Postoperative Complications and Patient’s Satisfaction after Harvesting of the Radial Artery for Coronary Artery Bypass

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Abstract: Objectives: There is a paucity of data regarding wound-site complications and patient’s satisfaction after harvesting of a radial artery. This study is conducted to evaluate the frequency complications and the level of patient’s satisfaction after myocardial revascularization in our setting. Methods: From April 2009 to October 2013, 97 patients had radial artery (RA) used as a graft in myocardial revascularization. The graft was harvested using open technique. This was retrospective study. Telephone questionnaire was used to evaluate: arm pain, swelling, mobility, sensory changes, patient’s contentment with a cosmetic result and the general health state. Results: Pain of limited duration was reported by 24 patients (24.7%), none of them reported permanent pain. Some problems in performing everyday’s activities were reported by 8 pts (8.2%). Sensory changes were permanently present in 5 pts (5.2%), and frequent arm fatigue was reported by 4 pts (4.1%). Positive opinion regarding the cosmetic result was reported by 95 pts (97.9%). State of the health after surgery, 81 pts (83.5%) described as excellent or good. Patients who had more mobility problems, also had more sensory and neurological discomfort respectively. Patients with better self-reported general health state were also more satisfied with the esthetic effect of the intervention. Conclusions: Using the open technique resulted in excellent cosmetic effect. This gives us credit to point out that exclusive need of the endoscopic as a supreme method might be under the question mark. Our study suggests that individual attitude of the particular patient plays extremly important role in his/her overall satisfaction with the end effect of the procedure.

Key words: Coronary artery bypass, radial artery, vascular grafting, quality of life.

1. Introduction

Because of the complexity of the heart surgery procedures, complications after RA harvesting might be a bit neglected or considered as less important. The aim of this study was to establish patient’s satisfaction after RA harvesting using the open technique, to identify frequency of complications, contentment with a scar, as well as to determine the general health state after surgery and its influence on the level of contentment with previous.

After unsuccessful early attempts in 70’s, radial artery was reintroduced in coronary artery surgery in 1992 by Acar [1]. According to the literature, endoscopic harvesting of the RA (radial artery) seems to reduce postoperative complications (with wound healing and symptoms due to the nerve injury) compared to the open technique [2]. It became more popular mainly because of the esthetic results (less of a scar), which may improve patient’s satisfaction. Still, there is no absolute consensus on this issue [3, 4]. On the other hand, open technique is very comfortable, visualization of the conduit is perfect, and it is not time consuming in the skilful hands. The open technique is also lesser costly, hence it is affordable in the majority of institutions [5].

The most serious complication after RA harvesting is forearm and/or hand ischemia [6]. Fortunately they are rare. According to Manabe et al. [7], severe hand ischemia was present in only 0.03% of cases. Some
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less dramatic complications, but still very uncomfortable for the patient are: local hematomas, wound infections and/or dehiscence, a permanent sensory loss in the certain areas of the forearm and/or the hand [8]. Additionally, the forearm and the hand are exposed body parts, and also active during almost the whole day, regardless of the occupation. For the patient’s life comfort, it’s very important to be asymptomatic after the surgery, as well as to have a good cosmetic result.

Frequency of the arm pain and numbness after the RA harvesting reported in the literature is surprisingly high. Three months after surgery, 16% of pts are reporting some of these complications [9]. After 12 months, the numbers go down to 8% and 12%, respectively [10], but this still cannot be considered negligible. Neurological complications, such as paresthesias (due to the nerve injury) are reported to be 13% and 7%, at 3 and 12 months [10], respectively. The occurrence of these symptoms is reported to be associated with: inappropriate surgical technique during the harvesting, a high EURO score, age, sex, body mass index, etc. [11]. In obese patients symptoms are more pronounced. In some studies [11] moderate association between patient’s EURO score, body mass index, age, history of TIA (transient ischemic attacks), problems with wound healing, and the persistent sensitivity disorders have been shown. Also, possibility to choose between endoscopic and traditional method [12], as well as age [11], was found to be of importance. Also, older patients paid less attention to cosmetic result. However, patients who had an option to choose the scar site (if there is no medical contraindication) were later completely satisfied with cosmetic result.

