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QUALITY OF LIFE OF A PATIENT WITH PERSISTENT COMPLICATIONS AFTER SARS-CoV-2 INFECTION REQUIRING URGENT SURGICAL INTERVENTION – ENDARTERECTOMY WITH EMERGENCY ANGIOPLASTY OF AN INFLAMED, BLEEDING RIGHT INTERNAL CAROTID ARTERY (RICA) USING THE TRANS-CAROTID ARTERY REVASCLARIZATION (TCAR)

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SUMMARY

Background:

The purpose of this study was to determine the quality of life of a patient with persistent complications of SARS-CoV-2 infection requiring urgent surgical intervention – endarterectomy with emergency angioplasty of an inflamed, bleeding Right Internal Carotid Artery (RICA) by direct access via Right Common Carotid Artery (RCCA), known as Transcarotid Artery Revascularization (TCAR).

Case study:

A patient in her 60s was infected with the SARS-CoV-2 virus and contracted COVID-19 in March 2022, as confirmed by RT PCR antigen test. The infection was followed by short- and long-term complications, many of which can be linked to COVID. These include significant weakness persisting for months after the illness, rapid weight loss of 25 kg, sleep disturbances, chronic fatigue, severe dizziness, onset of diabetes, decrease in immunity with increased periodontal inflammation (including formation of a periapical abscess of a molar tooth) and secondary suppuration of the submandibular lymph nodes, one of which lying adjacent to the right internal carotid artery (RICA). This accumulation of symptoms led the patient to seek medical and neuropsychological help. Test using the Beck Depression Inventory (BDI) confirmed depression, with vegetative disorders being the most predominant. Eight months after undergoing COVID-19, the patient suffered a Transient Ischemic Attack (TIA). The accumulation of diseases (diabetes mellitus, stage III hypertension and TIA) had a dramatic impact on the patient's health, including life-threatening conditions. A vascular surgeon consulted the patient advised immediate surgical treatment: carotid endarterectomy. The urgency of the situation was exacerbated by bleeding during the operation from the operated, secondarily inflamed wall of the RICA (lying adjacent to the suppurated submandibular node). This prompted an emergency decision for an endovascular procedure: the implantation of a stent covered with waterproof material (peripheral stent graft). This was made by a direct access via puncture of the common carotid artery (RCCA) below the endarterectomy level (TCAR). The SF-36 questionnaire was chosen to measure health-related quality of life (HRQOL). The SF-36 results are presented in such a way that higher scores correspond to fewer complaints, indicating better health and higher quality of life. Before revascularization, the patient's HRQOL was found to be lower, which was related to the negative impact of long COVID, while after the procedure, the quality of life gradually improved in subsequent surveys. A significant difference was found in physical function, with a mean score of 66.0 ($p < 0.001$) compared to a score of 94.9 (± 9.4) for 100 age-matched healthy subjects. A similar result was found in the physical role ($p < 0.001$). The patient's overall quality of life score was 331.0 compared to a score of 578.0 (± 111.9) for age-matched normal healthy people.

Conclusions:

Better quality of life in patients with long COVID is an important therapeutic goal that can be achieved through comprehensive, multispecialty treatment for both physical and psychological conditions.

Key words: long COVID, depression, diabetes, TIA, CAS, CEA, SF-36, emergency, TCAR, HRQOL

INTRODUCTION

The terms health, health-related quality of life (HRQoL), and quality of life (QoL) are used interchangeably (Karimi et al. 2016). Given that these are three key terms in the literature, their appropriate and clear use is important (Estoque et al 2019). Health is defined by the World Health Organization (WHO) as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity¹. The WHO definition of health as complete wellbeing is no longer appropriate, however, given the rise of chronic diseases. Machteld Huber et al (2011) propose changing the emphasis towards the ability to adapt and self-manage in the face of social, physical, and emotional challenges. The definition of QoL, in turn, highlights the individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns². In turn, the concept of health-related quality of life (HRQOL) includes aspects of overall quality of life that can be affected by health, both physical and mental. At the community level, HRQOL encompasses resources, conditions, policies and practices at the community level that influence perceptions of health and functional status in the population. Assessing patients' functional status is an important process, and measuring patients' quality of life can lead to objectification of their health status (Karimi et al. 2016; Trystuła 2017).

The COVID-19 pandemic had a strong impact on HRQoL in many people who were infected with SARS-CoV-2 and survived COVID-19 (Mitrović-Ajtić et al 2022; Aknin et al 2021; Pačalska 2022). This is because their physical and mental health may have deteriorated in many respects, and consequently their HRQOL may have also changed. Patients with long COVID often have multiple symptoms that can adversely affect quality of life (Beck & Akseptijevich 2020; Di Toro et al 2021; Frontera et al 2021; Hayes et al 2021; Tenforde et al 2020; Yan et al 2021; Zhao et al 2021). In addition to pervasive fatigue, the symptoms that can significantly affect quality of life include:

1. cardiovascular,
2. musculoskeletal,
3. neurological,
4. psychiatric
5. hematological,
6. immunological,
7. renal,
8. gastrointestinal,
9. endocrinological (including symptoms related to diabetes).

