestive heart failure.[6,7,8,9] Cardiovascular vulnerability may increase due to cumulative doses and concomitant use of adjuvant therapies, thorax radiation therapy along with other risk factors, lime preexisting cardiovascular disease, age, obesity, smoking, hypertension, diabetes and physical inactivity.[10] The main manifestations of acute cardiotoxicity are cardiac rhythm disturbances and the pericarditis/myocarditis syndrome.[11,12] Stress echocardiography is a useful tool for assessing risk in coronary artery disease and is used when exercise testing is difficult or the findings are difficult to interpret.[13,14,15,16,17] Dobutamine stress echocardiography (DSE) is a safe, feasible, and accurate modality for finding of myocardial ischemia and prognostication in patients with known or suspected coronary artery disease, particularly when they have limited exercise capacity.[18,19,20,21,22,23] Dobutamine is a synthetic catecholamine having a comparatively short plasma half-life of 2 minutes for rapid metabolization in the liver to inactive metabolites.[24,25] Several studies demonstrated, the usefulness of DSE, for monitoring the cardiac function of patients receiving chemotherapy.[26,27] Hence, this study aims to measure the dobutamine strem Echocardiogram (DSE) and to investigate the prevalence of Cardiotoxicity in patients receiving chemotherapy.

Objective of the Study

The objective of this study was to measure the dobutamine stress Echocardiogram (DSE) and to investigate the prevalence of Cardiotoxicity in relation with chemotherapy.

MATERIAL AND METHODS

This study is a cross-sectional observational study which was conducted at the Department of Cardiology, in BSMMU, Dhaka from June 2019- December 2019. The sample size for this study was 50.

Inclusion criteria:

The patients who had a normal baseline ejection fraction (EF) and had not received anthracyclines before the study period were included in this study.

Adult patients in between ≤65 years and >65 years who had undergone chemotherapy were included in this study.

The patients who were willing to give consent after knowing the study purpose were included.

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-8, Issue-3 | May-June 2022
DOI: 10.53339/aimdr.2022.8.3.11
Page no- 82-90 | Section- Research Article (Cardiology)

Exclusion criteria:

Patients who had received antihypertensive or cardiologic therapy, cardioprotective agents (dexrazoxane), and antidiabetic drugs before were excluded.

Those patients with poor cardiac echogenicity were excluded.

The patients with the history of ischemic, valvular and hypertensive heart disease, left ventricular ejection fraction (LVEF) < 50%, acute and chronic renal insufficiency (serum creatinine > 1.5 mg/dl), and liver disease (aspartate aminotransferase more than twice the upper normal limit) were also excluded from the study.

All the patients were treated as per the oncological protocol practice by international standard. All drugs were administered accordingly, basically at intervals of three times for four weeks. No patient had received chemotherapy before. The primary clinical examination include electrocardiogram, and chest X-ray. Patients underwent rest echocardiography and DSE before the 1st chemotherapy cycle (C1), before the 2nd chemotherapy cycle (C2) and before the 3rd chemotherapy cycle (C3), and at 1st month after chemotherapy (M1), and 6 months after chemotherapy (M6) and A final evaluation of rest LVEF was performed within eighteen months after HDC (f-LVEF). Each cycle was completed by an infusion of autologous peripheral blood progenitors' cells and granulocyte colony-stimulating factor. At the end of the follow-up patients were categorized according to the international guidelines for cardiac toxicity definition. A 12-lead electrocardiogram was routinely recorded during dobutamine infusion and also the blood pressure was measured in every 3 min, even at the end of each dobutamine phase. Echocardiographic images were recorded at rest and at the end of each dobutamine phase which also helped in this study. The study was approved by the Institutional Ethics Committee and written informed consent was obtained from all patients who were willing to take participate in this study. For statistical analysis SPSS version was used.

RESULTS

[Table 1] shows the age distribution of the respondents. The mean age was 56±12 where 17(34%) of the respondents were <65 years and 33(66%) were >65 years.

[Figure 1] shows the sex distribution of the respondents. The male respondent was 35(70%) where female was 15(30%).

