**Impact of Physician Performed Point of Care Ultrasound (POCUS) During first Outpatient Cardiology Consultation on Patient Management and Downstream Testing**

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**Abstract**

**Background**

Goal directed point of care ultrasound (POCUS) is a bedside tool to assisst with clinical diagnosis. We examined the impact of POCUS performed by consulting cardiologist (CC) during initial cardiology consult on clinical management and downstream testing.

**Methods**

69 study patients (pts) seen in a general cardiology outpatient clinic of a tertiary center by an expert imaging CC were compared to a control group of 65 pts seen by 3 different CCs without POCUS during the same time-period, in whom the first standard echo (SE) was performed after the initial visit.

**Results**

Baseline characteristics similar between the two groups for age, cardiac risk factors, and referral diagnoses. Echo findings on POCUS and by SE (mean delay of 17.2 days after visit) in the control group were comparable for RV size and function and for valvular heart disease. More patients with lower LVEF, higher LV filling pressures, new regional wall motion abnormalities and increased aortic root size were present among POCUS group resulting in greater yield of echo abnormalities. There were more cardiovascular medication changes at the first visit (15.3% vs. 5.7%, p<0.01), less referral for noninvasive stress testing (10% vs. 29%, p<0.01), more advanced cardiac testing and subspecialty referrals (29% vs. 18% pts, p=0.06), in the study compared to the control group after cardiology visit.

**Conclusion**

POCUS at time of consultation detects more abnormal echo findings, results in more medication adjustments, less referral for noninvasive stress testing, earlier referral for advanced cardiac diagnostic imaging and subspecialty cardiac referrals.

*Key words:* Point of care cardiac ultrasound, cardiology consultation, outpatient visit, physician performed echocardiogram, cardiovascular diagnostic testing, medication changes

**Introduction**

Transthoracic Echocardiogram (TTE) is the mainstay of cardiac evaluation allowing rapid and accurate assessment of cardiac anatomy, hemodynamics and function. Reimbursement requires specific indications and TTE is usually performed after a consultation and may be delayed by a few days depending on the echo lab schedule. Comprehensive outpatient standard echo (SE) is performed in echocardiography laboratory using state of the art echocardiography systems and by credentialed sonographers, using protocols recommended by the American Society of Echocardiography (1) and billed using the standard CPT codes (2).

Ultrasound technology has changed dramatically over the past two decades. Smaller portable ultrasound systems are powerful noninvasive diagnostic tools now available to trained physicians at the time of patient evaluation. These systems have all the diagnostic features of a SE platform including 2D, M-mode, color and spectral Doppler with similar image quality. Assessment of cardiac morphology, regional and global LV function, valvular heart disease, cardiac filling pressures, aortic and pericardial pathologies is quite feasible using these smaller platforms.

Hand carried ultrasound device assessment of cardiac function and anatomy during inpatient consultation by an experienced cardiologist leads to significant and immediate change in patient management (3). A normal echocardiogram and low risk clinical features may obviate the need for a SE. Exclusion of or confirmation of suspected clinical diagnosis or detection of other important findings relevant to clinical care may narrow further diagnostic workup. Use of a simple hand carried echo device in the outpatient cardiology clinic allowed reliable diagnosis in one third of the patients referred for echocardiography (4). However, effect of point of care ultrasound (POCUS) on specific immediate medical management, downstream testing and advanced cardiac referral in a real cardiology outpatient clinic has not been evaluated. In this study we evaluated the effect of physician performed POCUS on changes in medications at the time of consultation and influence on other diagnostic testing and referrals compared to standard cardiac consultation without the use of POCUS.

We hypothesized that POCUS by a skilled cardiologist may allow initiation of appropriate medical therapy or changes to medical therapy, referral to other cardiac sub-specialties and consideration of advanced cardiac diagnostic testing at the time of the initial consultation compared to outpatient cardiology consultation without an echocardiogram.