The world's first study dedicated to understanding the impact of the COVID-19 epidemic on health-related quality of life (HRQOL) using the EQ-5D Question-

¹ The enjoyment of the highest attainable standard of health should be considered one of the fundamental rights of every human being, without distinction for race, religion, political belief, economic or social condition.

² <https://www.who.int/tools/whoqol>

naire was conducted in the general population in China by Ping et al. (2020). The questionnaires included demographic and socioeconomic data, health status, epidemic situation and the EQ-5D scale. The associations of all factors and EQ-5D scores were analyzed. A logistic regression model was applied to the five dimensions of health. The respondents had a mean EQ-5D index score of 0.949 and a mean VAS score of 85.52. The most frequently reported problems were pain/discomfort (19.0%) and anxiety/depression (17.6%). Logistic regression models showed that the risk of pain/discomfort and anxiety/depression among people who were aging, had chronic diseases, lower incomes, effects of epidemics, and concerns about contracting COVID-19 significantly increased. This article provided important evidence on HRQOL during the COVID-19 pandemic. The risk of pain/discomfort and anxiety/depression in the general population in China was significantly increased among the elderly with chronic diseases and fears of contracting SARS-CoV-2 during the COVID-19 pandemic and the aftermath of contracting the disease.

COVID-19, as noted by many specialists (Aknin et al, 2021; Morga et al, 2023; Esendağlı et al, 2021), affects HRQOL not only in the acute stage, but also in the chronic stages of this infectious disease. These are defined according to NICE guidelines, which include acute and chronic stages of the disease (cf. Oronsky et al., 2023), such as:

- Acute COVID-19 (Acute COVID-19): presence of signs and symptoms of COVID-19 from onset to 4 weeks;
- Ongoing Symptomatic COVID-19: presence of signs and symptoms of COVID-19 between 4 and 12 weeks;
- Post-COVID -19 syndrome (PCS): the presence of signs and symptoms of COVID-19 that last longer than 12 weeks and cannot be explained by another diagnosis;
- Long COVID-19 (long-COVID-19): refers to the association of signs and symptoms both ongoing and following COVID-19.

Líška et al. (2022) indicate that many patients have prolonged and diverse symptoms after COVID-19 infection, which may affect their health-related quality of life (HRQOL). These authors, studied patients with prolonged COVID compared to healthy controls using the SF-36 questionnaire. The results confirmed that patients with prolonged COVID had a lower quality of life compared to healthy controls, which was related to the negative impact of prolonged COVID. A significant difference occurred in physical function, with a mean score of 94.9 (± 9.4) for control subjects, compared to patients with long COVID with a mean score of 66.0 ($p < 0.001$). A similar result was found in the physical role ($p < 0.001$). The overall quality of life score for controls, was 578.0 (± 111.9), and the overall score for patients with long COVID was 331.0. The lower HRQOL in patients with long COVID is an important therapeutic target that requires attention.

The mechanisms underlying long COVID are still largely unknown (Nabavi and Long COVID 2020; Sudre et al. 2021; Proal et al. 2021). Risk factors for long COVID-19 are inconclusive, but several potential risk factors have been identified

(Ziauddeen et al. 2022). The risk of long COVID-19 is twice as common in women as in men (Nabavi and Long COVID 2020). Increasing age is a risk factor. The presence of more than five symptoms in the acute phase of the disease is associated with an increased risk of developing long COVID³. The presence of comorbidities also increases the risk of developing long COVID.

Particular changes in HRQOL may occur in those patients who have developed new illness in a short period of time and have had a simultaneous aggravation of multiple pre-existing conditions. Many of these can be classified as the effect of long COVID-19. Disorders associated with a variety of often incomprehensible somatic symptoms, especially pain and/or confusion dramatically increase fear, anxiety and other emotional changes, significantly reducing the patient's quality of life. An additional, one extremely negative factor is being told by the treatment team that surgery is required. The accumulation of various somatic conditions also increases the difficulty of making a proper, comprehensive diagnosis, and secondarily makes it more difficult to undertake effective, often complex, treatment (Paçhalska 2022).

An example of these problems will be the patient presented in this case study, who developed short-term and long-term complications after suffering from SARS-CoV-2 and COVID-19, many of which can be linked to this viral infection. Each of these diseases, which could be treated in a low-stress, cumulative manner - caused a dramatic impact on the patient's health, including life-threatening. It was necessary to decide on immediate treatment – carotid endarterectomy. Situation was rendered even more urgent by bleeding from the operated inflamed RICA, laying adjacent to the suppurated submandibular node. This necessitated an immediate angioplasty with implantation of stent, in this case covered with a waterproof material – the Peripheral Stentgraft.

The purpose of this study was to determine the quality of life of a patient with persistent complications of SARS-CoV-2 infection requiring urgent surgical intervention - endarterectomy with emergency angioplasty of an inflamed, bleeding Right Internal Carotid Artery (RICA) by direct access via Right Common Carotid Artery (RCCA), known as Transcarotid Artery Revascularization (TCAR).