[Table 2] shows the clinical History of the respondents. Among the associated diseases, diabetes was found in 3(6%) cases and followed by Hypertension in 6(12%), Coronary Artery Disease (CAD) in 4(8%), ACE-inhibitors in 5(10%), Beta-blockers in 3(6%), Nitrates in 3(6%). In assessing the hematological disorders, acute leukemia was found in 13(26%), Hodgkin's disease in 8(16%), Non-Hodgkin lymphoma in 22(44%), Multiple myeloma in 5(10%) and Myelodysplastic syndrome in 2(4%).

[Table 3] Echocardiographic Findings at Baseline and During the Study Period. The mean LVEDD (mm) in C1 was 43±4, in C2 was 43±2, in C3 was 44±2, in M1 was 45±2, in M6

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-8, Issue-3 | May-June 2022
DOI: 10.53339/aimdr.2022.8.3.11
Page no- 82-90 | Section- Research Article (Cardiology)

was 44±3 and in M12-18 was 45±2 and followed by mean of LVESD (mm) was 27±4, 29±4, 29±4, 30±2, 30±3, 31±2. Mean of IVSd (mm) was 9±1, 9±1, 9±1, 9±2, 8±2, 8±3. Mean of IVSs (mm) was 13±1, 12±2, 12±2, 11±3, 11±2, 10±2. Mean of PWTd (mm) was 8±1, 8±2, 8±3, 8±1, 8±1, 8±1.Mean of PWTs (mm) was 15±2, 14±2, 14±2, 14±2, 14±1, 12±2. Mean of LVEDV (ml) was 88±19, 90±6, 92±11, 96±19, 96±18, 100±16. Mean of LVESV (ml) was 31±8, 35±5, 37±8, 38±9, 42±9, 50±7. Mean of Peak E (cm/s) was 80±10, 76±11, 74±16, 73±12, 66±9, 63±15 and the p-value was seen <0.001 which denotes a significant improvement in treatment (p<0.005). Mean of peak A (cm/s) was 60±7, 58±9, 61±20, 56±18, 55±7, 55±7. Mean of E/ A ratio was 1.35±0.24, 1.34±0.19, 1.28±0.31, 1.29±0.24, 1.19±0.14, 1.05±0.27. Mean of DT (ms) was 157±53, 183±40, 187±43, 157±33, 169±25, 184±38.Mean of IVRT (ms) was 105±15, 94±36, 104±13, 100±19, 93±14, 109±25.

Table 1: Age Distribution of the Respondents

Age Distribution of the Respondents		**N=50**	**Percentage (%)**
Age	(Mean ±SD)	56±12	
	<65 years	17	34
	>65 years	33	66