**Materials and Methods**

Ethics Statement: The study was reviewed and approved by Mayo Clinic Institutional Review Board. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

In this retrospective observational case control clinical study, we compared study patients who were seen in our general cardiology consultation clinic for their initial visit by a single consulting cardiologist (CC) who performed point of care ultrasound during cardiology consultation when no prior echocardiogram had been performed and a standard echocardiography (SE) was indicated, versus control patients who were seen by other general CCs during the same time period with matched referral indications in whom SE was ordered subsequent to the consultation visit.

A limited or complete TTE was performed using CX50 (Philips Medical system, Andover, Massachusetts) ultrasound system during initial outpatient consultation from January 30, 2014, through May 2016, by a single cardiologist (T.Z.N) who is also an expert echocardiographer. The consultation room was equipped with a drop down echo bed. Echocardiography was performed if the CC determined that it would provide further diagnostic information after the physical examination, including confirmation of a suspected diagnosis; change or add to a suspected diagnosis; and/or allow tailoring of pharmacologic therapy according to echocardiographic findings. During a standard 1-hour patient consultation, the cardiologist reviewed the medical records, took the patient history, and performed a physical examination, followed by goal directed POCUS. CX50, equipped with 2-dimensional (2D) B-mode, M-mode, color Doppler, tissue Doppler and pulsed-and continuous -wave Doppler, and a S5 1-MHz-phase -array pure wave crystal transducer with a resolution of 1,400 X 1,050 pixels was used. The images were stored in Digital Imaging and communications in Medicine (DICOM) format on the local hard disk of the device and transferred to PACS via internet. Three to images cine loops and still images were acquired over 3 to 10 minutes. The ultrasound examination protocol was flexible, and goal directed. The following viewed were obtained, as needed for each patient: parasternal long axis; right ventricle (RV) inflow long axis; parasternal short axis at the aortic valve level, mitral valve level, papillary muscle level, and apical level; apical 4-5-3-chamber; subcostal long and short axis; suprasternal; and posterior lower thoracic images. Color Doppler assessment of mitral, aortic and tricuspid valves was performed in at least one view for each valve for all patents. LV function was assessed in all patients based on parasternal long axis view and additional apical views for LV dysfunction and in the presence of wall motion abnormalities. The change in patient care was based on live interpretation of images during POCUS at the time of patient evaluation.

Linear measurements were made for aortic root and LV if visually abnormal. Left ventricular (LV) ejection function (LVEF) and valve regurgitation severity were visually estimated. Continuous wave Doppler was used to assess aortic and mitral valve gradient and regurgitation severity and for pulmonary artery systolic pressure using tricuspid regurgitant envelope. Right atrial pressure was assessed by inferior vena cava size and respiratory variation. The ratio of trans-mitral E wave to tissue Doppler e’ velocity of medial mitral annulus (E/e’ ratio) and pulmonary vein Doppler and isovolumic relaxation time were measured by pulsed wave Doppler for LV diastolic function assessment. The echo findings were dictated in the consultation note in the electronic health record.

History, physical exam findings, echocardiographic findings and management decisions including, medications changes and tests ordered after the index visit were compared to the control group who were seen for their initial cardiology consultation at our center by three different noninvasive general cardiologists during the same time period at the same clinic.

We had eight hundred and seventy-seven initial encounters during January 11 2014 through May 31 2015. We used the referral diagnosis for the case group (69 patients) and matched with same referral diagnosis for the control group and had 879 initial encounters during January 11 2014 through May 31 2015. For each referral diagnosis we randomly picked up to five patients who had similar referral diagnosis then reviewed the chart and applied inclusion and exclusion criteria. We reviewed two hundred initial encounters and excluded patients who did not have a follow up echocardiogram or had an echocardiogram on the day of the visit or within three months before the index visit. There was a final total of 65 patients in the control group.

**Results**

Baseline characteristics of the study and control groups are shown in Table 1. There was no difference in age, gender, history of coronary artery disease, hypertension or diabetes mellitus in the two groups.

