Interventional Cardiology and Elderly Patients: When Is It Too Late?

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Abstract: Background. The incidence of ischaemic heart disease in geriatric patients is permanently increasing. Despite this fact, elderly patients are often not admitted in studies analysing the benefit of revascularisation techniques, given the increased risk of complications. Objectives. To analyse the incidence of complications associated with interventional cardiology (myocardial revascularisation techniques or permanent cardiac pacing) in hospitalized elderly patients. Material and methods. We retrospectively studied 40 patients aged ≥ 65 years, with a history of interventional cardiology: percutaneous coronary intervention (PCI), coronary artery bypass graft (CABG) or permanent cardiac pacing who were admitted in the Geriatric Clinic between January-october 2013. We investigated the main causes that generated the present rehospitalization. Comprehensive geriatric assessment (CGA), including nutritional, functional and psychological assessments, were performed. Results. Most cardiovascular procedures were performed in patients aged ≥ 70 years. Current hospital admission was mainly the result of non-adherence to medical treatment. None of the patients were admitted because of complications due to any of the procedures mentioned above. CGA revealed: increased autonomy at home, reduced cognitive impairment, increased rate of mild depression and risk of undernutrition. Psychological examination confirmed that quality of life improved in all patients after interventional cardiology. Conclusion. Interventional cardiology confers major benefits in elderly patients, with low rates of late complications, and influences prognosis regarding quality of life.

Keywords: Interventional Cardiology, Elderly, Quality of Life

Introduction

One of the major cardiovascular risk factors is ageing itself, mainly due to inexorably advancing atherosclerosis but also due to inevitable ageing of the cardiovascular system and increased period of time for other risk factors to negatively influence cardiovascular condition (Conroy, 2003). Moreover, elderly patients frequently develop cognitive and functional impairments (sleep disorders, chronic pain etc.), which would require complex drug administration and special care in establishing a therapeutic plan. Given the high prevalence of cardiovascular diseases among the elderly, special attention for this group of patients is granted in the latest Ischaemic heart disease guide but information provided mostly derive from carefully selected randomised trials with carefully selected elderly groups. Patients aged ≥ 80 years are almost completely absent in trials, and when they are admitted, it would be only those without comorbidities, which is the hallmark of their age. We face an interesting paradox: the greatest benefit of the treatment recommended by the guidelines should be achieved by the patients at the highest cardiovascular risk, but this category is not really part of data supporting the guidelines (Forman, 2013).

Recommendations of interventional cardiology for the elderly population have permanently been updated in the past decade. The 2012 and 2013 guidelines regarding the management of stable angina and acute coronary syndromes emphasize that older patients are more likely to have diffuse and severe coronary atherosclerosis with a higher prevalence of three-vessel and left main coronary artery disease. The guidelines acknowledge the less frequent use of evidence-based therapies in older adults, due to therapeutic challenges secondary age-related modifications: altered pharmacokinetics (due to reduced muscle mass, renal and/or hepatic dysfunction, and reduced volume of distribution) and pharmacodynamics (increased risks of hypotension and bleeding) (Forman, 2013), and the risk of polypharmacy and iatrogeny. Therefore, we assist to a certain reluctance when applying the guideline's
recommendations for older patients, often based on a subjective risk evaluation.

This article aims to explore the benefits and the limits of interventional cardiology for the geriatric population.

**Material and Methods**

**Study Design**

We retrospectively analyzed a group of 1219 patients aged ≥ 65 years old who were admitted in the Geriatric Clinic of “Dr. C. I. Parhon” Hospital from Iasi, Romania between January-October 2013. Of the total amount of patients, 40 patients were having at least one of the following procedures: percutaneous coronary intervention (PCI), permanent cardiac pacing, coronary artery by-pass graft (CABG). Among them, 4 patients underwent surgery for hip fracture and were admitted for postoperative reevaluation and 2 patients were recovering from oncological surgery.

Patients were divided into two groups in order to assess significant differences between genders. The parameters we followed were: baseline demographics (age, gender, social origin), causes for present admission (including medical non-adherence), symptoms and signs, including angina equivalents, complications of cardiovascular procedures, evolution, and discharge status.