2. Materials and Methods

2.1 Materials

This was a retrospective study that included 102 consecutive patients. Inclusion criteria were: radial artery used as one of the grafts for myocardial revascularization and patient’s consent to participate. Five pts were lost in the study (one refused to participate and 4 pts passed away earlier than 6 months after surgery), so the study was carried out on 97 patients. Exclusion criteria were: CABG + concomitant procedures and non-elective procedures. We have checked Arcus palmaris before harvesting with ultrasound and Allen test. We have used VIO 200S Erbe diathermy machine, and electrocautery power level from 20 to 30 combined with clips. Radial arteries were harvested in a pedicle manner. Inform consent was given to and signed by all participants. The study has been carried out from April 2009 to October 2013 at the Dedinje Cardiovascular Institute, Belgrade, Serbia.

The following clinical characteristics were analyzed: arm mobility, arm pain, arm swelling, presence of sensory disorders in the forearm and/or hand, personal satisfaction with the scar, and the general health state. Data regarding clinical characteristics were collected using telephone questionnaire based on five Likert scale questions, not earlier than six months after the surgery. The patient could choose between the optional answers, presented in such an order as to make the best score and evaluation of every variable itself. For questions regarding arm swelling, arm mobility, sensory and neurological discomfort, answers were defined as: always, often, sometimes, rare and never, where always was regarded as 1 and never as 5. For questions regarding aesthetic result and general health state, answers were defined as: extremely weak, weak, acceptable, good and excellent, where extremely weak has been recorded as 1 and excellent as 5. Every parameter was analyzed separately.

2.2 Statistical Analysis

Descriptive and inferential statistics were used for data analysis in this examination. Absolute and relative numbers (n, %) were used to describe discrete, whilst mean with standard deviation (\( \bar{x} \pm \sigma \)), and
median with range (med (min-max)) for numerical data, depending on the distribution. Normal distribution was examined using mathematical (coefficient of variation; skewness and kurtosis; Kolmogorov-Smirnov and Shapiro-Wilk tests) and graphical methods (histogram; Q-Q diagram; detrended Q-Q diagram; box plot). For testing the association between two variables Spearman rank correlation coefficient was used. Level of confidence was \( \alpha = 0.05 \). The whole statistical analysis was conducted using software IBM SPSS ver. 21.

3. Results

The average age for the entire group was 57.84 ± 8.24 years, 89 pts (91.8%) being male. Mean and median scores for all clinical characteristics (pain, swelling, arm mobility, sensory and neurological discomfort, aesthetic result, and general health state) are presented in Table 1.

Constant presence of the arm pain was not reported, while 73 pts (75.3%) did not report any pain. Arm swelling was reported by 2 pts (2.1%). Rare or occasional problems in everyday motoric activities occurred in 4 (4.1%) and 3 pts (3.1%), respectively, whilst 90 pts (92.8%) were free of any symptoms. Sensory changes after the surgery occurred: always in 5 pts (5.15%), often in 4 pts (4.12%), sometimes in 13 pts (13.40%), rarely in 24 pts (24.7%) and never in 51 pts (52.6%). The esthetic result of the scar itself, 95 pts (95.9%) found at least acceptable, and by only 2 pts (2.1%) the result was judged as extremely weak.

One patient described his health state as extremely weak (1%), and 2 pts (2.1%) described it as weak. At least acceptable or better, was the result in 94 pts (96.9%): acceptable in 16 pts (16.5%), good state of health was reported by 43 pts (44.3%) and excellent

Table 1  Mean and median scores for clinical characteristics questionnaire.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answers (Likert scale from 1 to 5)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arm pain: Do you have any pain in your arm or forearm and hand?</td>
<td>Always, Often, Sometimes, Rare, Never, Always, Often</td>
<td>4.63 ± 0.71 5 (2-5)</td>
</tr>
<tr>
<td>Arm swelling: Do you have arm swelling?</td>
<td>Always, Often, Sometimes, Rare, Never, Always, Often</td>
<td>4.98 ± 0.14 5 (4-5)</td>
</tr>
<tr>
<td>Arm cosmesis: How do you consider the cosmetic result of the wound of your arm?</td>
<td>Acceptable, Good, Excellent, Always, Often, Sometimes, Rare, Never, Extremely poor, Poor</td>
<td>4.03 ± 0.95 4 (1-5)</td>
</tr>
<tr>
<td>Problems with arm mobility: Do you have any problem with arm mobility?</td>
<td>Always, Often, Sometimes, Rare, Never, Always, Often</td>
<td>4.87 ± 0.49 5 (2-5)</td>
</tr>
<tr>
<td>Sensory and neurological discomfort: Do you have any sensation as tingling, burning etc. in your arm?</td>
<td>Always, Often, Sometimes, Rare, Never, Always, Often</td>
<td>4.15 ± 1.13 5 (1-5)</td>
</tr>
<tr>
<td>General health state: Give a score to your general health after surgery?</td>
<td>Acceptable, Good, Excellent</td>
<td>4.19 ± 0.82 4 (1-5)</td>
</tr>
</tbody>
</table>
was reported by 38 pts (39.2%). Total of 81 out of 97 pts (83.5%) found it good or excellent—Fig. 1.

