1) Impact of Carotid Artery Stenosis on Quality of Life: a systematic review.

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Abstract

Objectives: The aim of this study was to identify themes that determine health-related quality of life (HRQoL) in patients with carotid artery stenosis and identify the patient-reported outcome measures that best cover the identified themes.

Methods: A systematic review of the main six databases from inception to September 2018 was undertaken to identify primary qualitative studies reporting on the HRQoL of patients with carotid artery stenosis. Quality of studies was assessed using the CASP criteria. Findings from the included studies were analysed using Framework Analysis methodology. The identified themes were mapped against the items/domains from the patient-reported outcome measures used previously in patients with carotid artery stenosis.

Results: The systematic review identified four papers that fulfilled the inclusion criteria. The included papers reported the views of sixty-two patients with symptomatic carotid artery stenosis; twenty-four of the patients were awaiting assessment for intervention, twenty-six had carotid endarterectomy and twelve were turned down for intervention and received best medical therapy. The overall quality of the included studies was good based on CASP criteria. Framework Analysis identified sixteen themes that were divided into six main domains: anxiety, impact on physical activity, effect on independence, impact on personal roles, psychological impact and symptoms. The best fit generic and disease specific PROMs were the Short-Form 36 (SF-36 ®) and the Carotid Stenosis Specific Outcome Measure (CSSOM) respectively. None of the PROMs covered all the themes identified in the qualitative systematic review.

Conclusion: The findings from the review identified the important themes that affect patients with carotid stenosis disease. The current generic and disease specific patient-reported outcome measures do not cover all themes that impact the HRQoL of patients suffering with this disease. The proposed themes can be used to develop a new disease specific PROMs to measure HRQoL.

Key Points

Carotid artery disease is the main cause of stroke; some patients with this disease can benefit from surgical intervention to reduce the risk of future stroke.

Understanding and measuring quality of life in these patients can guide intervention decisions.

This systematic review provides detailed overview of the impact of this disease on quality of life

Introduction

Carotid artery stenosis (CAS) is a major cause of stroke, accounting for about 20% of all cases **(1-2)**. It is caused by either carotid artery lesion thrombosis or embolism this lesion.

Patients with CAS can be asymptomatic or present with transient ischaemic attack (TIA) or stroke. Evidence shows that patients who present with disabling stroke with previous evidence of CAS can benefit from preventive procedures including carotid endarterectomy (CEA) and stenting **(3-10)**; however, these procedures are not risk free and can be complicated with perioperative stroke. The symptoms and the uncertainty of outcome can impact the daily living of patients with CAS. Therefore, several clinical studies that investigated the efficacy and safety of different preventative interventions used patient-reported outcome measures (PROMs) to investigate the impact of the disease and treatment on health-related quality of life (HRQoL). However, due to a lack of validated PROMs they either used generic PROMs **(11-14)** or developed and used questionnaires without validation **(14)**.

Patients presenting with symptomatic and asymptomatic CAS need support to choose the best treatment strategy to help reduce their risk of stroke and improve their HRQoL. Patients' experience of disease and impact of treatment is a major indicator of quality and it is only through better understanding of the impact of the disease on HRQoL that PROMs can be developed. It is argued that PROMs, when designed carefully (e.g. based on input from patients' experiences), can measure the issues of most importance to patients and any

changes to their HRQoL because of the disease or as consequence of the treatment they may have received **(15).**

The aim of this study was to systematically review the qualitative evidence to identify the impact of CAS and treatment pathway on patients' HRQoL. The identified themes were then mapped against the items and domains from the generic and disease specific PROMs we had previously identified **(16,17)**. The mapping was done to find the PROMs that captured the most important issues to patients with CAS.

Method

The systematic review aimed to identify all primary qualitative research studies that investigated the impact of CAS on HRQoL. The inclusion criteria included any patients with CAS and any studies with undefined population were excluded. For further information regarding the inclusion and exclusion criteria refer to **table 1**.

This systematic review was undertaken and reported in accordance with the general principles recommended in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. In accordance with the study protocol **(18)**, searches were conducted from inception up to April 2017 and further updated to September 2018, in the following bibliographic databases; CINAHL via EBSCO, Medline and Medline in Process via Ovid, Embase via Ovid, PsycINFO via Ovid, Social Science Citation Index/ Science Citation Index via Web of Science (Thomson Reuters) and Proquest dissertations and theses. No language or date constraints were applied.