**Geriatric Evaluation and Psychological Examination**

Every patient had been subjected to a comprehensive geriatric assessment (CGA) and a psychological examination, which included: ADL (Activities of Daily Living) (Katz, 1970), IADL (Instrumental Activities of Daily Living) (Lawton, 1969), MMSE (Mini Mental State examination) (Mungas, 1991), GDS (Geriatric Depression Scale) (Sheikh, 1986) and MNA (Mini Nutritional Assessment) (Vellas, 1999). In order to assess the functional status of the patients selected for this study data was collected from applying ADL and IADL scales. These are standard questionnaires used worldwide in order to evaluate a patient’s independent daily skills and need for assistance. The maximum score is 6/6 for ADL and 8/8 for IADL and indicates full function, with no need for assistance. Cognitive status was evaluated using MMSE, a brief 30-point questionnaire test that is commonly used to screen for cognitive impairment. Any score ≥ 27 points (out of 30) indicates a normal cognition. Below this, scores can indicate severe (≤9 points), moderate (10-19 points) or mild (20-26 points) cognitive impairment. Psychological examination together with a short form of the GDS, were performed to each patient. The grid sets a range of 0-4 as “no depression”, 5-10 as “mild depression” and ≥11 as “severe depression”. Although the test has well-established reliability and validity evaluated against other diagnostic criteria, a diagnosis of clinical depression cannot be based on GDS results alone.

The risk of malnutrition was assessed using MNA, a 30-point questionnaire, 17-23.5 points revealing risk of malnutrition and < 17 points indicating presence of malnutrition.

**Data Analysis**

Data were collected from the patients’ medical records by the medical staff involved in this study. The collected data were analyzed by the SPSS 18.0 software, using the Paired T Test for quantitative analyses and Chi-square Test for differences in proportions. We evaluated the possible influence of every parameter in each of the two groups (male vs female patients). In case the study of correlations indicated a degree of influence, we analyzed if there was a significantly statistical connection between that parameter and its dependent variables. The statistical significance was defined in 95% confidence interval (p<0.05). For the geriatric assessment we carried out an overall descriptive group analysis.

**Results**

Between January-October 2013, 1219 patients aged ≥ 65 years were admitted in the Geriatric Clinic of “Dr. C. I. Parhon” Hospital. Of the total amount of patients, 40 (23 men and 17 women) had a medical history of PCI, CABG or pacemaker implantation and were selected for our study. The baseline demographics are reported in Table 1. The male gender was prevalent (57.5%) with sex ratio 1.4/1. The mean age was 77.5 years (limits: 65 - 90 years).

The cohort included mainly old (52.5%) and young old (35%) patients, with no significant difference between genders (p=0.993). Regarding the home background, 55% of patients lived in the urban area and 45% of patients were from the rural area, with no significant difference between genders (p=0.923).

In conclusion, group study was homogenous between gender, age group and home background.

The causes for present admission (including medical non-adherence), symptoms and signs, including angina equivalents, complications of cardiovascular procedures, are reported in Table 2. The main cardiac procedures were: permanent cardiac pacing (42.5%) and coronary angioplasty (40%). The mean age of performing the intervention was 71.6 years. CABG was more frequent in the male population, and for this group the relative risk of re-hospitalization was increased threefold.

The symptoms at admission were diverse, but most patients presented with dyspnoea of cardiac origin (72.5%), mainly due to discontinuation of
treatment (47.5% of the patients). None of the symptoms were due to complications from their past cardiac procedures (e.g., stent/graft occlusion, pacemaker dysfunction).