Clinical Referral Indications

Referrals indications included palpitations, coronary artery disease, atrial fibrillation, chest pain, dyspnea on exertion, murmur, presyncope/syncope, cardiomyopathy, heart failure, lightheadedness/dizziness, pre operative cardiac assessment, hypertension, abnormal stress test and abnormal chest X ray and were similar in the two groups (Table 2). The study group comprised of 5 patients who were referred for coronary artery calcification detected on chest CT done for other reasons or those with family history of premature coronary artery disease. These patients were retained in the study cohort.

Physical Exam Findings

On physical exam there was no difference in presence of a cardiac murmur in the two groups (19, (27%) vs 22 (33%), P=NS). Volume overload (jugular venous distension and/or pedal edema along with echo findings of elevated LV filling pressure and/or pulmonary hypertension) tended to be more frequent in the study group (15 (31.4%) vs 6 (9%), p=0.058).

Echocardiographic Findings

Physician performed echocardiogram detected new findings in the study group at initial visit whereas there was a mean delay of 17 days for a SE in the control group. Table 3 shows significant echo findings during consult in the study group and on subsequent SE in the control group. Study vs control group echo findings included LVEF 55±9 vs. 59±10%, p<0.01; RV enlargement 38% vs 24%; p=NS, reduced RV function 11% vs 13%; p=NS, new regional wall abnormality 36% vs 14%; p<0.01, increased LV filling pressure 65% vs 23%; p <0.01, left atrial enlargement 34% vs 41%; p=NS, right atrial enlargement 27% vs 34%; p=NS and aortic root and ascending aortic enlargement 48% vs 10.5%; p<0.01. The percentages in the study group reflect varying denominators in whom echo findings listed above were assessed based on CC’s clinical assessment,

Limited color Doppler assessment of aortic, mitral and tricuspid valves was performed in in the study group whereas a comprehensive evaluation was performed in all patients in the control group. There was no difference in presence of mild valve regurgitation or stenosis present in 46 and-45% or of > moderate valve regurgitation or stenosis in 9% each of study and control subjects respectively. Supplemental Table 1 shows findings on valvular heart disease in the two study groups.

Medication Changes During Consultation

There was no significant difference in baseline use of antihypertensives (49% vs 38%), AV nodal blockers (45 % vs 40%), loop diuretics (26% vs 15%, p=0.13), statins (36 vs 37%) or antiarrhythmic medications (10 vs 8%) in study vs control groups.

Table 4 shows data on medications changed during cardiology consultation. There was no difference in changes for statins in study vs control groups (12% vs 9%). However more patients in the study groups had changes in antihypertensives (27% vs 5%, p<0.001), AV node blockers (24% vs 6%, p<0.01), diuretics (12% vs 3%, p=0.1) and antiarrhythmic agents (3% vs 0%, p=0.5).

In the control group further medications changed after SE included antihypertensives in 6.1%; AV nodal blockers in 10.7%, diuretics in 4.6% and statins in 1.5%. Total cardiac medications changed remained higher in the study vs. control groups; 35 (51%) vs 25 (38%). Changes made in antihypertensives (p=0.016) and in AV nodal blockers (p=0.043) remained higher in the study group

Downstream Testing Post Cardiology Consultation

Tests ordered after index cardiology consultation in the 2 groups are shown in Table 5 and combined cardiovascular tests ordered in the study (initial visit) and control group (initial and subsequent) are displayed in Figure 1.

Only 1 study patient had the need for a formal SE. Stress tests (including treadmill ECG, stress echo and nuclear stress tests) were ordered in 7 (10%) vs 19 (29% in the study vs control group (p<0.01). Other orders including cardiac MRI/CT, TEE, coronary angiogram, DC external cardioversion, pacemaker optimization, tilt table test, hospital admissions, cardiac subs specialty referrals were higher in the study group (29% vs 18%, p 0.06). There were fewer Holter monitor ordered in the study group (16% vs 28%; p= 0.41).

