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Review Article

The impact of pre-operative comprehensive geriatric assessment on postoperative outcomes in older patients undergoing scheduled surgery: a systematic review

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Summary

Comprehensive geriatric assessment is an established clinical approach. It reduces mortality and improves the physical wellbeing of older people in the community or hospitalised for medical reasons. Pre-operative comprehensive geriatric assessment seems a plausible method for reducing adverse postoperative outcomes. The objectives of this systematic review and narrative synthesis are to describe how pre-operative comprehensive geriatric assessment has been used in surgical patients and to examine the impact of comprehensive geriatric assessment on postoperative outcomes in older patients undergoing scheduled surgery. We searched MEDLINE, EMBASE and Web of Science from 1980 to 2013 (week 26). We included five studies: two randomised controlled trials and three before-and-after intervention quasi-experimental studies. Patient populations, interventions and outcome measures varied between studies. Both the randomised trials showed benefit on postoperative outcomes, including medical complications. Two of the before-and-after studies reported a positive impact on postoperative length of stay and other outcomes. The heterogeneity of study methods, populations, interventions and outcomes precluded meta-analysis. Based on this narrative synthesis, pre-operative comprehensive geriatric assessment is likely to have a positive impact on postoperative outcomes in older patients undergoing elective surgery, but further definitive research is required. Clinical services providing pre-operative comprehensive geriatric assessment for older surgical patients should be considered.

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An increasing proportion of the ageing population is undergoing surgery [1]. Despite the benefits of surgery seen in this population, the rate of adverse postoperative outcomes increases with age [2]. Postoperative complications are predominantly medical rather than surgical [3], and their increased rate is associated with physiological age [4], multimorbidity [5, 6] and geriatric syndromes, including frailty [7], sarcopenia [8] and delirium [9]. Although adverse postoperative outcomes and the risk factors for developing these are well described in older surgical patients [2], a national UK report has highlighted deficiencies in the care provided to this patient population [10]. Furthermore, pre-operative assessment has not been adapted to identify and modify these geriatric syndromes and multi-morbidity

proactively, with the aim of improving postoperative outcomes.

Comprehensive geriatric assessment (CGA) is an established method for evaluating and optimising physical, psychological, functional and social issues in older patients to improve longer-term outcomes. It involves a multi-domain assessment, which is usually interdisciplinary and is followed by the planning and implementation of investigations, treatment, rehabilitation and longer-term follow-up. Table 1 describes the components of CGA [11]. In medical inpatients [12] and community-dwelling older people [13], CGA has been shown to improve mortality at 36-month follow-up, increase the chance of living independently at home, and confer a positive effect on physical function.

A recent Cochrane meta-analysis of 22 trials of 10 315 hospitalised participants compared CGA with standard care [14]. The analysis was reported as odds ratios, but in terms of relative risk, CGA significantly increased the participants' relative risk (95% CI) of being both alive and in their own homes: at 6 months, 1.07 (1.03–1.12), $p = 0.0002$; and at a median of 12 months, 1.06 (1.02–1.10), $p = 0.003$. Furthermore, the relative risk of being institutionalised was less with CGA intervention, 0.83 (0.75–0.91), $p < 0.0001$ [14]. Thorough multi-domain assessment, followed by employment of comprehensive patient-centred plans, is thought to achieve the reductions in morbidity and mortality observed following CGA.

Table 1 Components of comprehensive geriatric assessment.

Domain	Items to be assessed
Medical	Co-morbid conditions and disease severity Medication review Nutritional status Problem list
Mental health	Cognition Mood and anxiety Fears
Functional capacity	Basic activities of daily living Gait and balance Activity/exercise status Instrumental activities of daily living
Social circumstances	Informal support from family or friends Social network such as visitors or daytime activities Eligibility for being offered care resources
Environment	Home comfort, facilities and safety Use or potential use of tele-health technology, etc. Transport facilities Accessibility to local resources

In contrast to the literature about medical inpatients, the use of CGA in surgical and cancer populations is often limited to the 'assessment' component of the process, which has been used for prognostication in several surgical and oncological studies [15]. This focus on assessment rather than optimisation reflects the limitations observed in standard pre-operative assessment processes. Given the increasing awareness of the challenges presented by the growing older surgical population, this systematic review aims to address the question 'does pre-operative CGA affect postoperative outcomes in older patients undergoing scheduled surgery?'