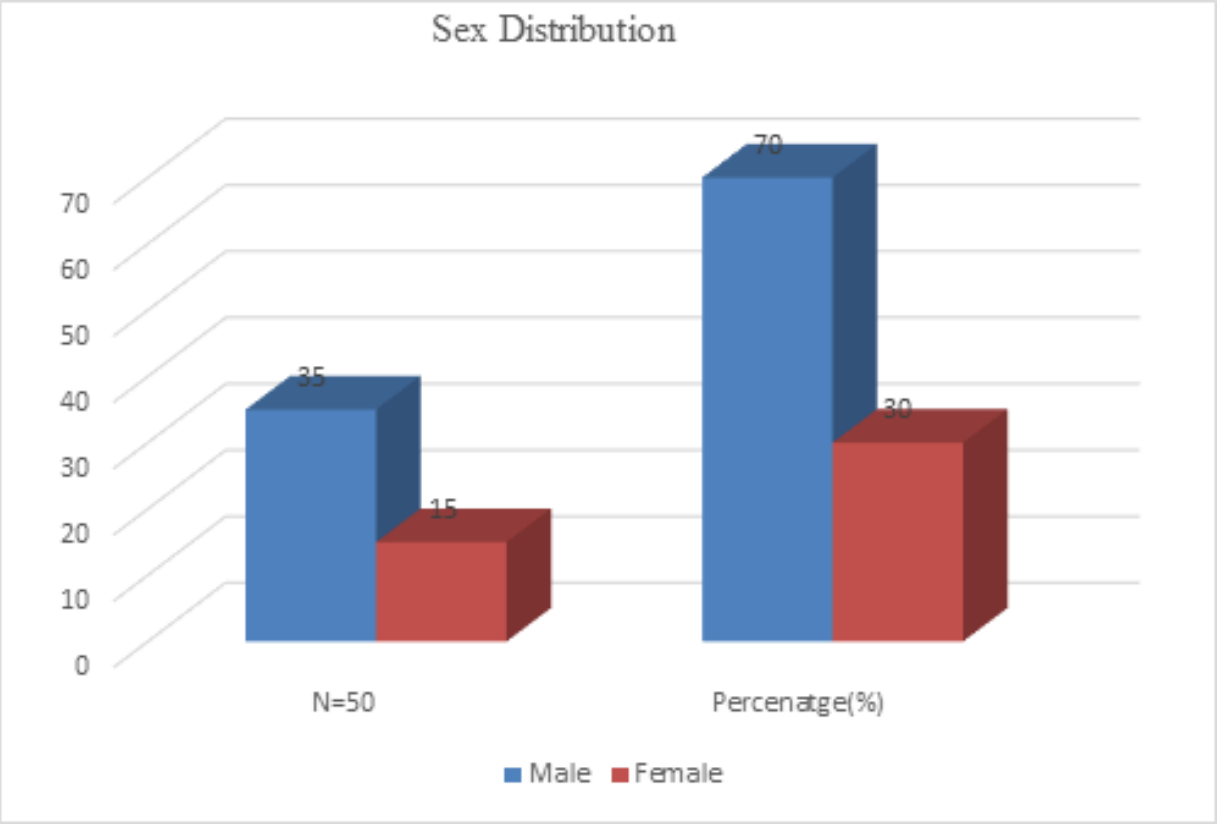

Figure 1: Distribution of the study according to sex

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-8, Issue-3 | May-June 2022
DOI: 10.53339/aimdr.2022.8.3.11
Page no- 82-90 | Section- Research Article (Cardiology)

Table 2: Clinical History of the Respondents.

Clinical History of the Respondents		**N=50**	**Percentage (%)**
Associated Diseases drughs	Diabetes	3	6
	Hypertension	6	12
	Coronary Artery Disease (CAD)	4	8
	ACE-inhibitors	5	10
	Beta-blockers	3	6
	Nitrates	3	6
Hematological disorders	Acute leukemia	13	26
	Hodgkin's disease	8	16
	Non-Hodgkin lymphoma	22	44
	Multiple myeloma	5	10
	Myelodysplastic syndrome	2	4

Table 3: Echocardiographic Findings at Baseline and During the Study Period

Echocardiographic Parameters	**C1**	**C2**	**C3**	**M1**	**M6**	**M12-18**	**P- value (p<0.005)**
LVEDD (mm)	43±4	43±2	44±2	45±2	44±3	45±2	
LVESD (mm)	27±4	29±4	29±4	30±2	30±3	31±2	
IVSd (mm)	9±1	9±1	9±1	9±2	8±2	8±3	
IVSs (mm)	13±1	12±2	12±2	11±3	11±2	10±2	
PWTd (mm)	8±1	8±2	8±3	8±1	8±1	8±1	
PWTs (mm)	15±2	14±2	14±2	14±2	14±1	12±2	0.001
LVEDV (ml)	88±19	90±6	92±11	96±19	96±18	100±16	
LVESV (ml)	31±8	35±5	37±8	38±9	42±9	50±7	0.002
Peak E (cm/s)	80±10	76±11	74±16	73±12	66±9	63±15	<0.001
Peak A (cm/s)	60±7	58±9	61±20	56±18	55±7	55±7	
E/ A ratio	1.35±0.24	1.34±0.19	1.28±0.31	1.29±0.24	1.19±0.14	1.05±0.27	0.001
DT (ms)	157±53	183±40	187±43	157±33	169±25	184±38	
IVRT (ms)	105±15	94±36	104±13	100±19	93±14	109±25	