Inclusion	Exclusion
Patients' experience of living with carotid artery stenosis and its impact on their health-related quality of life.	Studies not in English
	Studies with participants under 16 years of age
A defined population of participants with a diagnosis of carotid artery stenosis (CAS) who need, have had or are undergoing surgical treatment. Participants undergoing treatment for stroke or transient ischaemic attack (TIA) secondary to a diagnosis of CAS.	Patients with Stroke or TIA not related to CAD
Studies that include semi-structured interviews, descriptions, focus groups either as stand-alone studies or embedded in a quantitative study. Must include both data collection and data analysis	Quantitative studies with no primary qualitative data reported
Published or unpublished; Full-text or structured abstract with all relevant information	Full-text or structured abstract with incomplete or unclear evidence

Table 1: Summary of the inclusion and exclusion criteria

The search strategy combined condition terms, terms for patient views and terms for qualitative studies (which augmented a qualitative study filter) **(19).** Further details of the search strategy are provided in **Appendix 1** (supporting information).

Study selection

The search results were uploaded into Endnote X8™ (Thomson Reuters, Philadelphia, USA), two reviewers (AA, AH) independently screened the titles for inclusion and exclusion in accordance with the set criteria in the protocol. All titles were examined, and any citations that clearly did not meet the inclusion criteria (for example mixed population, quantitative PROMs data) were excluded. For included titles, abstracts were read and for the included abstracts, full-text articles were obtained.

Quality assessment

The Critical Appraisal Skills Program (CASP) qualitative checklist instrument was used to examine the methodological quality of the included studies **(20)**. This was selected for its appropriateness as it is commonly used in qualitative reviews of evidence **(21)**. Two of the authors (AA, AH) independently examined the quality of each study and any inconsistencies were resolved by discussion or involving a third author (GJ).

Data extraction and analysis

The data on authors, year of publication, country of study, number of participants, research aims, methods of recruitment, method of data collection, key results and analysis were extracted and tabulated for all the included studies by the first author. The included papers were uploaded into the qualitative data analysis software NVIvo10 (QSR International, Doncaster, Victoria, Australia) and the primary and secondary text (patient quotes reported in

the articles and themes), were analysed. The inductive process of framework analysis was used for the qualitative evidence synthesis. In another systematic review **(17)**; the PROMs used for this condition were examined for their validity; their conceptual domains were used to give a basis for the qualitative data synthesis **(22)**. The first stage of the framework analysis was reading all the included papers and identifying common themes from within and across the articles. The second stage involved establishing a thematic framework by creating a list of the main themes based on the domains of validated PROMs and common themes in the identified papers. In the third stage the thematic framework was applied to all the primary and secondary data. In the final stage themes were examined for their conceptual similarities and differences. The second author (AH) checked all the themes that were identified and differences in conceptualization were discussed and adjusted involving a third senior author (GJ).

Triangulation of PROMs items with qualitative themes

A triangulation of evidence was performed to examine how the items within generic and disease specific PROMs corresponded to themes from the qualitative review **(23,24)**. The items from generic and disease specific PROMs used in patients with CAS **(17)** were examined in detail. The items from these instruments were mapped against the themes identified, and two researchers (AA, AH) reviewed both the themes from the qualitative review and the items/ from each PROM to evaluate whether the concepts were the same (agreement), offered similar concepts (partial agreement) or were not present (silence). The aim was to identify whether any of the instruments covered the issues that are important to patients with carotid artery disease.

Results

The database searches identified 1,095 citations; after removing duplicates, 859 titles were assessed and subsequently fifteen full-text papers were reviewed in detail. Finally, only four