Table 1. Baseline demographics.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>All cohort (n=40)</th>
<th>Male (n=23)</th>
<th>Female (n=17)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years) mean±SD *limits</td>
<td>77.5 *(65-90)</td>
<td>77.21±6.45</td>
<td>76.41±4.74</td>
<td>0.300</td>
</tr>
<tr>
<td>Classification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young old (65-74 y)</td>
<td>14 (35.0%)</td>
<td>8 (34.8%)</td>
<td>6 (35.3%)</td>
<td>0.993</td>
</tr>
<tr>
<td>Old (75-84 y)</td>
<td>21 (52.5%)</td>
<td>12 (52.2%)</td>
<td>9 (52.9%)</td>
<td></td>
</tr>
<tr>
<td>Oldest old (85+ years)</td>
<td>5 (12.5%)</td>
<td>3 (13.0%)</td>
<td>2 (11.8%)</td>
<td></td>
</tr>
<tr>
<td>Home background</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>14 (45.0%)</td>
<td>10 (43.5%)</td>
<td>8 (47.1%)</td>
<td>0.923</td>
</tr>
<tr>
<td>Urban</td>
<td>21 (55.0%)</td>
<td>13 (56.5%)</td>
<td>9 (52.9%)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Clinical history and medical status.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>All cohort (n=40)</th>
<th>Male (n=23)</th>
<th>Female (n=17)</th>
<th>p</th>
<th>RR (IC95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of intervention</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCI</td>
<td>16 (40.0%)</td>
<td>9 (39.1%)</td>
<td>7 (41.2%)</td>
<td>0.845</td>
<td>0.95(0.44÷2.04)</td>
</tr>
<tr>
<td>Pacemaker</td>
<td>17 (42.5%)</td>
<td>9 (39.1%)</td>
<td>8 (47.1%)</td>
<td>0.859</td>
<td>0.83(0.41÷1.70)</td>
</tr>
<tr>
<td>CABG</td>
<td>5 (12.5%)</td>
<td>4 (17.4%)</td>
<td>1 (5.9%)</td>
<td>0.546</td>
<td>2.96(0.36÷24.1)</td>
</tr>
<tr>
<td>PCI+ pacemaker</td>
<td>1 (2.5%)</td>
<td>1 (4.3%)</td>
<td>0 (0.0%)</td>
<td>0.878</td>
<td>-</td>
</tr>
<tr>
<td>CABG + pacemaker</td>
<td>1 (2.5%)</td>
<td>0 (0.0%)</td>
<td>1 (5.9%)</td>
<td>0.876</td>
<td>-</td>
</tr>
<tr>
<td>Mean age at intervention time (years) ±SD</td>
<td>71.69±6.37</td>
<td>70.35±6.86</td>
<td>73.20±5.61</td>
<td>0.105</td>
<td>-</td>
</tr>
<tr>
<td>Symptoms at present admission</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>breathlessness</td>
<td>29 (72.5%)</td>
<td>19 (82.6%)</td>
<td>10 (58.8%)</td>
<td>0.191</td>
<td>1.40(0.90÷2.18)</td>
</tr>
<tr>
<td>angina</td>
<td>5 (12.5%)</td>
<td>2 (8.7%)</td>
<td>3 (17.6%)</td>