DISCUSSION

The mean age was 56±12 where 34% of the respondents were <65 years and 66% were >65 years. [Table 1] A related study in this field found the mean age was 57±13.[28] Another study related to this present study was conducted among the patients who were older than 65 years.[29] The male respondent was 70% where female was 30%. [Figure 1] The study of J. Gavila, et. Al,[29] was conducted only on the female participants where M. Bountioukos, et. al. conducted their study on 71% male and 29% female.[28] Among the associated diseases, diabetes was found in 6% cases and followed by Hypertension in 12%, Coronary Artery Disease (CAD) in 8%, ACE-inhibitors in 10%, Beta-blockers in 6%, Nitrates in 6% patients. In assessing the hematological disorders, acute leukemia was found in 26%, Hodgkin's disease

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-8, Issue-3 | May-June 2022
DOI: 10.53339/aimdr.2022.8.3.11
Page no- 82-90 | Section- Research Article (Cardiology)

in 16%, Non-Hodgkin lymphoma in 44%, Multiple myeloma in 10% and Myelodysplastic syndrome in 4%. [Table 2] In the study of M. Bountioukos, et. al., diabetes was found in 6.5% cases and followed by Hypertension in 12.9%, Coronary Artery Disease (CAD) in 12.9%, ACE-inhibitors in 9.7%, Beta-blockers in 6.5%, Nitrates in 6.5% cases, where acute leukemia was found in 26%, Hodgkin's disease in 16%, Non-Hodgkin lymphoma in 44%, Multiple myeloma in 10% and Myelodysplastic syndrome in 3%.[28]

The mean LVEDD (mm) in C1 was 43±4, in C2 was 43±2, in C3 was 44±2, in M1 was 45±2, in M6 was 44±3 and in M12-18 was 45±2 and followed by mean of LVESD (mm) was 27±4, 29±4, 29±4, 30±2, 30±3, 31±2. Mean of IVSd (mm) was 9±1, 9±1, 9±1, 9±2, 8±2, 8±3. Mean of IVSs (mm) was 13±1, 12±2, 12±2, 11±3, 11±2, 10±2. Mean of PWTd (mm) was 8±1, 8±2, 8±3, 8±1, 8±1, 8±1.Mean of PWTs (mm) was 15±2, 14±2, 14±2, 14±2, 14±1, 12±2. Mean of LVEDV (ml) was 88±19, 90±6, 92±11, 96±19, 96±18, 100±16. Mean of LVESV (ml) was 31±8, 35±5, 37±8, 38±9, 42±9, 50±7. Mean of Peak E (cm/s) was 80±10, 76±11, 74±16, 73±12, 66±9, 63±15 and the p-value was seen <0.001 which denotes a significant improvement in treatment (p<0.005). Mean of peak A (cm/s) was 60±7, 58±9, 61±20, 56±18, 55±7, 55±7. Mean of E/ A ratio was 1.35±0.24, 1.34±0.19, 1.28±0.31, 1.29±0.24, 1.19±0.14, 1.05±0.27. Mean of DT (ms) was 157±53, 183±40, 187±43, 157±33, 169±25, 184±38.Mean of IVRT (ms) was 105±15, 94±36, 104±13, 100±19, 93±14, 109±25. [Table 3] The study of Maurizio Civelli et. al. also analyzed the echocardiographic parameters where they found the mean LVEDD (mm) in C1 was 44±4, in C2 was 44±2, in C3 was 45±2, in M1 was 44±2, in M6 was 44±3 and in M12-18 was 45±2 and followed by mean of LVESD (mm) was 27±4, 29±4, 29±4, 31±2, 31±3, 32±2. Mean of IVSd (mm) was 9±1, 9±1, 9±1, 9±2, 8±2, 8±3. Mean of IVSs (mm) was 14±1, 13±2, 13±2, 12±3, 12±2, 11±2. Mean of PWTd (mm) was 8±1, 8±2, 8±3, 8±1, 8±1, 8±1.Mean of PWTs (mm) was 15±2, 14±2, 14±2, 14±2, 14±1, 12±2. Mean of LVEDV (ml) was 89±19, 91±6, 93±11, 97±19, 96±18, 100±16. Mean of LVESV (ml) was 32±8, 36±5, 38±8, 39±9, 43±9, 51±7. Mean of Peak E (cm/s) was 80±10, 77±11, 75±16, 74±12, 66±9, 64±15 and the p-value was seen <0.001 which denotes a significant improvement in treatment (p<0.005). Mean of peak A (cm/s) was 60±7, 58±9, 61±20, 56±18, 55±7, 55±7. Mean of E/ A ratio was 1.36±0.24, 1.35±0.19, 1.29±0.31, 1.30±0.24, 1.20±0.14, 1.06±0.27. Mean of DT (ms) was 157±53, 183±40, 187±43, 157±33, 169±25, 184±38.Mean of IVRT (ms) was 105±15, 94±36, 104±13, 100±19, 93±14, 109±25.[30]

