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Assessment of hand functional efficiency and the role of physiotherapy in its improvement in patients after coronary artery catheterization via radial access

Abstract

Background

The incidence of cardiovascular diseases is increasing with age. One of the most common cardiovascular diseases is ischaemic heart disease, which is often manifested as the coronary artery disease. This disease is primarily diagnosed with the use of coronary angiography, which enables assessment of the coronary artery anatomy and location of stenosis, leading to the establishment of an adequate treatment method. Apart from pharmacological treatment, an invasive technique of so-called coronary artery revascularisation is often used. Both coronary angiography and revascularisation are usually performed via radial artery access. Although the access via radial artery is associated with a lower risk of complications and shorter hospitalisation, certain complications may occur, and patients point to resulting discomfort in the punctured limb.

As of this moment, there are not many studies on the presence of pain in the area of the punctured arm post arterial catheterisation from radial access. There are papers assessing the incidence of complications post puncture. Few of them, however, refer to the assessment of functional performance of the limb, complaints of pain, sensory deficits, or muscle weakness. There are no publications on the use of physiotherapy in the convalescence of the upper limb post puncture, either. Such parameters as muscle strength, range of movement, or pain sensation in the arm have an undoubted influence on the patient's functioning in everyday life.

Objectives

The main objective of this paper was to compare the functional performance of the arm after radial artery puncture with regard to selected (objective and subjective) parameters in the group of patients receiving physiotherapy as compared to subjects not undergoing physiotherapy. Moreover, the study also aimed to assess selected parameters of those undergoing physiotherapy, with regard to arm function after the procedure of cardiac catheterisation. In addition, another objective was to verify if patients after radial artery puncture had objective symptoms of arm dysfunction, or if there were subjective symptoms reported by patients, and if selected anthropomorphic factors and those related to the procedure of arterial puncture affected the complaints reported.

Material and methods

The study included 85 successive patients admitted to the Department of Cardiology, Hypertension and Internal Diseases of the Medical Faculty at the Medical University of Warsaw in Mazowiecki Bródnowski Hospital for the purpose of coronary angiography or coronary angioplasty in 2018 – 2021. All the patients who took part in the study gave their informed, written consent to the participation.

Inclusion criteria:

- age between 45 and 80;
- first radial artery puncture;
- no obvious complications right after the procedure with radial artery puncture;
- giving informed consent to the participation in the study.

Exclusion criteria:

- failure to meet the inclusion criteria;
- coagulation defects, renal failure, diabetes mellitus, neurological deficits, past injuries of arm and wrist, chronic diseases potentially impairing arm functional performance;
- mental disorders hindering an informed decision regarding the participation in the study;
- no written consent to take part in the study.

All the patients participating in the scientific programme were divided into two groups: the study group including subjects who after the procedure of radial artery puncture received a set of exercises to do at home on their own for the period of 14 days, and the control group who did not receive any exercises, but was managed according to the previous course of action. The study protocol provided for two visits of patients from both groups. The first visit took place in the hospital, after removing a pressure dressing within 24 hours of the procedure, and the second visit took place after 14 days of the procedure. At each visit, objective measurements were taken for all the patients, with the use of an authorial examination report, e.g. measurement of grip strength, measurement of the range of movement, measurement of the wrist circumference to assess swelling, and assessment of the occurrence of sensory deficits. Subjective patient sensations were also assessed with the use of an authorial survey. At visit II, each patient filled an additional QuickDASH questionnaire used for functional assessment of the upper limb subject to the procedure.

Statistical analysis

An analysis of numerical data compatibility with normal distribution showed that most of the studied features did not have this characteristics: therefore, non-parametric tests were selected for data comparison. The study used such descriptive statistics as: median, minimum and maximum, and box plots presenting those statistics. A non-parametric Mann-Whitney-U test was used to show differences in numerical values of the studied variables between the groups. A Wilcoxon signed-rank test was used in each group to analyse differences in the case of related features, e.g. by time interval between two measurements, in the case of visit I and II. The analysis of quantitative features was conducted with the use of chi-square test or, where numbers of observations in table cells were lower than 5, Fisher exact test. A McNemar test was used for comparison of paired sizes (dichotomous – yes/no or plus/minus). Statistical significance was set at $\alpha=0.05$, which was compared with results of the calculated value of test probability "p". Test analysis and calculations were made with the use of a statistical package MedCalc (v21 under licence of the Institute of Medical Information Technology and Telemedicine, Medical University of Warsaw).