Methods

We searched MEDLINE, EMBASE and Web of Science databases from 1980 to 2013 (week 26; see Appendix for details). We examined identified references for all relevant full-text papers. The search was limited to English language articles only.

Two researchers (JP and JD) independently screened all identified abstracts according to the following pre-defined inclusion and exclusion criteria. Discrepancies were resolved through a third reviewer (DH).

We considered all experimental or quasi-experimental trial designs for inclusion (randomised controlled trials, observational before-and-after studies or quality improvement programmes), but we excluded case reports, case series and editorials. Studies where a multi-domain assessment was performed pre-operatively were included, regardless of whether this intervention was undertaken by a full multidisciplinary team or just a single healthcare professional, such as an internist, hospitalist or general physician. Trials were excluded if they employed CGA purely as a risk assessment tool for adverse postoperative outcomes. Similarly, studies were excluded if they assessed only one CGA domain, such as frailty, rather than employing a full multi-domain assessment and optimisation plan, or

Table 2 Tools and techniques used to complete each element of the synthesis process.

Element or step in synthesis process	Tool or technique used
Developing a theory	
Developing a primary synthesis	Tabulation Textual descriptions Groupings or clusters
Exploring relationships within and between studies	Qualitative case reports /textual descriptions
Assessing the robustness of the synthesis product	Reflecting critically on the synthesis process

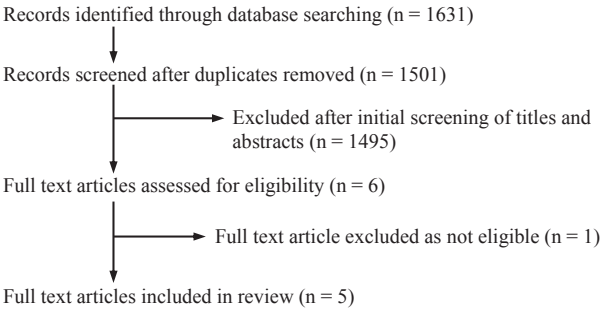

Figure 1 Included and excluded studies.

when there were no outcomes, or the outcome was restricted to delirium. We also excluded studies of enhanced recovery programmes. Inclusion bias was limited by searching trial databases and grey literature.

Full-text articles were assessed for risk of bias in the following domains, according to Cochrane guidelines: selection; performance; detection; and attrition. We conducted a narrative synthesis when meta-analysis was not possible, in accordance with guidance from a methodology review [16], using tools and techniques shown in Table 2.

Results

The electronic searches identified 1501 potentially relevant publications (Fig. 1). Six full-text articles were eligible following screening of abstracts [17–22]. One study was excluded after review of the full-text article [19] as no CGA-based intervention was undertaken. We included two randomised controlled trials [20, 21] and three before-and-after studies [17, 18, 22]. Heterogeneity in study design, population, intervention and outcomes precluded meta-analysis. Table 3 summarises the included studies.

Randomised controlled trials

Both randomised controlled trials identified were conducted in the USA, and used a pre-operative 'hospitalist' or internal medicine assessment as the intervention. One trial examined patients aged over 50 years undergoing various types of elective non-cardiac surgery (ENT, orthopaedics, ophthalmology, gastrointestinal, urological, plastic, neurosurgery, vascular, dental) [21]. The other study included all patients over the age of 18 years undergoing elective orthopaedic procedures: despite the inclusion of younger patients, the mean (SD) ages in the intervention and control groups were 72.6 (10.6) and 73.7 (8.7) years, respectively [20]. Outcome measures included length of stay, cancellations, resource use and postoperative medical complications.

Macpherson et al. [21] recruited 355 participants older than 50 years with life expectancies more than 30 days. Following pre-operative referral by surgical teams, participants were randomly allocated to intervention or control, stratified by surgical procedure. The intervention was a pre-operative outpatient internal medicine assessment, the results of which were delivered to the surgical ward on the day of hospital admission. In this 1994 study, the control group did not receive any pre-operative assessment before hospital admission and internal medicine consult was sought only at the discretion of the surgeon. Total and postoperative lengths of stay were not significantly different between the two groups. Pre-operative length of stay was reduced in the intervention group by 1.3 (0.8–1.8) days, from 2.9 to 1.6 days, $p < 0.001$. Cancellations after admission were reduced from 22 to 10 ($p = 0.03$) in the intervention group. Total resource usage was unchanged between the groups, but a greater proportion of resources were used in the outpatient setting in the intervention group. The opportunity costs of cancellations were not included in the economic analysis.