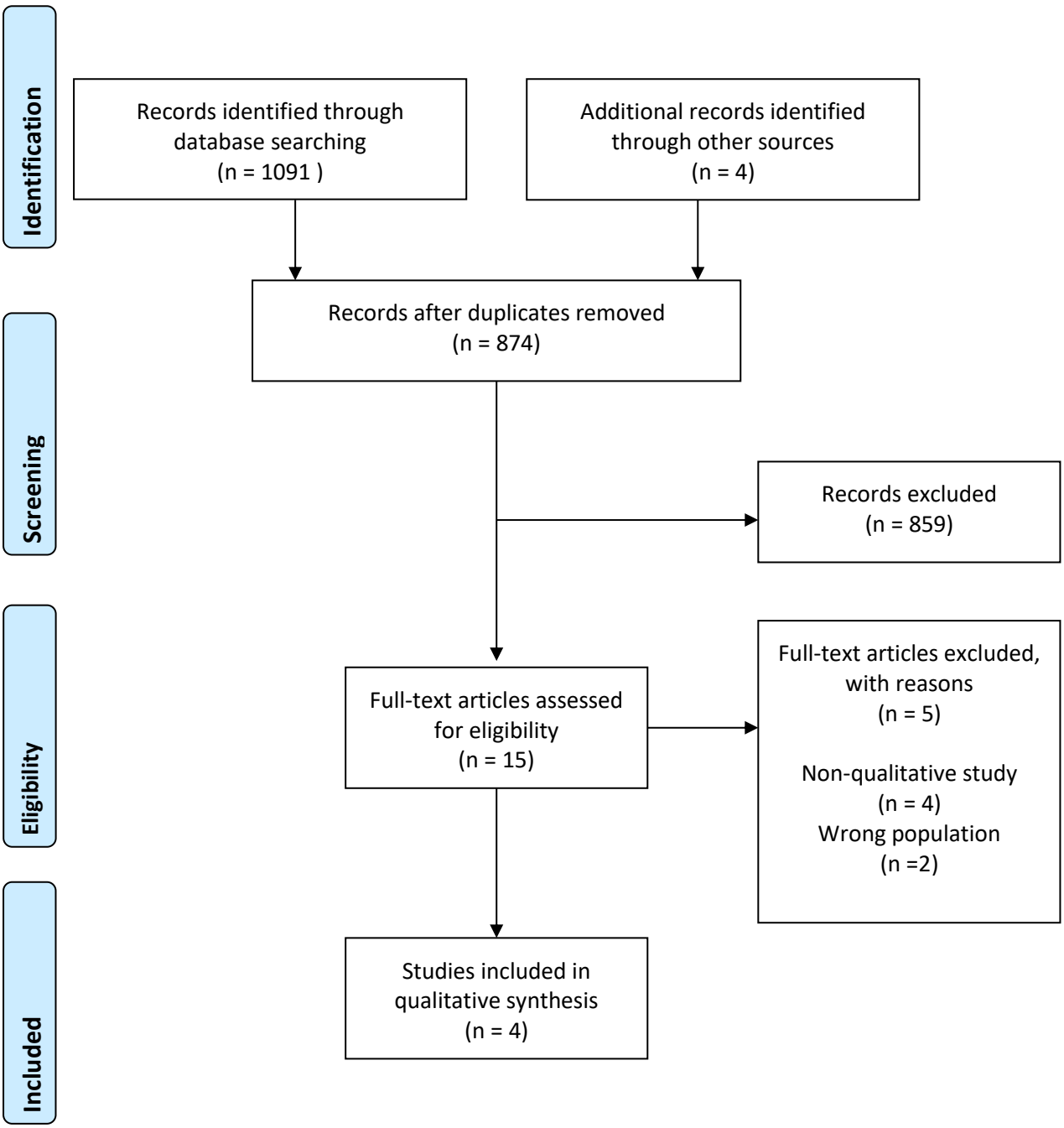
papers fulfilled the inclusion criteria and were included in the qualitative evidence synthesis **(Please see PRISMA chart (Figure 1)).** The studies included in the qualitative synthesis are summarized in table 2.