<td>0.717</td>
<td>2.03(0.38÷10.8)*</td>
</tr>
<tr>
<td>atypical chest pain</td>
<td>11 (27.5%)</td>
<td>2 (8.7%)</td>
<td>9 (52.9%)</td>
<td>0.006</td>
<td>6.09(1.50÷24.6)*</td>
</tr>
<tr>
<td>ankle swelling</td>
<td>10 (25.%)</td>
<td>6 (26.1%)</td>
<td>4 (23.5%)</td>
<td>0.853</td>
<td>1.11 (0.37÷3.33)</td>
</tr>
<tr>
<td>fatigue</td>
<td>4 (10%)</td>
<td>0 (0.0%)</td>
<td>1 (5.9%)</td>
<td>0.876</td>
<td>-</td>
</tr>
<tr>
<td>palpitations</td>
<td>9 (22.5%)</td>
<td>3 (13.0%)</td>
<td>6 (35.3%)</td>
<td>0.200</td>
<td>2.71(0.79÷9.31)*</td>
</tr>
<tr>
<td>headache/dizziness</td>
<td>15 (37.5%)</td>
<td>3 (13.0%)</td>
<td>12 (70.6%)</td>
<td>0.001</td>
<td>5.41(1.80÷16.2)*</td>
</tr>
<tr>
<td>fever</td>
<td>2 (5.0%)</td>
<td>2 (8.7%)</td>
<td>0 (0.0%)</td>
<td>0.608</td>
<td>-</td>
</tr>
<tr>
<td>cough=sputum</td>
<td>11 (27.5%)</td>
<td>10 (43.5%)</td>
<td>1 (5.9%)</td>
<td>0.023</td>
<td>7.39(1.04÷52.4)*</td>
</tr>
<tr>
<td>nausea/abdominal pain</td>
<td>7 (17.5%)</td>
<td>1 (4.3%)</td>
<td>6 (35.3%)</td>
<td>0.034</td>
<td>8.12(1.07÷61.3)*</td>
</tr>
<tr>
<td>other</td>
<td>13 (32.5%)</td>
<td>6 (26.1%)</td>
<td>7 (41.2%)</td>
<td>0.505</td>
<td>0.63(0.26÷1.55)</td>
</tr>
<tr>
<td>Causes for re-hospitalization</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>medical non-adherence</td>
<td>19 (47.5%)</td>
<td>10 (43.5%)</td>
<td>9 (52.9%)</td>
<td>0.785</td>
<td>0.82(0.43÷1.57)</td>
</tr>
<tr>
<td>infection</td>
<td>8 (20.0%)</td>
<td>6 (26.1%)</td>
<td>2 (11.8%)</td>
<td>0.472</td>
<td>2.22(0.51÷9.67)</td>
</tr>
<tr>
<td>hypertension crisis</td>
<td>5 (12.5%)</td>
<td>3 (13.0%)</td>
<td>2 (11.8%)</td>
<td>0.717</td>
<td>1.11(0.21÷5.92)</td>
</tr>
<tr>
<td>others (arrhythmia, anxiety, anaemia, excessive physical effort etc)</td>
<td>8 (20.0%)</td>
<td>3 (13.0%)</td>
<td>5 (29.4%)</td>
<td>0.379</td>
<td>0.44(0.12÷1.61)</td>
</tr>
<tr>
<td>Discharge status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>recovered</td>
<td>36 (90.0%)</td>
<td>22 (95.7%)</td>
<td>14 (82.4%)</td>
<td>0.394</td>
<td>1.16(0.92÷1.47)</td>
</tr>
<tr>
<td>transferred</td>
<td>1 (2.5%)</td>
<td>0 (0.0%)</td>
<td>1 (5.9%)</td>
<td>0.878</td>
<td>-</td>
</tr>
<tr>
<td>dead</td>
<td>3 (7.5%)</td>
<td>1 (4.3%)</td>
<td>2 (11.8%)</td>
<td>0.795</td>
<td>0.37(0.04÷3.75)</td>
</tr>
</tbody>
</table>