CONCLUSIONS

Although several guidelines are existing but scientific evidence about how often and how long cardiac function should be monitored during and after cancer treatment are not sufficient. The early discovery of cardiotoxicity may ensure the improved chemotherapeutic process and timely management of the treatment of cardiomyopathy, such as beta-blockers and ACE inhibitors. DSE has become an accepted means for evaluating the perfusion-limiting coronary artery. But coronary artery disease with chest pain is a challenge because this is still the chief cause of death in the western region. Formerly, electrocardiography exercise was done as a first-line noninvasive diagnostic stress test.

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-8, Issue-3 | May-June 2022
DOI: 10.53339/aimdr.2022.8.3.11
Page no- 82-90 | Section- Research Article (Cardiology)

But, recently, DSE has become a well-known method for assessing a wide spectrum of challenging clinical conditions, including systolic or diastolic heart failure,F non-ischemic cardiomyopathy, valvular heart disease, pulmonary hypertension (PH), athletes' hearts, congenital heart disease (CHD), and heart transplantation.

REFERENCES

1. Jiji RS, Kramer CM, Salerno M. Non-invasive imaging and monitoring cardiotoxicity of cancer therapeutic drugs. J Nucl Cardiol. 2012;19(2):377-88. doi: 10.1007/s12350-012-9512-2.
2. Minotti G, Menna P, Salvatorelli E, Cairo G, Gianni L. Anthracyclines: molecular advances and pharmacologic developments in antitumor activity and cardiotoxicity. Pharmacol Rev. 2004;56(2):185-229. doi: 10.1124/pr.56.2.6.
3. Gibbons RJ, Abrams J, Chatterjee K, Daley J, Deedwania PC, Douglas JS, et al; American College of Cardiology; American Heart Association Task Force on practice guidelines (Committee on the Management of Patients With Chronic Stable Angina). ACC/AHA 2002 guideline update for the management of patients with chronic stable angina--summary article: a report of the American College of Cardiology/American Heart Association Task Force on practice guidelines (Committee on the Management of Patients With Chronic Stable Angina). J Am Coll Cardiol. 2003;41(1):159-68. doi: 10.1016/s0735-1097(02)02848-6.
4. van den Boogaard WMC, Komninos DSJ, Vermeij WP. Chemotherapy Side-Effects: Not All DNA Damage Is Equal. Cancers (Basel). 2022;14(3):627. doi:10.3390/cancers14030627
5. Hershman DL, McBride RB, Eisenberger A, Tsai WY, Grann VR, Jacobson JS. Doxorubicin, cardiac risk factors, and cardiac toxicity in elderly patients with diffuse B-cell non-Hodgkin's lymphoma. J Clin Oncol. 2008;26(19):3159-65. doi: 10.1200/JCO.2007.14.1242.
6. Gianni L, Munzone E, Capri G, Fulfaro F, Tarenzi E, Villani F, Spreafico C, Laffranchi A, Caraceni A, Martini C, et al. Paclitaxel by 3-hour infusion in combination with bolus doxorubicin in women with untreated metastatic breast cancer: high antitumor efficacy and cardiac effects in a dose-finding and sequence-finding study. J Clin Oncol. 1995;13(11):2688-99. doi: 10.1200/JCO.1995.13.11.2688.
7. Eisenhauer EA, Vermorken JB. The taxoids. Comparative clinical pharmacology and therapeutic potential. Drugs. 1998;55(1):5-30. doi: 10.2165/00003495-199855010-00002.
8. Giantris A, Abdurrahman L, Hinkle A, Asselin B, Lipshultz SE. Anthracycline-induced cardiotoxicity in children and young adults. Crit Rev Oncol Hematol. 1998;27(1):53-68. doi: 10.1016/s1040-8428(97)10007-5.
9. Pai VB, Nahata MC. Cardiotoxicity of chemotherapeutic agents: incidence, treatment and prevention. Drug Saf. 2000;22(4):263-302. doi: 10.2165/00002018-200022040-00002.
10. Barrett-Lee PJ, Dixon JM, Farrell C, Jones A, Leonard R, Murray N, Palmieri C, Plummer CJ, Stanley A, Verrill MW. Expert opinion on the use of anthracyclines in patients with advanced breast cancer at cardiac risk. Ann Oncol. 2009;20(5):816-27. doi: 10.1093/annonc/mdn728.
11. Alexander J, Dainiak N, Berger HJ, Goldman L, Johnstone D, Reduto L, et al. Serial assessment of doxorubicin cardiotoxicity with quantitative radionuclide angiocardiography. N Engl J Med. 1979;300(6):278-83. doi: 10.1056/NEJM197902083000603.
12. Larsen RL, Jakacki RI, Vetter VL, Meadows AT, Silber JH, Barber G. Electrocardiographic changes and arrhythmias after cancer therapy in children and young adults. Am J Cardiol. 1992;70(1):73-7. doi: 10.1016/0002-9149(92)91393-i.
13. Braunwald E, Antman EM, Beasley JW, Califf RM, Cheitlin MD, Hochman JS, et al; American College of Cardiology; American Heart Association. Committee on the Management of Patients With Unstable Angina. ACC/AHA 2002 guideline update for the management of patients with unstable angina and non-ST-segment elevation myocardial infarction--summary article: a report of the American College of Cardiology/American Heart Association task force on practice guidelines (Committee on the