Table 2. Qualitative studies exploring living with carotid artery stenosis

Author (Year)	Country	Research Design	Method of Analysis	Age (years)	Sample	Diagnosis /Treatment	Study Aims and Objectives
Gibson (2002) **(25)**	UK	Qualitative semi-structured interviews	Grounded Theory	Age, mean 70.9 (50-79)	6 Participants Male (%): 50	Symptomatic carotid stenosis Medical management: 1 Post CEA: 5	Explore ways in which patients comprehend and live with risk of CEA or medical management only for carotid stenosis.
Halin *et* al. (2002) **(26)**	Sweden	Mixed methods including a qualitative component using semi-structured interviews	Thematic analysis	Age, mean 71 (56-80)	20 Participants Male (%): 60	Symptomatic carotid stenosis Medical management, no intervention: 1 Post CEA: 11 Pre-CEA or Stent: 8	Assess quality of life of patients with carotid artery stenosis
Gibson & Watkins (2012) **(27)**	UK	In-depth interviews	Grounded Theory	Age, Mean 71.6(50-80)	16 Participants Male (%): 65	Symptomatic carotid stenosis	Explore the lived experience of patients with TIA secondary of carotid stenosis
Gibson & Watkins (2013) **(28)**	UK	In-depth semi-structured interviews	Thematic analysis	Age, mean 70.2 (50-80)	20 Participants Male (%): 65	TIA/Recovered stroke Post CEA: 10 Medical management: 10	To examine the use of formal and informal knowledge by patients in making decisions about (CEA) and medical treatment after TIA／recovered stroke caused by carotid stenosis

Abbreviations: Carotid revascularisation Enarterectomy (CEA), Transient ischaemic attack (TIA)

Figure 1. PRISMA Diagram: CS Qualitative Systematic Review



Three of the included studies were from the UK **(25, 27-28)** and one from Sweden **(26)**. The studies were published between 2002 and 2013; the age of patients with carotid artery disease in the included studies ranged from 50-80 years, and the percentage of male participants was 50-65%. The included studies reported the views of sixty-two patients with twenty-four of the patients awaiting assessment for surgery, twenty-six had surgery and twelve were turned down for intervention and received best medical therapy.

Quality assessment

The quality of the included studies was assessed independently by two authors (AA, AH) using the CASP checklist **(10)** for qualitative studies, any disagreement on the final score was resolved through discussion and/or involving a third senior author (GJ). The overall quality of the included studies was good, and all the studies scored "yes" for almost all the criteria set in the CASP checklist; Only one study scored 'can't tell' on the rigour of the data analysis **(25)**. For detail on the quality of the included studies see table 3.

Table 3: CASP checklist final score for included studies

Paper	CASP Quality Appraisal									
	1. Was there a clear statement of the aims?	2. Is a qualitative methodology appropriate?	3. Was the research design appropriate to address the aims of the project?	4. Was the recruitment strategy appropriate to the aims of the research?	5. Was the data collected in a way that addresses the research issue?	6. Has the relationship between researcher and participants been adequately considered?	7. Have ethical issues been taken into consideration?	8. Was the data analysis sufficiently rigorous?	9. Is there a clear statement of findings?	10. How valuable is the research?
Gibson 2002 (25)	✓	✓	✓	✓	✓	✓	✓	?	✓	✓
Hallin et al. 2002 (26)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gibson & Watkins 2012 (26)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gibson & Watkin 2013 (28)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Analysis

The Framework Analysis of the primary and secondary data of the included papers identified sixteen themes. These were divided into five main domains comprising; anxiety, impact on personal roles, effect on independence, psychological impact and symptoms. Please see Table 4 for further details.

Table 4: Themes identified from qualitative research studies of patients with carotid artery stenosis.

Themes **(Domains in bold font)**	Gibson (2002)	Halin *et* al. (2002)	Gibson & Watkins (2012)	Gibson & Watkins (2013)
Anxiety				
Fear of stroke	√	√	√	√
Fear of becoming a burden	√	√	√	√
Fear of operation	√	√		√
Uncertainty about future	√	√	√	√
Impact on personal roles & activities	√	√	√	√
Effect on independence	√	√	√	√
Psychological impact				
Happiness	√		√	√
Health perception	√			
Symptoms				
Weakness			√	
Numbness or loss of sensation			√	
Loss of ability to speak			√	
Loss of vision			√	
Cognitive function			√	
Duration of symptoms			√	
Neck stiffness	√		√	

Anxiety

The anxiety domain had several themes including fear of stroke, fear of becoming a burden, worry and uncertainty and fear from consequences of the operation. These four themes were grouped together because of overlapping. The impact of anxiety on daily living of patients suffering with CAS featured in all four studies. Patients experiencing symptoms of transient ischaemic attack (TIA) secondary to CAS expressed concern about fear of stroke, patients said:

"I'm afraid of having a stroke and then becoming paralysed" (Pre-operative patient, age not reported) **(26)**

"I'd be worrying a lot, yes, wondering when or where or how it (stroke) was going to happen…it would be in the back of my mind…which takes some of the pleasure out of life." (Patient experienced TIA –before CEA) **(27)**

"Well, I wouldn't like to be here and have one (stroke) on my own." (*Patient experienced TIA –before CEA*) **(25)**

Two of the major causes for worry from having symptomatic CAS that can cause stroke were uncertainty and fear of becoming a burden. Participants in the included studies reported feeling that their life was put on hold and many were worried that a disabling stroke may make them a burden on others including their family members.