Among 5 study patients who were not matched, one patient had mild MR and AR, two had aortic root dilation, one patient had antihypertensives changed, 1 patient had stress treadmill ordered and one had a stress echo ordered. Excluding these patients did not affect study results.

**Discussion**

Our study shows that cardiologist performed POCUS during initial cardiology consultation can detect cardiac functional, valvular and hemodynamic abnormalities that are often not apparent on physical examination which directly impact initial medical management and downstream testing and referral. Most of the echocardiographic findings were ultimately similar in the groups with similar referral indications and baseline characteristics however the study group patients had lower mean LVEF, higher incidence of regional wall motion abnormalities, increased LV filling pressure and increased aortic root/ascending aortic diameter. POCUS aortic enlargement was found on all 3 study patients who were referred for abnormal aorta on CT or CXR.

The higher yield of echo abnormalities reflect goal directed echo exam performed after medical history, physical exam with tentative suspected potential diagnoses which were confirmed or excluded by POCUS instead of following a conventional and elaborate echo protocol as in a SE.

There were more medication changes in the study group even after accounting for medication changes in the control group after their echocardiogram that occurred after a mean delay 17 days. Overall, there was more cardiovascular medication changes in the study group compared to the control group (15.3 vs 5.7% pts).

Less noninvasive stress tests and more advanced cardiac testing was ordered in the study group after the initial visit. It is well known that many of outpatient stress echocardiograms yield normal results and inappropriate imaging stress tests are the source of highest loss of revenue due to lack of insurance reimbursement further strengthening the benefit of POCUS during cardiac consultation.

We found that there was still a mean delay for SE of 17 days in the control group following cardiac consultation. This translated into an attendant delay in patient management. Despite the widespread practice of performing echocardiography prior to cardiac consultation, many patients are not able to get this procedure due to the overbooked lab schedule, shortage of echo lab staff (particularly during the COIVD pandemic), inability of the patient to come for a separate visit for an echocardiogram and lack of approval by insurance. Even if SE is performed, as often time happens in clinical practice, the indication may not meet the appropriateness criteria and imaging may miss or evaluate in detail the relevant pathology in order to meet the ICAEL requirements.

The yield of abnormal findings was higher in the goal directed POCUS studies than during SE where all patients underwent a complete echocardiographic evaluation. The higher yield of echo abnormalities in the study group suggests that patients who underwent POCUS met “appropriateness” indication for echo. This is borne out in a sub-analysis of the Echo WISELY Trial which showed that in an outpatient ambulatory group, 89.6% of identified echo abnormalities occurred when the echo met appropriateness criteria laid out by the imaging societies as compared with only 4.3% on “inappropriate” scans (5).

Goal directed echocardiogram after history and physical exam and review of prior relevant lab and imaging data allows the physician to make immediate management decisions at the time of the initial consultation, thus improving patient care and satisfaction, besides leading to cost saving for the patients and health care systems.

Our study findings resemble earlier studies where a standard echo performed by sonographers was shown to find additional significant information not suspected by history and physical exam in half the patients by the cardiologists in the clinic setting (5) In particular valve disease was detected by physical exam by cardiologists only 50% of the time. Standard echo led to change in management strategy in one 3rd of patients including change in pharmacologic therapy in 62% of patients and avoidance of additional cardiac procedures that would have otherwise been ordered resulting in substantial cost savings (6). It is to be noted that in a SE, a credentialed sonographer performs a comprehensive echocardiogram as the sonographer goes through a full TTE study based on ASE/ICAEL recommendations. Referral indication for echocardiogram often times may not reflect underlying cardiac pathology to focus on (especially if the echo order is entered by the secretarial staff), that may lead to inadequate or incomplete evaluation of the relevant pathology. Interpretation of the images by the reading cardiologist in a busy echo lab unaware of patients’ history and physical exam (unless the cardiologist chooses to review patients medical record) may also lead to missing of underlying pathology, For the patient there is dissociation of care with multiple personnel involved in their care besides an increased number of patient visits for diagnostic workups, as well as an attendant delay in patient care.