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-8, Issue-3 | May-June 2022
DOI: 10.53339/aimdr.2022.8.3.11
Page no- 82-90 | Section- Research Article (Cardiology)

Management of Patients With Unstable Angina). J Am Coll Cardiol. 2002;40(7):1366-74. doi: 10.1016/s0735-1097(02)02336-7.
14. Chuah SC, Pellikka PA, Roger VL, McCully RB, Seward JB. Role of dobutamine stress echocardiography in predicting outcome in 860 patients with known or suspected coronary artery disease. Circulation. 1998;97(15):1474-80. doi: 10.1161/01.cir.97.15.1474.
15. Krivokapich J, Child JS, Walter DO, Garfinkel A. Prognostic value of dobutamine stress echocardiography in predicting cardiac events in patients with known or suspected coronary artery disease. J Am Coll Cardiol. 1999;33(3):708-16. doi: 10.1016/s0735-1097(98)00632-9.
16. Pingitore A, Picano E, Varga A, Gigli G, Cortigiani L, Previtali M, et al. Prognostic value of pharmacological stress echocardiography in patients with known or suspected coronary artery disease: a prospective, large-scale, multicenter, head-to-head comparison between dipyridamole and dobutamine test. Echo-Persantine International Cooperative (EPIC) and Echo-Dobutamine International Cooperative (EDIC) Study Groups. J Am Coll Cardiol. 1999;34(6):1769-77. doi: 10.1016/s0735-1097(99)00423-4.
17. Marwick TH, Mehta R, Arheart K, Lauer MS. Use of exercise echocardiography for prognostic evaluation of patients with known or suspected coronary artery disease. J Am Coll Cardiol. 1997;30(1):83-90. doi: 10.1016/s0735-1097(97)00148-4.
18. Kamaran M, Teague SM, Finkelhor RS, Dawson N, Bahler RC. Prognostic value of dobutamine stress echocardiography in patients referred because of suspected coronary artery disease. Am J Cardiol. 1995;76(12):887-91. doi: 10.1016/s0002-9149(99)80255-0.
19. Poldermans D, Fioretti PM, Boersma E, Bax JJ, Thomson IR, Roelandt JR, et al. Long-term prognostic value of dobutamine-atropine stress echocardiography in 1737 patients with known or suspected coronary artery disease: A single-center experience. Circulation. 1999;99(6):757-62. doi: 10.1161/01.cir.99.6.757.
20. Severino S, Dandrea A, Caso P, Celentano E, De Simone L, Liccardo B, et al. Long-term prognostic value of dipyridamole and dobutamine stress echocardiography in patients with known or suspected coronary artery disease. Ital Heart J. 2001;2(4):256-64.
21. Gudmundsson P, Shahgaldi K, Winter R, Dencker M, Kitlinski M, Thorsson O, et al. Quantitative detection of myocardial ischaemia by stress echocardiography; a comparison with SPECT. Cardiovasc Ultrasound. 2009;7:28. doi: 10.1186/1476-7120-7-28.