CASE STUDY

The patient, 60 years old, a single, woman living alone, with a master's degree in sociology, with no chronic illnesses to date, became infected with SARS-CoV-2 and contracted COVID-19 in March 2022. Her first symptoms were an increased cough, shortness of breath and a fever of up to 39 degrees Celsius. The presence of SARS-CoV-2 virus was confirmed by RT PCR antigen test. Eight months after passing this disease, the patient rapidly lost weight by about 25 kilograms, at which time she did not go for periodic checkups, as she associated

³ Attributes predictors of Long-COVID: analysis of COVID cases their symptoms collected by the COVID Symptoms Study App. medRxiv. (2020). Available online at: <https://www.medrxiv.org/content/10.1101/2020.10.19.20214494v2>

Fig. 3. Assessment of the patient's health-related quality of life (HRQoL) across eight spheres of the SF-36. The four bars show sequentially the mean score obtained in study I (before revascularization), study II (two weeks after revascularization), study III (3 months after revascularization) and study IV (6 months after revascularization)

Symptoms	Component		KMO	Bartlett's test	Correlation matrix
	Factor 1	Factor 2			
Changes in sleep patterns	0,92	-0,01	0,79	$\chi^2 = 102,812; df = 10;$ $p < 0,001$	0,06
Strong irritation	0,85	0,14			
Changes in appetite	0,75	0,15			
Difficulty in focusing attention	0,93	-0,19			
Tiredness	0,03	0,98			

the weight loss with periodic stress and decreased appetite. When her symptoms worsened and there were changes in her sleep patterns (sleep inversion, the patient slept during the day and did not sleep at night), increased irritability, difficulty concentrating attention and significant fatigue, she sought psychological help. Tests using the Beck Depression Scale (BDI) confirmed the presence of depression, with vegetative disorders being the most dominant (see Table 1).

Eight months after undergoing COVID-19, the patient suffered a Transient Ischemic Attack (TIA). After the episode, she was stressed and had a significant reduction in quality of life. At this time, her periodontal inflammation also worsened, and due to the formation of a periapical abscess of a mandibular molar, there was significant enlargement and inflammation of the submandibular lymph nodes. The inflammatory infiltration of one lymph node spread to the surrounding soft tissues, causing inflammation of the initial segment of the RICA. It is also likely that this inflammatory infiltrate provoked the expansion of a thrombus within the internal carotid artery pad of the internal carotid artery, resulting in symptoms of TIA. The patient was admitted to the Department of Vascular Surgery and Endovascular Interventions at the St. John Paul II Hospital in Kraków with urgent indications and after preparation was qualified and underwent surgical treatment. Due to the presence of a large, critically stenosed, heavily calcified, ulcerated, thrombus-ridden atherosclerotic plaque, the patient was disqualified from angioplasty with stent implantation so that the thrombus would not be released during guidewire and stent guidance through the stenosis of the plaque and cause another stroke. Prior to the procedure, there was no information about inflammation/proliferation of the carotid arteries and lymph node in the carotid region, and the ultrasound-Doppler examination was mainly focused on assessing flow in the carotid arteries.

Description of the procedure

The procedure was performed under general endotracheal anesthesia. A transverse incision was made on the right side of the neck in the skin fold. The right common carotid artery (RCCA), external carotid artery (RECA) and internal carotid artery (RICA) were reached and dissected posteriorly from the jugular vein.

Enlarged, inflamed, disintegrating lymph nodes were found in the submandibular region, two of which were collected for microscopic and bacteriological examination. Further vessel preparation was obstructed. A long (ca. 2.5 cm), heavily scaled atherosclerotic plaque was found in the RCCA, RICA and RECA divisions, with ulceration and smear-like contents, along with thrombus at the site of plaque disintegration. At this level, the lumen of the vessel was threadlike, which disqualified the patient for angioplasty with stenting. The decision was made to perform a classical endarterectomy (from a longitudinal cut of the RCCA-RICA), because of the high level of the division of the RCCA), using collateral flow (shunt) and a vascular patch. After administering 5,000 IU of Heparin intravenously, tourniquets were placed and clamped on the vessels involved (in this order: RECA, RCCA, RICA), and the RECA, the RICA and RCCA were incised along the axis of the vessels. A shunt was inserted into the RICA and RCCA. The jamming time was 3 min 10 sec. An endarterectomy of the RICA and RCCA over a length of about 5 cm was then performed. It turned out that the proximity of the inflamed lymph nodes had caused softening of the secondary inflamed wall of the RICA and RCCA, due to the underlying inflamed lymph node. As a result, during the suturing of an antibacterial silver salt-coated vascular patch (Hemapatch Silver Knitted Ultrathin), the vessel wall was systematically abraded, and blood was spilled over the entire area of the vessel from which the atherosclerotically altered inner lamina of the artery had been removed. Repeated attempts to seal the anastomotic line in the upper section of the RICA patch were unsuccessful. The vessel jamming time after shunt removal for complete (but ineffective) seal, with no suturing, came to about 3 min. Declamping was done in the order: RECA-RCCA-RICA. Attempts to achieve tightness through additional layers of sutures with fascial patches were unsuccessful. Successive stages of carotid endarterectomy are presented in Fig. 1.