We had wound infection in one patient and we had no re-explorations due to hematoma problems.

Report of mobility, sensory or neurological discomfort, as well as of cosmetic result were in a significantly positive correlation ($\rho = 0.253; p = 0.004$) with a general health state ($\rho = 0.289; p = 0.012$). Patients with more frequent motor activity disorders also frequently have sensory problems. Patients with better general health state were also more satisfied with aesthetic results after surgery. Correlation matrix of all questions is presented in Table 2.

![Graphs showing various postoperative complications and patient satisfaction metrics.](image-url)

**Fig. 1**  Results of questionnaire presented in percentages per respective variables.
Table 2  Correlation matrix between all clinical characteristics (Spearman rank correlation coefficient).

<table>
<thead>
<tr>
<th>Clinical characteristic</th>
<th>Arm pain</th>
<th>Arm swelling</th>
<th>Arm cosmesis</th>
<th>Arm mobility</th>
<th>Sensory and neurological discomfort</th>
<th>General health state</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arm pain</td>
<td>1.000</td>
<td>0.105</td>
<td>0.151</td>
<td>0.039</td>
<td>-0.096</td>
<td>0.190</td>
</tr>
<tr>
<td>Arm swelling</td>
<td></td>
<td>1.000</td>
<td>0.101</td>
<td>-0.043</td>
<td>0.082</td>
<td>0.027</td>
</tr>
<tr>
<td>Arm cosmesis</td>
<td></td>
<td></td>
<td>1.000</td>
<td>0.116</td>
<td>0.007</td>
<td>0.289</td>
</tr>
<tr>
<td>Arm mobility</td>
<td></td>
<td></td>
<td></td>
<td>1.000</td>
<td>0.253</td>
<td>0.158</td>
</tr>
<tr>
<td>Sensory and neurological discomfort</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.000</td>
<td>-0.038</td>
</tr>
<tr>
<td>General health state</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.000</td>
</tr>
</tbody>
</table>

4. Discussion

4.1 Esthetic Satisfaction and Arm Pain

In general, complications after RA harvesting for coronary bypass using open technique are rare and mild. Also, patients’ satisfaction after surgery is usually reported as being high. The results obtained at our hospital were compared with the results reported by others [10], as well as with results achieved using more sophisticated endoscopic method [9].

In our study for questions regarding: arm pain, arm swelling, mobility and sensory problems median reported values were 5 (on Likert scale 1 to 5), whilst for esthetic satisfaction and general health state median reported values were 4, similar to the results of Arrigoni et al. [9]. Each and every variable separately had mean value above 4. In other study [13], esthetic satisfaction with small incision scar was high, but similar to our result (4.1 ± 0.4 vs. 4.1 ± 1.1).

In our study, constant arm pain was not reported at all, while 75.3% of pts never felt it. These results are in consistency with conclusions from the study of Arrigoni et al. [9]. In another study, arm pain was very mild 3 months after the surgery, and even milder 9 months later expressed by scores 17.5 and 13 (score from 1 to 100), respectively [14].

Esthetic result was at least acceptable for almost all patients (95.8%). Same result was reported in previously cited study, where 98% of pts were satisfied, and only 1.6% considered scar as extremely bad [9]. Very good cosmetic results were also reported by others, after using endoscopic technique [2, 15, 16].

One of the main reasons for using endoscopic way of harvesting radial artery is the smaller incision [17]. Given that 95.8% of our pts were satisfied with the open technique, a question arises should endoscopic harvesting be rightfully considered as a preferred method. Since the open technique is easier to perform, allows for easier defining the anatomic details, requires no sophisticated equipment, is less costly and, at the same time, as demonstrated in this study, pts are also very pleased with the results achieved with this technique, this technique should perhaps be given more credit.

4.2 Sensory and Neurological Changes

Indeed, in our study as many as 91.8% of pts have never had mobility disorder, a half of all pts (52.6%) have never experienced sensory or neurological discomfort, and just 5.2% reported to have it constantly. Some sensory and neurological complications occurred in 9 pts (9.3%), which is significantly less than 16.7% reported in Arrigoni study, using endoscopic method [9]. We achieved better result regarding any kind of sensory disorders, which occurred in 47.4% of pts, as opposite to 67.7% pts reported by Saeed et al. [18]. In another study neurological symptoms were present in 44% of pts [19], which is similar to our results (47.4%).