22. Hu SJ, Liu SX, Katus HA, Luedde M. The value of contrast dobutamine stress echocardiography on detecting coronary artery disease in overweight and obese patients. Can J Cardiol. 2007;23(11):885-889. doi:10.1016/s0828-282x(07)70844-9
23. Swinburn JM, Senior R. Myocardial viability assessed by dobutamine stress echocardiography predicts reduced mortality early after acute myocardial infarction: determining the risk of events after myocardial infarction (DREAM) study. Heart. 2006;92(1):44-8. doi: 10.1136/hrt.2004.058990.
24. Ruffolo RR Jr. The pharmacology of dobutamine. Am J Med Sci. 1987;294(4):244-8. doi: 10.1097/00000441-198710000-00005.
25. Meyer SL, Curry GC, Donsky MS, Twieg DB, Parkey RW, Willerson JT. Influence of dobutamine on hemodynamics and coronary blood flow in patients with and without coronary artery disease. Am J Cardiol. 1976;38(1):103-8. doi: 10.1016/0002-9149(76)90070-9.
26. Boujon B, Lechat P, Mantz J, Fraysse JB, Leblond V, Drobinski G, et al. Etude des relations fraction de raccourcissement-contrainte et fraction de raccourcissement-diamètre télésystolique du ventricule gauche [Echocardiographic detection of adriamycin cardiotoxicity. Study of the relationship between the shortening fraction-constraint and the systolic shortening fraction-diameter of the left ventricle]. Arch Mal Coeur Vaiss. 1989;82(2):167-75.
27. Marchandise B, Schroeder E, Bosly A, Doyen C, Weynants P, Kremer R, Pouleur H. Early detection of doxorubicin cardiotoxicity: interest of Doppler echocardiographic analysis of left ventricular filling dynamics. Am Heart J. 1989;118(1):92-8. doi: 10.1016/0002-8703(89)90077-x.
28. Tsutsui JM, Elhendy A, Anderson JR, Xie F, McGrain AC, Porter TR. Prognostic value of dobutamine stress myocardial contrast perfusion echocardiography. Circulation. 2005;112(10):1444-50. doi: 10.1161/CIRCULATIONAHA.105.537134.

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-8, Issue-3 | May-June 2022
DOI: 10.53339/aimdr.2022.8.3.11
Page no- 82-90 | Section- Research Article (Cardiology)

29. Gavila J, Seguí MÁ, Calvo L, López T, Alonso JJ, Farto M, et al. Evaluation and management of chemotherapy-induced cardiotoxicity in breast cancer: a Delphi study. Clin Transl Oncol. 2017;19(1):91-104. doi: 10.1007/s12094-016-1508-y.
30. Civelli M, Cardinale D, Martinoni A, Lamantia G, Colombo N, Colombo A, et al. Early reduction in left ventricular contractile reserve detected by dobutamine stress echo predicts high-dose chemotherapy-induced cardiac toxicity. Int J Cardiol. 2006;111(1):120-6. doi: 10.1016/j.ijcard.2005.07.029.

Source of Support: Nil, Conflict of Interest: None declared