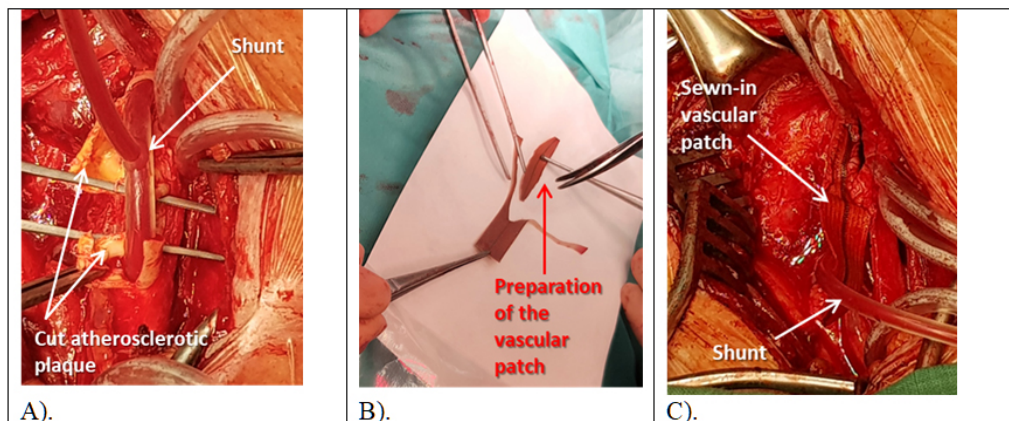


Fig. 1. Successive stages of carotid endarterectomy: A) During removal of atherosclerotic plaque from RICA, with the presence of a RICA-RCCA shunt, B) Preparation of the vascular patch, C) Suturing a vascular patch with a shunt inserted into the RICA and the RCCA

Through all the time after blood flow was restored through the RCCA and RICA, bleeding from these vessels persisted. Therefore, ad hoc, the patient was qualified for an endovascular procedure: angioplasty with implantation of a stent covered with waterproof material (peripheral stent graft), which offered the chance to seal the vessel from access through a vascular port inserted much lower into the common carotid artery, a technique known as TransCarotid Arterial Revascularization (TCAR).

With the bleeding vessel covered by a finger to minimize bleeding, the RCCA was punctured, about 5 cm below the level of the vascular patch suture. A 6-F

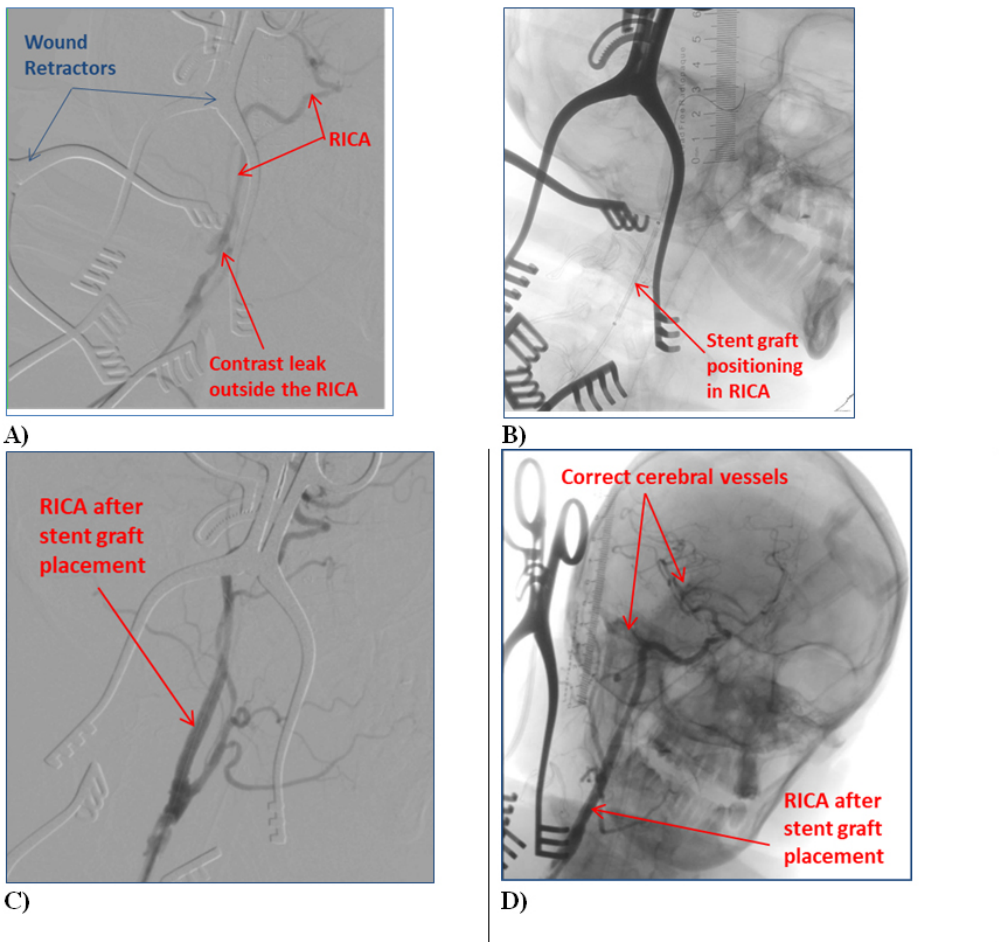


Fig. 2. Angiographic image of the next steps in the patient's surgery: A) RICA angiography through an introducer inserted into the RCCA. Visible contrast leakage from the RICA, B) Stent graft positioning in the RICA, C) RICA angiography after stent graft placement. No contrast leakage is visible and the full lumen of the vessel has been restored, D) Right hemisphere angiography. No defects in the contrast of the cerebral vessels