* increased relative risk in the female population

CGA showed that most of the patients had increased autonomy at home. ADL test showed that 31 patients (77.5%) had full function, and 9 patients (22.5%) had moderate impairment and none of them had severe impairment. The IADL test showed that all patients were independent, none of them needed any assistance at home. CGA and psychological examination concluded that 34 patients (85%) had normal cognitive function and only 6 patients (15%) had mild cognitive impairment. There were no signs
of depression in 14 patients (35%), while mild depression was detected in 17 patients (42.5%) and severe depression was registered in 9 patients (22.5%). The MNA scale showed that most of our patients registered a risk of malnutrition (26 patients, 65%), 8 patients suffered from malnutrition (15%) while only 8 patients (15%) had a good nutritional status.

Patients that underwent surgery for hip fracture had a good post-operative outcome and their recovery period was normal, since rehabilitation started in the same time as patients without cardiac surgery.

**Discussions**

Demographic studies show an increase in elderly population which will continue in the decades to come. The most important causes are the increase in life expectancy and the ageing of the post World War II baby boom (1946-1970). Ischaemic heart disease is a very common cause of morbidity in elderly patients (Gunal, 2008).

In general, one is considered “old” if aged ≥ 65 years, but this chronological mark varies in the guidelines cited in this paper. Geriatricians disagree with this shallow definition and consider calendar age an arbitrary point of reference. They stand for a more complex evaluation, considering the patient’s functional status, lifestyle and socio-economic factors. Our study proved them right as it emphasizes the favorable long term outcomes of elderly patients who underwent interventional cardiology procedures (PCI, CAGB or pacemaker implantation). Despite the fact that most patients followed one of these three procedures after the age of 70 years, subsequent hospitalizations were mostly due to medical non-adherence usually due to polypharmacy and iatrogeny. As a result, these patients quickly recovered after resuming the optimal drug therapy.

Interventional cardiology is often controversial, and strong debates argue the optimal therapeutic indications for patients ≥ 75 years old who require myocardial revascularization and/or cardiac pacing treatment.

**Interventional Therapy Versus Conservative Treatment**

Elderly patients with acute coronary syndrome have increased rates of atypical symptoms, non-specific electrocardiograms, and multiple comorbidities that can mask and/or delay proper diagnosis and treatment.

There are conflicting data if there is an increased rate of mortality in older patients compared with young adults undergoing a myocardial revascularization technique (interventional or surgical). The CRUSADE Initiative points out that 7% of patients presenting with STEMI were not considered for myocardial revascularization because of their advanced age (Madhan, 2011). If coming to choose between techniques, a superior number of geriatric patients seem to benefit from PCI compared to CAGB, but their age shouldn’t be the sole criterion for the type of revascularization. Their selection should be based on the assessment of frailty, comorbidities, life expectancy and personal desire (Forman, 2013; Poorhosseini, 2011; Biondi Zoccai, 2013).

Evidence from the medical literature show that PCI should be a viable treatment option for elderly patients (Ohlow, 2012; Gharacholou, 2010; Anderson, 2013; Montalescot, 2013). PCI is a low-invasive procedure and carries a small likelihood for cognitive impairment. In carefully selected patients with clinically relevant coronary stenosis, PCI may provide greater symptomatic relief than medical therapy. Patients presenting with ST-elevation myocardial infarction (STEMI) who are expected to live an autonomous life style after discharge are the best candidates for PCI in order to secure vessel patency and achieve myocardial salvage (Biondi Zoccai, 2013).

Still, PCI is frequently avoided in elderly patients because of increased complication rates. There is no doubt that coronary instrumentation is an invasive act, associated with potential local access site complications, such as bleeding, dissection, perforation or thrombosis, especially in a group with an increased prevalence of diffuse coronary disease, severe calcification, and tortuosity of the heart vessels. Even after the procedure is completed, age is a potent and independent negative predictor of death, myocardial re-infarction, stent thrombosis, and re-hospitalization (Biondi Zoccai, 2013). Hence, a careful follow-up of these patients is mandatory, associated with maximizing their medical treatment and sustaining therapeutical education to prevent non-adherence.

The determination of geriatricians to assess the benefit of interventional cardiology for the elderly heart patients is reflected by studies that included specific subgroups, such as octogenarians (Poorhosseini, 2011) and nonagenarians (Biondi Zoccai, 2013; Ohlow, 2012). A study that enrolled 112 octogenarians who were compared with 336 young adults, 1 year after undergoing PCI showed no significant differences with regard to procedural success, in-hospital complications and major cardiovascular events between the 2 groups. Although the one-year cardiovascular mortality was more significant in the octogenarian group, the study disagrees with the idea of using the patient’s age as a sole criterion for not receiving myocardial revascularisation treatment (Poorhosseini, 2011).
PCI or CABG?

The decision to favor an interventional or surgical procedure should be carefully taken, since enrollment criteria of the patients and results of the studies show significant discrepancies. PCI remains a reliable treatment for carefully selected elderly patients, after applying a number of cautions such as having a good radial or ulnar access site, limiting contrast load and optimizing fluid status to prevent contrast associated nephropathy, and favoring bare-metal stents. Without denying both short-term and long-term complications of PCI, in order to achieve a risk-benefit and cost-benefit ratio in favor of PCI, these risks should be surpassed by a superior prognostic, with improvement in quality of life.