POCUS in study patients provided the benefit of detecting heart rate, atrial or ventricular ectopy as well as short runs of arrythmia on the ultrasound ECG monitor that may have further helped in deciding on prescriptions for AV nodal blockers and antiarrhythmic medications and lowering referrals for Holter monitoring.

Our study extends observations by Waggoner et al (5) further by incorporating POCUS during cardiac consultation. Echo was performed prior to cardiac consultation in an outpatient setting by an experienced echocardiographer using hand carried ultrasound found that in 84 out of 300 patients it was not necessary to perform SE. In 159 of the remaining 203 patients (78%) hand carried echo was able to confirm or refute the suspected clinical diagnosis (7).

One study showed that medical students who had received a few hours of training on POCUS using hand carried ultrasound, identified cardiac pathology in 75% of patients as opposed to 49% by physical exam by expert cardiologists (8). Medical residents (9) and hospitalists (10) who received basic training in echo used hand held unit (HHU) were able to confirm clinical diagnosis or make new diagnoses. One study found that if all inpatients or those with requests for LV function assessment underwent POCUS using HHU initially, and only those with abnormal scans underwent further SE, there would be a 29% and 22% respective reduction in departmental workload (11). When used in the outpatient setting by the medical residents trained in limited POCUS, there was an improvement in their diagnosis of LV dysfunction, valvular disease, and LV hypertrophy by 19%, 39%, and 14% respectively compared to history and physical alone and management decisions were reinforced in 76% and changed in 40% of patients (12).

In a fee-for-service model, the potential benefits of POCUS discussed above need to be weighed against reduced profits from reduction in SE studies that are reimbursed (13). On the other hand, in a universal health care service, use of POCUS can reduce the workload of echocardiographic laboratories and result in substantial cost savings for the hospitals.11 Use of miniaturized echo system on the floors compared to SE in the echo lab led to increased productivity of the sonographers and improved cost effectiveness of echocardiography (14).

To apply the study group model in the current outpatient hospital practice at large will require presence of ultrasound equipment, a cardiologist with advanced echo skills, possibly a technician who may enter patient identifiers on the ultrasound system or pull an echo order from the PACS system on the machine and apply ECG leads etc. In our study all above was done by the CC. Other elements needed include image storage linked with patient identifiers and transfer of images to server for record keeping and dictation of echo findings in the consultation note. A formal limited report may be generated with basic liner measurements of cardiac chamber size, aortic root and ascending aorta, LV ejection fraction, pulmonary artery systolic pressure, LV diastolic function, qualitative, semiquantitative or quantitative assessment of valvular stenosis or regurgitation, presence and size of pericardial effusion and other significant findings. Management steps in response to these findings should be documented.

No billing was performed for echo in the study group, instead consultative time was increased to include echo assessment, however billing for a limited echo study may be performed if a formal echo report is generated linked with patient identifiers and images.

Although formal cost-saving analyses are difficult to perform, some economic analyses have shown that implementing POCUS in daily care management in internal medicine (15) as well as in cardiology practice (16) can produce consistent savings besides evident medical benefits.

Use of POCUS as an adjunct to physical exam not only allows the physician to make a definitive diagnosis at the first visit but also reduces physician workload by reducing follow up work up including patient visits.

Although we did not collect this data in our study, echocardiographic assessment during cardiology visit allowed a more informed discussion with the patient and increased patient insight into cardiac condition.

Our results support that echocardiography training during cardiology fellowship should consider providing level 3 training which includes fellow performed transthoracic echocardiograms, particularly for fellows who wish to pursue a career as a general cardiologist in a hospital or private setting.

Study Limitations

Our study is a retrospective, observational and non-randomized. Hence despite matching control group with the study group biases likely remain. At the same time the study reflects real life practice and not biased on how the CCs managed patients during real patient encounters. Despite our small sample size, we found significant differences in patient management and downstream testing in the 2 groups. We do not have data on subsequent patient follow up after the index visit. Patient outcome data is not available to realize the effect of echo performed at the time of the visit vs later on cost of medical care or on patient outcome.