introducer was inserted. Through it, under angiographic control, along a 0.018" guidewire, a peripheral stent graft (Bentley; BeGraft Peripheral Stent Graft System; 6x38 mm) was inserted and seated. Complete hemostasis was achieved, and angiographic control showed full RICA tightness, i.e., no contrast leakage outside the arterial lumen. Cerebral angiographic examination ruled out the presence of congestion in the cerebral arteries. Sutures were placed on the muscles and subcutaneous tissue of the neck with a Vicryl 4-0 suture, and the epidermis with Prolene 4-0. A Redon drain was placed at the bottom of the wound from a separate skin incision. A medical wound plaster was applied. Angiographic image of the next steps in the patient's surgery is presented in Figure 2.

Due to the presence of an advanced bacterial infection (periapical abscess, purulent inflammation of submandibular lymph nodes), the patient had already been given a broad-spectrum antibiotic (Clindamycin) during the procedure, especially since two "foreign bodies" were left in the operated site: an antibacterial vascular patch coated with silver salts (silver acetate), which was sewn into the RICA-RCCA incision, and intravascularly, a stent covered with waterproof material (peripheral stent graft). Both of these foreign bodies, without antibiotic treatment, could have become superinfected with severe long-term consequences for the patient in the form of suppuration, bleeding, stroke and even death from exsanguination. The appearance of the neck after the wound had been sutured is shown in Fig. 3.

To emphasize the critical urgency of the situation, it should be added here that the entire angioplasty (TCAR) procedure was carried out while holding the bleeding internal carotid artery with a finger to minimize blood loss. The procedure could be performed thanks to the hybrid operating room's equipment for en-

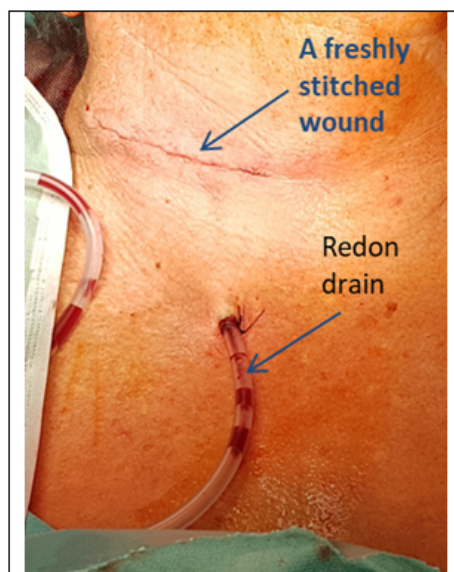


Fig. 3. Appearance of the neck after suturing of the wound

dovascular procedures (fig. 4) and the operating vascular surgeon's experience in performing both such procedures, i.e. open and endovascular.

Health-related quality of life assessment (hrqol)

The assessment of health-related quality of life (HRQoL) was based on the SF-36 Quality of Life Survey (in eight SF-36 spheres) validated to assess HRQoL in post-TIA and post-stroke patients, as well as in patients with critical carotid artery stenosis undergoing revascularization (Trystula 2017; Pačalska & Trystula 2020). Scores for the SF-36 range from 0-100; a difference of 5-10 points is considered a clinically significant change for an individual, while smaller differences may be important for group comparisons. In the current study, SF-36 scores are presented in a way in which higher scores correspond to fewer complaints, indicating better health and higher quality of life (Trystula, Tomaszewski, Pačalska 2019). The patient's results are illustrated in Fig. 5. In study I (before revascularization), the patient was found to have a reduced health-related quality of life across all eight spheres of the SF-36. Study II, conducted two weeks after critically narrowed carotid revascularization, showed significant improvement in HRQoL compared to study I. This improvement was associated with a significant reduction in complaints about both mental and physical health. In study III, after 3 months, there was a further increase in the HR-QoL score. In study IV, six months after surgery, there was a further significant improvement in HRQoL, which was statistically significant compared to baseline in study I and study II, 2 weeks after revascularization.