"It's the unknown isn't it, that's what makes you fearful, you don't know what's going to happen." (patient after the CEA reflecting on experiences prior to the surgery) **(25)**

"I'm afraid of becoming dependent on care" (Pre-operative patient) **(26)**

The uncertainty about the future and fear of sudden stroke was affecting patients treated with best medical therapy when compared to patients treated with preventive procedures such as CEA or stenting (**27)**. Another source of anxiety was the worry from complications of surgery including death or stroke. Many patients' perceptions about the risk of stroke from the

preventive procedures were disproportionate **(25),** some patients thought that their risk of stroke from the surgery was 50% and this higher than the 2% reported by clinical studies **(3,4).** Furthermore, many patients had an inaccurate recall of the risks of treatment options offered to them **(25).**

"if somebody tells you there's a 50% chance of having a stroke (without surgery) that's in your mind all the time" (patient after the CEA reflecting on experiences prior to the surgery) **(25)**

"You're damned if you do and damned if you don't, I mean I'd have a stroke if I didn't have it, and I might have the stroke under the operation." (Patient experienced TIA –before CEA) **(25)**

Patients with successful revascularisation reported improved psychological wellbeing and felt that they could move on with their lives compared to the time prior to their procedure when they felt that their daily livings were overshadowed by the worry associated with the CAS diagnosis and possible stroke **(25).**

I'm a happier person, physically and emotionally." (patient after the CEA reflecting on experiences prior to the surgery) **(25)**

Impact on Personal Roles & Activities

Some participants in the included studies described the onset of symptomatic CAS to have put a hold on their life and without the preventative surgery, they would have not been able to carry on with their personal roles and daily activities **(25)**. Some patients took many measures in their daily living to avoid activities that they perceived may increase their risk of further TIA or major stroke. For instance, some patients made changes to their diet **(26)**. One patient said:

"I'd have been worried about having a stroke, it curtailed my activities" (Post-operative patient) **(26)**

The anxiety associated with further TIA or strokes as well as residual symptoms of strokes had an impact on the physical functioning of the patients **(25**).Patients also suggested that

the symptomatic CAS causing TIA dramatically changed their perception about their physical health, Furthermore, attitude of family and friend reinforced this view of diminished physical function **(27)**.

"I've always kept my health…this has absolutely shattered me." (Patient experienced TIA) **(27)**

"you're not as fit as you thought you were, everybody's always telling me to be careful, and have a rest…people around me have sort of convinced me that I'm a bit fragile…" (Patient experienced TIA) **(27)**.

Effect on Independence

All the included studies reported that patients suffering with CAS felt that their social life and independence were compromised because of the disease and potential consequences. Patients expressed concerns about the impact of the disease and possible consequences of on their independence.

*"*I'm afraid of becoming paralysed and dependent on care*"* (patient reporting after surgery) **(25)**

"I' m enjoying life and I want it to go on, without having a stroke" (patient reporting after surgery) **(28)**

Psychological Impact

Patients suffered with issues related to their health perception; the diagnosis had adverse consequences for many patients; with some reporting that they felt their daily life is being shattered with the new diagnosis **(27)**.

Some patients developed low mood when they understood the risks associated with their disease, however, on the other hand, patients who had the operation and did not experience any complications reported that they felt happier emotionally because of dealing with a potentially significant disease that made them felt unhappy **(25, 27-28)**. One patient reported:

"I'm a happier person, physically and emotionally." (patient reporting after surgery) **(25)**

Symptoms

The symptomatic outcomes that were reported by the patients could be divided broadly into two main groups: symptoms associated with TIA and post-intervention symptoms. Patients experiencing TIA reported classical symptoms including loss of sensation, weakness, temporary loss of ability to speak and loss of vision **(27)**.