For cardiologists, it may be difficult to accommodate an echocardiogram during cardiac consultation given time constraints in outpatient visit slots and the burden of electronic health record data review and entry. In our study POCUS was performed by an experienced CC with advanced echo skills. Thus, our findings cannot be extrapolated to other less experienced users. In fact, the use of these devices by unqualified users in other scenarios may even be harmful and could lead to further unnecessary testing or unnecessary interventions in the case of false-positive findings or inadequate investigation of false-negative findings. Appropriate training and credentialling are required by the hospital for ultrasound privileges. For physicians without echocardiography expertise, the availability of sonographer and an echocardiographer who can interpret images and discuss findings with the referring provider at the time of patient evaluation may be a good substitute and has already been demonstrated to reduce the need for SE (6).

**Conclusion**

This study investigated the impact of physician performed POCUS during cardiac consultation on immediate patient diagnosis, downstream testing and management Focused echo at time of consultation leads to earlier and more medication adjustments, less referral for noninvasive stress testing, earlier referral for advanced cardiac diagnostic imaging and shortens time to advanced diagnostic workup.

**Figure Legend**

**Figure 1**

Combined Cardiovascular Tests Ordered in the Study Group at First Visit and Control Group at First Visit and After Standard Echocardiogram

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**Table 1: Baseline Characteristics of the Study Population**

|  |  |  |
| --- | --- | --- |
|  | Groups | |
| Variables | **Study** | **Control** |
| Number | 69 | 65 |
| Age | 62.1+16 | 64+19 |
| Gender (Male/Female) | 39/30 | 36/29 |
| Body surface area (m2) | 1.91 | 1.93 |
| Systolic blood pressure (mm Hg) | 133+22 | 131+19 |
| Diastolic blood pressure (mm Hg) | 76+10 | 77+9.8 |
| Coronary artery disease | 19 (27%) | 18 (27%) |
| Hypertension | 31 (44%) | 31 (47%) |
| Diabetes Mellitus | 12( 17%) | 12 (18%) |

Data are mean + SD, numbers (%). P value not significant for all variables

**Table 2: Referral Indications for the Study and Control Groups**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Referral Indications | Study Group (69) | | Control Group (65) | |
| **N** | **%** | **N** | **%** |
| Palpitations/Tachycardia | 7 | 10 | 9 | 14 |
| Coronary artery disease | 10 | 14 | 8 | 12 |
| Atrial fibrillation | 9 | 13 | 8 | 12 |
| Chest pain | 5 | 7 | 8 | 12 |
| Dyspnea on extension | 5 | 7 | 8 | 12 |
| Valve disease/murmur | 10 | 14 | 7 | 11 |
| Pre syncope/syncope | 3 | 4 | 5 | 8 |
| Cardiomyopathy | 4 | 6 | 4 | 6 |
| Heart failure | 4 | 6 | 3 | 5 |
| Lightheadedness/dizziness | 2 | 3 | 1 | 2 |
| Pre-op assessment | 2 | 3 | 2 | 3 |
| Hypertension | 2 | 3 | 1 | 2 |
| Abnormal ECG/stress test | 1 | 1 | 1 | 2 |
| Abnormal aorta (CXR) | 1 | 1 |  |  |
| Abnormal aorta chest CT | 2 | 3 |  |  |
| Cardiac eval for diabetes | 1 | 1 |  |  |
| Family history of PVD | 1 | 1 |  |  |

ECG, electrocardiogram; CXR, chest X ray; CT, computed tomography; PVD, peripheral vascular disease. P value not significant for all variables