Fig. 4. The new hybrid operating room's equipment for endovascular procedures at the St. John Paul II Hospital in Kraków

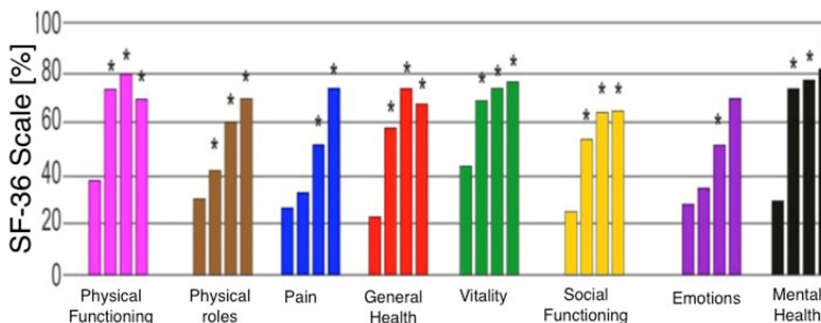


Fig. 5. Assessment of the patient's health-related quality of life (HRQoL) across eight spheres of the SF-36. The four bars show sequentially the mean score obtained in study I (before revascularization), study II (two weeks after revascularization), study III (3 months after revascularization) and study IV (6 months after revascularization)

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The patient in the initial period after revascularization was in euphoria, emphasizing that she had not expected to survive. However, she reported slight difficulty swallowing and slight neck pain, which disappeared after about 7-10 days. There was also a change in phonation (quieter, hoarse speech), caused by temporary paresis of the laryngeal retrograde nerve.

The patient did not complain about this postoperative complication which subsided after three months. She was very glad because of the improvement of walking skills, which can probably be attributed to improvement in brain blood supply after RICA revascularization, which had a positive effect on her quality of life. Six months after the procedure, the patient reported being much more vital.

DISCUSSION

The main objective of our study was to determine the quality of life of a patient after endarterectomy followed by emergency intraoperative implantation of a peripheral stentgraft into an inflamed bleeding internal carotid artery with direct access through the common carotid artery (TCAR).

Of course, surgery is associated with the course of SARS-CoV-2, COVID-19 and the accumulation of symptoms shortly after the end of the acute phase of the disease, including chronic fatigue, dizziness, sleep disorders, diabetes and hypertension of the third degree, worsening of periodontal inflammation with the formation of a periapical abscess and suppuration of lymph nodes and TIA. This had a dramatic impact on the health of the patient, including a possible fatal outcome. It was necessary to make decisions about surgical treatment immediately. The urgency of the situation was aggravated by the

intraoperative finding of inflammation of the RICA wall with subsequent bleeding through its inflamed wall after the endarterectomy. As a result, it was necessary to use rarely used and more complicated methods of surgical procedure, requiring appropriately technologically advanced equipment and the multifaceted skill set of the treatment staff.

It is therefore important to point out the difficult conditions that have affected this patient with long COVID in terms of quality of life. We observed a reduction in quality of life (HRQoL) in all parameters monitored in our study, compared to a healthy control group. The control group was selected to show that our patient, with long COVID, like other patients studied around the world (cf. Nabavi and Long 2020; Sudre et al. 2021; Proal et al. 2021; Ziauddeen et al. 2022), suffers from a lower quality of life. This serious diagnosis is often underestimated, so it is important that we point out that before revascularization, the average quality of life scores of our patient were much lower than in 100 people from her age norm. After revascularization, she has shown gradual improvement and half a year after the procedure, the HRQOL results of our patient are within normal limits compared to 100 people from her age norm.

SARS-CoV-2 infection and COVID-19 have a devastating effect on human beings (Wilson et al., 2020; Aknin et al., 2021; Paçhalska 2022) and their HRQOL (Ping et al. 2022). It also destroys the system of self, destabilizing their biological, cognitive, social or cultural selves in various people (cf. Paçhalska 2022). Such a patient's condition is a burden on the health care system, society and economy, and requires various treatment programs and help, as well as health care system (Wu et al., 2020).

The long-term symptoms of COVID-19 can have a devastating effect (Aiyegbusi et al. 2021:5). Persistent symptoms in patients with prolonged COVID-19 lead to reduced quality of life for patients. The subjective persistence of symptoms, such as fatigue in patients, may affect aspects of quality of life, such as physical functioning, body pain, vitality, emotional health, and social functioning, which are significantly lower in COVID patients compared to a healthy control group (Daines et al. 2022). Patients experienced a significant decrease in social functioning, which may indicate a reduced interest in engaging in normal life as a result of the disease (Desai et al. 2022).

CHRONIC FATIGUE AND QUALITY OF LIFE

The chronic fatigue our patient felt is a common symptom of long-term COVID and is also often reported after overcoming COVID-19. It is worth noting that the fatigue she experienced was greater than normal fatigue after exercise. The patient described this fatigue as a constant state of exhaustion that reduces energy, motivation and concentration. Such a condition of the patient, as also noted by other authors, can have a significant impact on the quality of life. Chronic fatigue can negatively affect all aspects of quality of life (Duan & Zhu 2020).

Post-covid diabetes and quality of life

Lima-Martínez et al. (2021), found that diabetes is one of the most common comorbidities in people with COVID-19, with a prevalence ranging from 7 to 30%. Diabetics infected with SARS-CoV-2 have higher rates of hospital admissions, severe pneumonia, and higher mortality compared to those without diabetes. Chronic hyperglycemia can impair innate and humoral immunity. In addition, diabetes is associated with low-grade chronic inflammation, which promotes the development of an excessive inflammatory response and thus the appearance of, for example, acute respiratory distress syndrome. Recent evidence has shown that SARS-CoV-2 can also cause direct damage to the pancreas, which can worsen hyperglycemia and even trigger diabetes in people who have not previously had it. Therapeutic strategies should aim to facilitate patients' access to the health care system.