Neurological complications with the mean score result of 4.15 is not significantly worse compared to the result achieved in the study of Arrigoni et al. [9]. It is very interesting that the mechanism and manner in which sensory complications are caused is unclear. It might be the consequence of the nerve trauma during
the preparation, a part of the compartment syndrome or the compression from the hematoma. One study [11] shows mild correlation between these complications and high Euro score values, diabetes mellitus but stronger correlation with obesity. Patients with lower values of EURO score (who are mostly younger), have a faster recovery and they are well-aware of every sensory discomfort or a wound-site complication. They might be “more demanding”, so they need to be very well-informed beforehand, including even the option to choose the site of the graft harvesting eventually.

The results show that 5.2% of the patients have a constant sensory discomfort, and additional 4.1% frequently feel it. In the majority of cases these include tingling or numb sensations in the thumb, along the scar line and/or the wrist. In further conversation with the patients who experienced this kind of discomfort, asking about their general state of health, we found out the following: out of the 9 patients with some sort of sensory discomfort only 1 stated that his general health state was weak. This means that sensory complications of the forearm and the hand can be considered as minor complication. In other words, providing that everything else is good, majority of patients did not take this complication as a serious one. We assumed that patients who are highly dependent on the function of their hands such as craftsmen or artists may see such sensory disturbances as being more relevant than others, and we avoid using this conduit in these cases.

4.3 Arm Swelling and General Health State

Arm swelling was rarely present in 2 pts (2.1%), which was even less than after the endoscopic technique, where it was reported to be present in 12% of pts [20].

Health state was reported as acceptable by 13 pts (13.4%), good by 43 pts (44.3%), and excellent by 38 pts (39.2%). Only 3 pts (3.1%) reported extremely poor or poor health state. This result is better than 6.9% reported in another study [9].

In some cases (because the examination was based on the subjective experience of the patients), good state of health after the surgery may enhance the satisfaction with the wound-site scar. On the other hand, poor patient’s health state may reduce the esthetic contentment. This state is proved by the correlation between general health state and satisfaction with cosmetic result.

Myocardial revascularization is a kind of surgery that is a life-saving or life-extending procedure, and the aesthetic results of the surgery itself might be considered of less importance. However, cosmetic result and/or invasiveness of the applied procedure nowadays become very important issue [17]. But in the same time, ultimate goal-long term patency rate is surely the most important. Endothelial damage, vasoreactivity and histology of the radial artery after harvesting using any of the techniques have been reported to be similar [21, 22]. That is, of course, of extreme importance for the long term patency rate. In one study [23], respectable number of cases was reported, with a follow-up period longer than 5 years, but patency rates were not reported. In other studies [24, 25] patency rates were reported, but follow-up period was short. For the open technique more data are available in the literature [26, 27]. Excellent patency rates have been reported after a long follow-up periods [26-28]. Since the long term results, so far, are at least equal (if not superior) and complication rates, as well as esthetic result is (at least in our study) very good after using open RA harvesting technique, we believe that it should be equally appreciated and not put aside as the less desirable technique. This is particularly true for the countries and/or institutions with limited resources. Lately, even wealthier communities must be aware of the ever rising costs of the medical treatment and cut it whenever and wherever it is proved to be justified. We believe that this is one of the very good examples.

Finally, we must also mention that one possible
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downside of our study is the lack of a control group in which endoscopic harvesting would be used. Since this technique is not available at our institution our findings and main conclusion warrant further, more detailed comparative examination.

5. Conclusions

Open technique of the RA harvesting is accompanied by rare and mild postoperative problems such as arm pain, swelling, mobility problems, sensory and neurological complications. High degree of the patients’ contentment regarding esthetic result was achieved. Along with the issue of cost-effectiveness, we believe that a question for the need of a routine (or even frequent) endoscoping RA harvesting is more than appropriate. If there is no medical contraindication, adding an option to the patient to choose which hand (and/or leg) we should use for grafts harvesting, we can get even better results in terms of individual and esthetic satisfaction. This may further decrease the need to offer endoscopic RA harvesting and I would suggest to other researchers to repeat this research by using this methodology, I think that might be useful, no matter which method is preferable.

6. Funding Statement

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7. Conflict of Interest Statement

The authors whose names are listed on the title page certify that they do not have any conflicts of interest to declare.

References


[14] Holman, W. L., Davies, J. E., Lin, J. Y., Wang, Y.,