The study received a positive opinion of the Ethics Committee at the Medical University of Warsaw – KB/109/2017 – 11 April 2017.

Results

Both groups (study and control) were comparable with regard to anthropomorphic features, sex, duration of hospitalisation and parameters related to the procedure of radial artery puncture. Anthropometric parameters and those related to the procedure did not show a significant effect on objective and subjective patient sensations. It was observed, however, that the female sex was significant for the improvement in the grip strength ($p=0.03$) and range of wrist movement ($p=0.003$).

Most objective parameters (grip strength, range of movement, swelling, sensory deficits) and subjective parameters (authorial survey) differed significantly between the punctured and non-punctured arm.

More than half (52%) of all the participants declared the occurrence of dysfunction in the punctured arm (46%), haematoma (27%) and complaints of pain (26%). 44% of the respondents stated that their arm performance decreased after puncture.

No significant differences were observed at visit I and II with regard to objective (wrist circumference, range of movement, grip strength, sensory deficits) and subjective (authorial survey) parameters between the study group and control.

The result of the QuickDASH questionnaire completed at visit II in the study group and control showed no significant difference between the groups. There was a tendency, however, to lower results in the responses of the study group.

It was observed that the range of wrist movement in the study group, with regard to all the movements measured, as well as the grip strength in the punctured arm were significantly improved at visit II as compared to visit I. It was also observed that the wrist circumference of the punctured limb was significantly reduced and sensory deficits disappeared in 24% patients at visit II as compared to visit I. It was also showed in the study group that significantly fewer subjects reported concern to use the punctured arm at visit II than at visit I. Statistical significance was also observed in the case of remission of any dysfunction and improvement in the performance of the punctured arm.

The control group revealed a significant improvement in the grip strength, range of movement except for adduction, and significant reduction in the wrist circumference at visit II as compared to visit I. Sensory deficits in the control group were not significantly improved at

visit II, when present at visit I. It was also revealed that significantly fewer people reported concerns regarding the use of the punctured arm at visit II than at visit I. Statistical significance was also shown for remission of any dysfunction and sensation of improved performance of the punctured limb at visit II as compared to visit I.

A significant improvement in the extension movement was observed at visit II as compared to visit I in the study group and control ($p=0.014$).

78% of patients in the study group and 61% of patients in the control group had improved grip strength in the punctured arm at visit II as compared to visit I. However, no statistical significance was observed between the groups. 12% of subjects from the control group and none from the study group showed decreased grip strength, and the difference was statistically significant ($p=0.02$). No significant difference were observed between the groups with regard to improved range of wrist movement, except for adduction movement ($p=0.013$).

No significant differences were revealed between the groups in the remission of sensory deficits, although improvement was observed in a higher number of subjects in the study group (20%) than in the control group (13%). An improvement in the parameter of swelling occurred in both groups and was not statistically significant.

A comparison of the results of the objective and subjective assessment of arm performance showed that both in the study and control group, improvement was significantly more often observed with regard to objective rather than subjective assessment.

Conclusions

- The female sex is significant with regard to the improvement in the grip strength and range of wrist movement.
- The punctured arm is significantly more often exposed to symptoms of dysfunction than non-punctured arm, and more than half of the patients report discomfort in the arm after puncture.
- Results of the QuickDASH questionnaire showed that the study group had a tendency for higher assessment of the performance of the punctured limb.
- Both the study and control group showed improvement in the objective parameters: grip strength, range of movement, sensory deficits, wrist swelling, and in the objective parameters of arm impairment post puncture, assessed at two visits. In the control group, no improvement was observed with regard to the adduction movement and sensory deficits.

- In the control group, a significant number of patients showed decreased arm strength at visit II as compared to visit I.
- In the study group, higher improvement was observed with regard to superficial sensation and range of movement, and the range of adduction movement was statistically significant.
- Certain dysfunctions (e.g. sensory deficits) were observed at visit II, while being absent in the assessment after arterial puncture, which shows the need for assessment in the post-procedure period (in the program – a 14-day period).

Improvement in objective examinations was more frequent than the one declared by the patient in the survey.