Huddleston et al. [20] enrolled 526 patients aged 18 or more years when scheduled for elective primary, or revision, total knee or hip arthroplasty. Allocation was stratified according to surgical procedure. The

Table 3 Summary of included studies.

Author/Year/Region	Patient population	Intervention	Comparison	Outcome measures	n	Summary of findings	Issues with study
Before-and-after studies							
Ellis 2012 [22] Airdrie, UK	Aged 65 Elective orthopaedic, urological, gastrointestinal surgery	Nurse/OT with expertise in geriatric medicine used MMSE, Barthel and referred and managed identified conditions using protocols (already in use in the geriatric medicine service)	Usual nurse-led pre-operative assessment	Length of stay MMSE Delay to surgery Cancellations Postoperative infection	313 (141 pre, 172 post)	Reduction in cancellations and delays to surgery 45% reduction in length of stay	Underpowered Redesign of process change during study period increasing potential for period effect Unblinded researchers
Harari 2007 [18] London, UK	Aged 65+ Elective orthopaedic surgery	Pre-operative multidisciplinary CGA and optimisation	Usual nurse-led pre-operative assessment (with referral to anaesthetists /physicians as required)	Length of stay Medical complications	108 (54 pre-POPS, 54 POPS)	31% reduction in median length of stay Reduction in medical complications (pneumonia, delirium, pressure sores, inadequate pain control, delayed mobilisation, unnecessary urinary catheter)	Potential for period effect Unblinded researchers
Richter 2005 [17] Alabama/ New York, USA	Aged 60+ Elective pelvic floor surgery	'Enhanced pre-operative assessment' of ADL, IADL, TUAG, clock drawing, nutritional assessment, GDS, social support scale	Usual pre-operative evaluation by physicians	Change in scores on physical and mental components of SF36	62 (32 in enhanced assessment arm, 30 in routine arm)	No change in outcomes measure (SF36 scores) following 'enhanced assessment'	No optimisation Insensitive outcome measure Potential for period effect Unblinded researchers

Table 3 (*Continued*)

Author/Year/Region	Patient population	Intervention	Comparison	Outcome measures	n	Summary of findings	Issues with study
Randomised, controlled trials							
MacPherson 1994 [21] Pennsylvania, USA	Age 50+ Elective surgical patients referred for internist review pre-operatively	Internal medicine assessment 3 weeks before surgery Laboratory and radiology tests	Admission to hospital without pre-operative assessment Patients were also seen by an internist if referred during admission by surgeons	LOS Admissions who did not then undergo surgery Resource use (laboratory, radiology, consultations)	355 (176 intervention group, 179 control group)	Reduction in admissions who did not undergo surgery No reduction in LOS or resource usage	Bias Not CGA Good stratification of randomisation
Huddleston 2004 [20] Rochester, USA	Aged 18+ (mean age 73 years) Elective orthopaedics	Collaborative hands on hospitalist input pre- and postoperatively	Internist ± anaesthetic pre-operative assessment Orthopaedic care postoperatively	Medical complication rate Length of stay	526 (251 intervention, 254 control, 21 excluded)	Reduced complications in intervention group No difference between LOS if 'adjusted for discharge delays' LOS shorter in intervention group Cost neutral	No blinding

ADL, activities of daily living; CGA, complete geriatric assessment; GDS, geriatric depression scale; IADL, instrumental activities of daily living; LOS, length of stay; MMSE, mini-mental state examination; OT, occupational therapy; POPS, proactive care of older people going to have surgery; TUAG, timed up and go.

control group received standard pre-operative laboratory investigation, physiotherapy and nursing education, according to an established clinical pathway. Postoperatively, the orthopaedic team were responsible for daily care, and were the gatekeepers for referrals to other services and specialities. Participants in the intervention group received collaborative hospitalist/orthopaedic care. Pre-operatively, patients were assessed by the hospitalists, who took a lead in postoperative care. Comprehensive geriatric assessment significantly reduced postoperative complications by 11.8 (2.8–20.7)%, from 50.2 to 38.4%, $p = 0.01$, and the time to be 'fit for discharge' by 0.5 (0.8–0.1) days, from 5.6 to 5.1 days, $p < 0.001$. Total costs were unchanged, $p > 0.2$.