Control of blood glucose and comorbidities must be individualized to reduce the incidence of complications and reduce the burden on health systems. The authors reviewed the pathophysiological mechanisms that explain the bidirectional relationship between COVID-19 and diabetes, its impact on the prognosis and treatment of hyperglycemia in this group of patients. One can also add that metabolically decompensated type 2 diabetes adversely affects not only the course of COVID-19 infection, but by imposing changes in immunity in the course of diabetes on changes in immunity in the course of SARS-CoV2, it has a negative impact on all inflammations in the body, especially those of an infectious nature. After COVID-19, this type of diabetes may worsen and require verification of treatment and insulin therapy. Pediatricians are raising the alarm about the emerging epidemic of type 1 diabetes in children after COVID-19, which is related to autoimmune disorders (Zajac, 2023).

Increased stress and quality of life

Most publications on COVID-19 and mental health emphasize that increased stress can persist in patients both during infection and even after overcoming infection, and it is well known that stress negatively affects quality of life (Alexopoulos et al. 2014; Khodami 2022; Parsaei et al. 2020; Ribeiro et al. 2018 42-46; Silva et al. 2017). Psychological stressors are a public health problem. The body's response to stress is attributed to the activity of several axes, such as the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic adrenal-renal circuits (Smith & Vale 2006; Silva et al. 2017). Stressful life events, including the struggle with the SARS-CoV-2 virus, can affect the functioning of the neuroendocrine and immune systems, physical and mental well-being, and thus the quality of life.

Pain conditions and quality of life

Patients with long COVID may experience multiple pain conditions (van Kessel et al. 2022, Carfi et al. 2020; Proal et al. 2021; Crook et al. 2021). It is possible that there was bias in our study due to the age of the patients compared

to the age of the healthy control group. According to Yeziarski et al. (2012), the increase in pain sensitivity under various experimental conditions can be explained by age-related anatomical, physiological, and biochemical changes, resulting in compensatory changes in homeostatic mechanisms and the intrinsic plasticity of somatosensory pathways involved in pain processing and perception. In the case of this patient, in whom, a priori the level of anxiety was higher than in other people because of her loneliness and lack of support. The dependence of the level of pain sensation on the level of anxiety has been described many times. We know that the threshold for pain is lowered with increased anxiety (cf. also Crook et al. 2021).

Perception of patients by the environment and quality of life

Another negative factor that may contribute to a lower quality of life in patients with long COVID is the perception of patients by the social environment. Patients' symptoms are often simplified due to the lack of clear diagnostic methods. The trivialization of symptoms by the environment, as well as by medical staff, can lead to increased anxiety and a decrease in the overall quality of life in patients with long COVID. Patients' symptoms are often simplified due to the lack of clear diagnostic methods. Trivialization of symptoms by the environment, as well as by medical staff, can lead to increased anxiety and a decrease in the overall quality of life in patients with long COVID. Studies have shown that patients with long COVID had a lower quality of life. This indicates the need to improve the quality of life of patients with long COVID. It is necessary to study different methods of treatment in order to improve the state of health and quality of life of patients. Lack of long-term COVID treatment can further contribute to a worsening of quality of life. Long-term COVID-related health services are growing, but there are no randomized trials on how to improve patients' quality of life. Specialized centers have been set up in some countries, and calls have been made worldwide for the development of rehabilitation programs and services for patients with long COVID (Macpherson et al. 2022).

Studies have shown that women with COVID-19 were 3-5 times more likely to experience anxiety/depression and negative impact on their usual activities 5 months after diagnosis (van Kessel et al. 2022). At the same time, reduced mobility was 3-4 times more likely in older COVID-19 patients whose levels of pain and discomfort increased. Lonely patients, low-income individuals, and those with severe clinical outcomes were 2-4 times more likely to limit their usual activity, while the presence of comorbidities and lower levels of education were associated with increased pain and discomfort. Age-induced pain/discomfort and anxiety/depression were significantly increased in elderly patients with widespread vaccination (Proal et al. 2021).

How a patient with critical carotid stenosis that caused transient ischaemic stroke (TIA) could have been helped

Stroke is the second leading cause of death worldwide, with an annual mortality rate of about 5.5 million people. The burden of stroke is not only high mor-

tality, but also high morbidity, which causes up to 50% of stroke survivors to be chronically disabled (Trystuła & Pačalska 2019; Pieniżek et al 2008, 2009; Musiałek et al. 2016; 2017). One of the causes of stroke is critical stenosis of the internal carotid artery, a symptom that greatly increases the risk of recurrence of TIA or even full-blown stroke (Katzan et al. 2021). The co-occurrence of these two disease entities, namely critical stenosis of the internal carotid artery and TIA, was also observed in our patient.

Although the primary symptoms of TIA by definition disappear completely within 24 hours, numerous studies have shown that patients complain of various secondary symptoms, including depression (El Husseini et al. 2012), fatigue (Winward et al. 2009), cognitive impairment (van Rooij et al. 2016), and reduced HRQOL (Coutts et al. 2012). These results have been interpreted as suggesting that TIA patients have residual mental and physical adverse effects after the event (Moran et al. 2014, 2015; Turner et al. 2016; Trystula and Pachalska 2019)..