"I couldn't pick anything up at all, I had great difficulty in using the knife and fork…and then suddenly it came back."(Patient reporting TIA symptoms) **(27)**

"I just thought a film had come over my eye." (Patient reporting TIA symptoms) **(27)**

Patients described symptoms of neck pain and discomfort at the site of operation to treat CAS following CEA **(25).**

"….did feel better, apart from residual minor discomfort from surgical incision pain and neck stiffness." (patient reporting after surgery) **(25)**

Lastly, some patients described loss of cognitive function that was noticeable by their family and caused concern for the patient **(25).**

"I have difficulties taking part in advanced discussions"(patient with carotid artery stenosis) **(25)**

Triangulation

The identified themes were compared to items from PROMs that were identified in a recent study **(17).** These PROMs include the carotid artery disease quality of life questionnaire developed by the Carotid revascularisation Enarterectomy vs. Stenting Trial group (CREST Randomised controlled trial), Carotid Stenosis Specific Outcome Measure developed by Ivanova et al **(28),** Dizziness Handicap Inventory (DHI), Hospital Anxiety and Depression Scale (HADS), EuroQoL-5D (EQ-5D), and the Short-Form 36 (SF-36 ®). Two reviewers (AA,

AH) examined the overlap between the themes in the qualitative review and items in the PROMs. When there was complete overlap between the theme and an item in an instrument an agreement score (+) was awarded; however, when the theme is covered in a general question a partial agreement score was awarded (+/-).

Table 5: Themes identified from the qualitative review mapped against items of validated PROMs

Themes	CREST trial PROMs	CSSOM	DHI	HADS	EQ-5D	SF-36
Anxiety	-	+	+/-	+	+	+
Fear of stroke	-	-	-	-	-	-
Fear of becoming a burden	-	+	-	-	-	-
Fear of operation	-	-	-	-	-	-
Uncertainty about future	-	-	-	-	-	-
Impact on personal roles & activities	-	+	+	+/-	-	-
Effect on Independence	-	-	+/-	-	-	-
Psychological impact	-	+	+	+	+/-	+
Happiness	-	+	+	+	-	+
Health Perception	-	-	-	-	-	-
Symptoms	+/-	+	+	-	-	-
Weakness	-	+	+/-	-	-	-
Numbness or loss of sensation	-	+	-	-	-	-
Loss of ability to speak	-	-	-	-	-	-
Loss of vision	-	+	-	-	-	-
Cognitive function	-	+	-	-	-	-
Duration of symptoms	-	-	-	-	-	-
Neck Stiffness	+	+	-	-	-	-

Abbreviations: Carotid revascularisation Enarterectomy vs. Stenting Trial **(CREST Randomised controlled trial)**, Dizziness Handicap Inventory **(DHI)**, Hospital Anxiety and Depression Scale **(HADS)**, EuroQoL-5D **(EQ-5D)**, and Medical outcomes study 36-item short form **(SF-36 ®)**, Carotid Stenosis Specific Outcome Measure **(CSSOM)**.

Scores: −, silence; −/+, partial agreement; **+**, agreement.

None of the identified PROMs covered important HRQoL themes such as fear of stroke or fear from the operation as well as uncertainty about future caused by the diagnosis of the disease. Many of the symptoms described in the qualitative evidence synthesis of this study were not included in the PROMs used previously. The generic PROM that captured most of the important issues for patients with CAS was the SF-36 ® and the disease specific PROM was the PROMs for carotid artery disease developed by Ivanova *et* al **(28).** However, both PROMs did not cover all the themes identified in this review. For further details on the results of triangulation see table 5.

Discussion

We identified six domains that impacted upon the HRQoL of patients with CAS throughout their care pathway. These include anxiety, impact of the disease on personal roles/ activities, impact on physical functioning, impact on social functioning, psychological impact, and symptoms associated with it.

The HRQoL of patients with CAS undergoing either revascularisation or best medical therapy have only been measured using generic PROMs, anxiety specific PROMs and questionnaires developed by clinicians with no validation (RCT) **(5-11)**. A single RCT attempted to develop a disease specific PROM for patients with CAS **(11)** however, the instrument was made of the six items suggested by clinicians and, more importantly, patients were not consulted. Furthermore, there was no further validation for this PROM.