Before-and-after intervention quasi-experimental studies

All three before-and-after intervention studies compared outcomes after pre-operative assessment based on the principles of CGA with historical standard care, administered either by physicians or nurses, depending on the routine practice within the centre. One study was conducted in the USA [17] and the other two in the UK [18, 22]. Outcome measures were comparable to the randomised controlled trials, including length of stay, delay to surgery and cancellations, quality of life and postoperative medical complications such as infections, delirium and delayed mobilisation. The surgical populations studied were all aged over 60, and all underwent elective orthopaedic, urological, gastrointestinal or gynaecological procedures.

Ellis et al. recruited patients aged over 65 years scheduled for orthopaedic, urological or gastrointestinal surgery [22]. An additional inclusion criterion was one or more difficulties with: cognition; mobility; falls; daily activities; or home circumstances. In the control phase of the study, 141 patients underwent routine evaluation by a pre-operative assessment clinic nurse, and were then seen by a care of the elderly nurse who recorded baseline data on medical issues, cognition, falls, nutrition, functional ability, continence and carer roles. The need for onward referrals was recorded by the care of the elderly nurse, but no referral was actually made. One hundred and seventy-two patients were recruited in the intervention phase, where a care of the elderly nurse and an occupational therapist made relevant referrals to physiotherapy, occupational therapy, dietetics, social work, the falls team, general practice, a district nurse and other support agencies. Fewer operations were cancelled during the intervention phase, 17.7% vs. 5.2%, $p < 0.001$. The mean (SD) inpatient stay fell from 8.9 (7.6) to 4.9 (5.0) days, $p < 0.001$. Postoperative complications were reduced from 8.5% to 2.3%, $p = 0.01$.

Harari et al. enrolled 108 elective orthopaedic patients aged over 65 [18]. The initial modelling phase involved screening patients aged over 65 years on elective orthopaedic waiting lists using a self-completion questionnaire identifying co-morbidities, functional limitations and social support. This identified unmet needs that could adversely impact on postoperative outcomes. Based on this modelling, a geriatrician-led multidisciplinary team was established. The proactive care of older people undergoing surgery (POPS) team consisted of a consultant geriatrician, clinical nurse specialist, occupational therapist, physiotherapist and social worker and undertook CGA pre-operatively within the outpatient setting. Fifty-four patients in the pre-POPS cohort received standard pre-operative assessment by a pre-operative assessment clinic nurse. The POPS group had fewer medical complications and other unwanted occurrences: pneumonia 20% vs 4%, $p = 0.008$; delirium 19% vs 6%, $p = 0.036$; pressure sores 19% vs 4%, $p = 0.028$; inadequate analgesia 30% vs 2%, $p < 0.0001$; delay to mobilisation 28% vs 9%, $p = 0.012$; and inappropriate catheter use 20% vs 7%, $p = 0.046$. The mean (SD) length of stay was reduced from 15.8 (13.2) days to 11.5 (5.2) days, $p = 0.028$, with fewer delays relating to medical complications or waits for domiciliary occupational therapy equipment.

Richter et al. recruited a convenience sample of 62 patients aged over 60 scheduled for pelvic floor surgery [17]. During the 6-month control phase of the study, 30 patients received standard pre-operative physician evaluation. In the intervention phase, 32 patients received additional pre-operative assessment of function (Activities of Daily Living/Instrumental Activities of Daily Living), mobility (Timed up and go), cognition (clock drawing), nutrition (Mini Nutritional Assessment), mood (Geriatric Depression Scale) and

social support (Social Support Scale). Research nurses recorded the results in the medical records, which then informed postoperative care delivered by surgical teams and resident physicians. Both groups completed the same two outcome measures, pre-operatively, at 6 weeks and at 6 months postoperatively: the Short Form 36 (SF 36), a generic multi-domain quality of life assessment tool; and a Utility Item Score, a subjective score of how well they felt, between 0 (dead) and 100 (full health). The study was powered to detect a difference between groups of 10 points on the SF 36 score, calculated as the change from pre-operative to post-operative scores, at both 6 weeks and 6 months. There were no significant differences in these scores between the two groups. Notably, the authors concluded that the majority of the study participants were in good health, with no functional limitation, no mood disorder and good social support networks.