**Table 3: Echocardiographic Data in the Study (POCUS) and Control Groups (Standard Echo)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Echocardiographic Findings | N Study Group | Study | Control | p value |
|  | | | | |
| LVEF | 67 | 54.6+8.8 | 59.5+10.35 | 0.004 |
| RV enlargement | 32 | 38% | 24% | 0.17 |
| Reduced RV function | 28 | 11% | 13% | 1.00 |
| Regional Wall Motion | 36 |  |  | 0.34 |
| No RWMA | 36 | 36% | 88% |  |
| New RWMA |  | 36% | 14% | 0.0001 |
| Old RWMA |  | 28% | 6% |  |
| LV filling Pressure | 26 |  |  |  |
| Normal | 26 | 35% | 75% | 0.0022 |
| Increased |  | 65% | 23% | 0.0003 |
| Aortic evaluation | 13 |  |  |  |
| Aortic sinus enlargement |  | 48% | 6% | 0.0049 |
| Ascending aortic enlargement |  | 62% | 11% | 0.0011 |
| Valve Disease | 69 |  |  |  |
| > Moderate valve reg. or stenosis |  | 9% | 11% | 0.77 |
| > Mild valve reg or stenosis |  | 29% | 18% | 0.16 |
| Mild reg or stenosis |  | 46% | 45% | 0.86 |

RV: Right ventricle, LV: left ventricle, LVEF, left ventricular ejection fraction; RMWA; regional wall motion abnormality, LA: Left Atrium, RA: Right atrium, Mod: moderate, Reg: Regurgitation

**Table 4: Medication Changed at the First Clinic Consultation**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Medications** | **Study Group** | | **Control Group** | | **P value** |
| **Antihypertensives** | 19 | 27% | 3 | 4.60% | 0.0003 |
| **AVN Blockers** | 17 | 24% | 4 | 6.10% | 0.003 |
| **Loop Diuretics** | 8 | 11.50% | 2 | 3% | 0.097 |
| **Antiarrhythmic drugs** | 2 | 2.80% | 0 | 0% | 0.49 |
| **HMG CoA Reductase Inhibitors** | 8 | 11.50% | 6 | 9.20% | 0.78 |

AVN, atrioventiruclar nodal blockers

**Table 5:Tests Ordered at the First Cardiac Consultation in the Study and Control Groups**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Investigations ordered |  | Study Group (69) | | Control Group (65) | | P value |
|  | **N** | **%** | **N** | **%** |
|  |  |  |  |  |  |  |
| Holter monitoring |  | 11 | 16 | 18 | 27.6 | 0.1 |
|  |  |  |  |  |  |  |
| Stress Tests: |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  | Ex. Treadmill | 1 | 1.4 | 7 | 10.7 |  |
|  | Stress Echo | 5 | 7.1 | 7 | 10.7 |  |
|  | Nuclear Stress | 1 | 1.4 | 5 | 7.6 |  |
|  |  |  |  |  |  |  |
| *Total Stress tests* |  | 7 | 10 | 19 | 29 | 0.005 |
|  |  |  |  |  |  |  |
| Advanced Cardiac Testing/Mgmt. |  |  |  |  |  |  |
|  | Cardiac MRI/CT | 4 | 5.7 | 1 | 1.5 |  |
|  | TEE | 4 | 5.7 | 1 | 1.5 |  |
|  | Cor. Angiogram | 2 | 3 | 1 | 1.5 |  |
|  | DC Cardioversion | 2 | 2.8 | 0 | 0 |  |
|  | Pacemaker optimization | 1 | 1.5 | 0 | 0 |  |
|  | Tilt table | 1 | 1.5 | 1 | 1.5 |  |
|  | Admit | 0 | 0 | 1 | 1.5 |  |
|  | Cardiac surgery/EP/HCM Referral | 3 | 4 | 2 | 3 |  |
| *Total* |  | 17 | 25 | 7 | 11 | 0.036 |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Carotid plaque screen/CAC |  | 3 | 4.3 | 1 | 1.5 |  |
| Carotid Duplex |  | 1 | 1.4 | 2 | 3 |  |
| Chest CT |  | 0 | 0 | 1 | 1.5 |  |

**CAC, coronary artery calcium, CT, computerized tomography**