Clinical outcomes such as 30-days mortality, stroke-free survival, and re-stenosis have been used to compare the efficacy of surgical, radiological and medical therapies for patients with CAS. These are important outcomes, however, HRQoL, when measured using a validated PROM can provide comprehensive data about the impact of different therapies. The themes from this review can be used to develop a more tailored PROM that can be used in routine

clinical practice both to inform discussion between patients and clinicians, as well as, a quality measure of the carotid revascularisation service.

One of the strengths of this study is that the qualitative review included patients at different stages of their care pathway including sixty**-two** patients with symptomatic carotid artery stenosis; twenty-four of the patients waiting for to meet a clinician to decide whether they are suitable for surgery or stenting, twenty-six patients had carotid endarterectomy with no complications and twelve patients turned down for surgical or interventional radiology procedures. This review used the evidence from an earlier systematic review **(11)** by the same group to evaluate the validity of PROMs used in patients with CAS. This earlier systematic review was performed to examine the psychometric validation evidence for PROMs used in patients with CAS. In the triangulation section of this study the themes from the qualitative review were mapped against the items from the generic and disease specific CAS PROMs that were identified.

The main limitation of this study is that it relies on the primary and secondary data of existing studies. The patients sampled in one of the studies only included patients with CAS waiting for operation (27); whereas, the other three studies included patients on best medical therapy for CAS as well as patients waiting for preventive surgery and patients following their operation. Furthermore, the included studies beside investigating aspects of HRQOL also examined issues such as decision making about management that were not related to HRQoL. Additionally, few patients who were treated with best medical therapy or turned down for revascularisation were included in any of the studies. The included papers did not distinguish clearly between patients with resolved stroke symptoms and TIA. Some papers mentioned important themes such as denial of diagnosis and depression but failed to report any primary evidence to support these themes **(27, 28).**

Amongst some clinical academic circles HRQoL has confusingly come to be known as anything which is not clinical **(30)**. However, this study demonstrates that patients with CAS experience distress related to diagnosis and the risks associated with the intervention. These have an adverse impact on their wellbeing and should be taken into consideration by the clinician. The review identified anxiety to be an important domain that impacts the HRQoL of patients with CAS and this is related to fear of stroke, uncertainty about future, fear of becoming a burden on others and fear of operation. Carotid artery disease also had an impact of on the patient independence, the personal functioning and beyond anxiety had a further psychological effect on patients.

This systematic review of the qualitative evidence combine all the relevant data concerning the impact of CAS and its treatments on the patients. One of the strongest finding of this study is that none of the generic and disease specific PROMs covered all the important issues for CAS patients revealed by this qualitative systematic review.

Conclusions

The identified themes that impact the HRQoL of patients with CAS can be used to develop a disease-specific PROM. Our group designed this instrument and currently validating this PROM in an extensive survey of patients with CAS. The aim is to perform a factor analysis as well as further psychometric studies to ensure the PROM's validity, reliability, and responsiveness.

"Data Availability Statement"

The analysis data cannot be shared since some of the papers included in the systematic review have copy rights and these prohibit publishing them in other journals but allow researchers to use them for secondary analysis. These papers were uploaded into the software in which we performed the analysis. Supplementary materials are included regarding the search strategy and analysis.

Compliance with Ethical Standards

Acknowledgment

Ahmed Aber contributed to the analysis and interpretation of data, drafting of the manuscript, and critical revision; Aoife Howard contributed to the analysis and interpretation of data and drafting of the manuscript; Helen Buckley Woods performed the searches for the systematic review and helped in drafting of the manuscript. Georgina Jones contributed to the study conception and design, analysis and interpretation of data, and drafting of the manuscript; and Jonathan Michaels contributed to the study conception and critical revision.

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Conflict of interest

Ahmed Aber, Aoife Howard, Helen Buckley Woods, Georgina Jones, Jonathan Michaels have no conflicts of interest directly relevant to the content of this article.

Abbreviations

CASP: Critical Appraisal Skills Program, CREST: Carotid revascularisation Endarterectomy vs. Stenting Trial, DHI: Dizziness Handicap Inventory, HADS: Hospital Anxiety and Depression Scale, EQ5D: EuroQoL-5D, SF-36®: Medical outcomes study 36-item short form, CAS: Carotid artery stenosis, CEA: carotid endarterectomy, PROMs: patient reported outcome measures, HRQOL: health-related quality of life, PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses, TIA: transient ischaemic attack, Carotid Stenosis Specific Outcome Measure (CSSOM).

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