A study conducted by Sheridan on 10141 patients aged ≥ 85 years who underwent PCI or CABG after an acute coronary syndrome showed that PCI was associated with lower mortality and morbidity on short-term, while CABG was followed by superior outcomes on the long-term. Therefore, the authors consider that, for elderly patients with extensive coronary disease presenting with an acute coronary syndrome, CABG provides several advantages compared with PCI, especially on survival rates and adverse cardio-vascular events (Liu, 2013, Sheridan, 2010). The same conclusions are found in another study that included octogenarians: CABG poses a greater risk of short-term complications compared with PCI, but provides a better survival (Dacey, 2007; Charytan 2012).

Impact of PCI on Quality of Life for Elderly Patients

The main issue in recommending PCI for geriatric patients is to improve the patient’s quality of life (Kamiya, 2007). Therefore, many studies analyzed if the patient’s status after PCI correlated with a better quality of life. Thus, quality of life in octogenarians after PCI appears to be acceptable, with main improvements in their cognitive status (Gunal, 2008). Spertus and al (Spertus, 2004) found that the only factors independently associated with the improvement of quality of life 1 year after PCI were improvement of physical function and decrement of angina frequency. In another study, Panasewicz et al (Panasewicz, 2013) showed that predictors of impaired quality of life were generally different for the elderly (diabetes, previous PCI) compared to younger cohorts (smoking, previous bypass surgery), although poor six-months, health-related predictors for quality of life - anxiety and depression - were common for both groups.

Frailty, comorbidity and quality of life are highly prevalent in elderly patients undergoing PCI. These factors should be incorporated in current risk-prediction models along with traditional cardiovascular risk factors in order to assess the risk of patients undergoing PCI. For example, their inclusion improved the discriminatory ability of the Mayo Clinic risk score to evaluate the long-term prognosis of elderly patients after PCI (Singh, 2011). Long-term mortality/ myocardial infarction were significantly higher in patients considered to be frail.

Hip fracture is highly frequent in geriatric patients. For the management of these patients, Papp (Papp, 2010) developed a useful algorithm to assist the surgeon in gathering important information and developing perioperative approaches to treatment according to the personal medical profile of the patient.

The Risks Associated With Pacemaker Implantation in Elderly Patients

While acute myocardial infarction is increasing in younger adults, the conditions that require a pacemaker implantation (complete atrio-ventricular block, atrial fibrillation with a spontaneous heart rate < 40 bpm, sick sinus disease etc) are prevalent in older patients. Some statistics estimate that 70-80% of pacemaker implantations are performed in patients aged ≥ 65 years (Mond, 2011).

The most common complications associated with a pacemaker implantation are: pocket hematoma, infection of the pocket, pneumothorax – at the time of implantation, and late complications: lead displacement/failure, lead endocarditis, pocket fibrosis and myocardial rupture. Ozcan et al (Ozcan, 2013) published in 2013 a prospective study in which they compared the incidence of these complications in older patients compared to younger patients. Their results showed that pacemaker implantation in elderly patients is a safe procedure when performed by an experimented team and patients who are more than 70 years old may even have fewer complications than younger patients. The explanation could be the higher proportion of dual chamber pacemaker implantation in younger patients, which is frequently associated with atrial lead dislodgement. None of the patients included in our study presented with late complications of pacemaker implantation.

Conclusion

Late complications of PCI, CABG or pacemaker implantation were not registered in our study. Although most procedures were performed after the age of 70 years, the cognitive, psychological and social status of our patients revealed a positive impact of these procedures. Hence, on the basis of current evidence, the decision to perform an invasive cardiac procedure should not be based on chronological age alone, but rather on each patient’s general eligibility and the clinical circumstances as a whole.
Study Limitation

Our study is a single center study which includes a small population for the observed prevalence of complications related to past cardiac interventions. Bias results could be induced by the small sample size. The study group was homogenous between gender, age group and home background, but absence of statistical significance between the parameters analyzed should be taken with caution.

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