Qualification for urgent surgery, as in the case of the patient described here, is determined by the degree of stenosis and its symptomatic character; on the scale of severity, this includes TIA, temporary loss of vision in one eye (amariosis fugax), and ischemic stroke. It is believed that patients whose internal carotid stenosis is above 70% will experience a stroke on this side within two years (Hingwala et al 2013), and qualification for surgery in the case of symptomatic stenosis may apply to as many as 50%, especially in the case when the atherosclerotic plaque has an irregular shape, is long and extensive or features of plaque ulceration are found within it (Trystuła 2017). Patients such as ours should be offered radical treatment of the cause, i.e. internal carotid revascularization.

At present, in our armamentarium we have three different methods, the use of which depends on the morphology of the plaque, the age of the patient, comorbidities, anatomical conditions (strongly calcified plaque, presence of fresh thrombi in the internal carotid artery, high division of the common carotid arteries, obstruction of the iliac or aortic arteries and subclavian arteries) as well as the patient's personal belief in how to solve the problem (Friedman, 2014):

The oldest method is internal carotid endarterectomy (CEA), i.e. surgical removal of atherosclerotic plaque and thrombi, from a longitudinal incision of the carotid arteries, with subsequent reconstruction of the wall continuity, and when the diameter of the vessels is too small, also with sewing a patch from the vascular prosthesis. It is not entirely clear who carried out the first ever successful carotid endarterectomy, or when. Michael DeBakey stated that he accomplished this in 1953, although he did not publish it until 1975. According to Denton Cooley, however, he was the first to perform a successful procedure in 1956 at Methodist Hospital in Houston, Texas (Friedman, 2014). This method has been modified by cutting off the internal carotid artery from the common carotid artery and removing the atherosclerotic plaque by eversion of the internal carotid artery wall (eversive method). After cleaning the wall of atherosclerotic lesions, the internal carotid artery is sawing back into the common carotid artery (see also: Trystula 2017).

A second very popular method for several years has been percutaneous internal carotid angioplasty with stent implantation (Carotid artery stenting, CAS), with access through the common femoral artery or radial artery (Dabrowski et al 2003; Pieniasek 2008; Cho et al 2018; Lamanna et al 2019; Dzierwa et al 2019). Several randomized controlled trials have compared CEA to CAS in the treatment of carotid artery stenosis. These studies have suggested that CAS is more strongly associated with periprocedural stroke; however, CEA is more strongly associated with myocardial infarction. Published long-term outcomes report that CAS and CEA are similar. A reduction in complications associated with CAS has also been demonstrated over time (Trystuła et al. 2019). The symptomatic status of the patient and history of previous CEA or cervical radiotherapy are significant factors when deciding between CEA or CAS. Numerous carotid artery stents are available, varying in material, shape and design but with minimal evidence comparing stent types (Lamanna et al 2022).

The latest method, which is hybrid in nature, is a combination of open and endovascular methods, i.e. internal carotid angioplasty with access through a common carotid artery, i.e. Transcarotid Carotid Artery Revascularisation (TCAR) (Trystuła and Musiałek 2020; Sujjantararat et al 2022). This technique is particularly valuable in patients in whom there is no possibility of endovascular access through the femoral artery, common or radial artery (Leriche syndrome - obstruction of the iliac arteries and/or aorta and additionally obstruction of the subclavian arteries). It is believed that regardless of the access (femoral or through CCA) for carotid angioplasty procedures, the best anti-embolic protection of the brain is the use of flow reversal in the ICA and a double-layer anti-embolic stent (Musiałek, 2016; 2017; Pieniasek, 2008; 2009).

In the case here, in the second stage of the procedure, there was no requirement to use any brain protection, either distal (filter), or proximal (flow reversal). The embolic material that could cause cerebral embolism had already been removed during endarterectomy (CEA). During its performance, brain protection was also applied by setting up a shunt supplying blood to the brain. In turn, the use of a stent, even a two-layer mesh-stent, was not justified, because it would not close the leak from puncture sites and the surface of the RICA wall that was devoid of intima (togetherwith the atherosclerotic plaque). Only the use of a stent covered with waterproof material could give the effect of obtaining tightness. In addition, the situation was unique and required a quick decision and a short time to implement it. Implantation of the peripheral stent graft through the RCCA puncture made it possible to achieve this goal.

Modern vascular surgery centers should have surgical skills in all three methods and appropriate technological capabilities (angiograph for intraoperative imaging of arteries). As can be seen in the example shown, it is important to be able to use each of the treatments listed above, as they may be complementary, especially in emergency situations, it can be crucial for the patient's survival and faster recovery (see also: Trystuła 2018; Trystuła and Paçhalska 2019; Trystuła et al. 2019). An example of this claim is our patient, in whom only the use of the

hybrid method allowed us to obtain an optimal therapeutic effect and, consequently, improve her quality of life.

CONCLUSIONS

Better quality of life in patients with long COVID is an important therapeutic goal that can be achieved through comprehensive, multispecialty treatment for both physical and psychological conditions.

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