Discussion

Five full-text articles were included in this narrative synthesis review. Meta-analysis was precluded by the heterogeneity of the surgical patient population, the CGA intervention and the differing outcome measures used. Although there are clear limitations in these studies as discussed below, narrative synthesis suggests that pre-operative CGA may be beneficial in reducing adverse postoperative outcomes, in terms of both patient-specific clinical measures and process measures.

Numerous study abstracts were identified in which CGA was used to predict the risk of adverse post-operative outcomes in both surgical and oncology patients. However, the majority focused on the assessment component of CGA without introducing specific management plans aimed at optimising modifiable risk factors for adverse postoperative outcomes. Published evidence in medical patients concludes that *both* assessment *and* patient-specific optimisation are required in order for CGA intervention to be successful [12–14]. For this reason, those abstracts that only used the assessment component of CGA, without modification, were excluded from this synthesis. Five studies remained eligible for review.

Conducting research into the impact of multi-component interventions is fraught with difficulties; however, the Medical Research Council (MRC) does provide a clear framework for such research [23]. Despite the availability of these guidelines since 2000, there were clear limitations in the studies presented in this review including standardisation of the design and delivery of the interventions, incorporation of factors specific to the local context, and the inability to blind researchers as contemporaneous caregivers (a source of observer bias in both the randomised controlled trials and pre- and post-intervention cohort studies).

The main limitations of the two RCTs relate to whether the intervention constituted CGA. Macpherson et al.'s study [21] was well powered with stratified randomisation according to surgical procedure, but the methods did not state clearly how patients were assessed or optimised. Instead, it focused on resource use, namely laboratory and radiology tests ordered and the setting in which these investigations were arranged. This limits the study's relevance to the review question posed in this study. Similarly, Huddleston et al. [20] used proxy CGA delivered by a non-geriatrician internist both pre- and postoperatively. Although the intervention was effective in terms of a reduction in postoperative complications, it is difficult to state conclusively that this was due to CGA per se rather than the involvement of any physician in the care of surgical patients. Length of stay was shorter in the intervention group, but only when adjusted for organisational discharge delays. This suggests that although postoperative medical complications were less common, functional or social issues may not have been identified pre-operatively or addressed in a timely fashion until the end of the hospitalisation, when the patients were 'medically fit for discharge' but still required extra care, rehabilitation or institutional placement.

The before-and-after studies have additional methodological shortfalls. The period effect between assessments may introduce bias resulting from confounding factors unrelated to the intervention being tested, such as organisational change, alterations to clinical practice or staff variation. Attempts to minimise the period effect were made by the studies included in the review using a short study timeframe [18]. The effect of organisational change (the introduction of a centralised appointment system), although acknowledged in one study [22], may still have biased results. The inability to blind researchers was also acknowledged and attempts to reduce sub-

jective observer bias were made (although not eliminated) using objective endpoints such as length of stay and postoperative complications [18, 22].

The two before-and-after studies that demonstrated a reduction in postoperative complications and total length of stay employed both components of CGA – assessment and optimisation with follow-through delivery of care [18, 22]. In contrast, Richter et al. used several well-validated assessment tools, but failed to perform any optimisation or establish management plans for the issues identified during the pre-operative assessment process. The results of the scores were documented for potential action by the usual care teams, but this does not constitute full CGA and the lack of impact from CGA seen in this study may be because no meaningful 'hands on' optimisation or 'follow through' occurred. The primary outcome measure, a change in several components of the SF 36, may not be a sensitive enough tool to identify change over a short time period and therefore the lack of impact from CGA in this study may simply reflect use of an insensitive outcome measure.

In summary, this systematic examination and narrative synthesis of the literature suggests that pre-operative CGA may have a positive impact on postoperative outcomes (medical complications and length of stay) in older patients undergoing elective surgery. However, the current evidence is inconclusive and definitive research evaluating pre-operative CGA is required. Such research should be conducted according to the MRC guidelines [23], using an adequately powered, randomised, controlled design and outcome measures relevant to all stakeholders, including patient-related and -reported outcomes, process measures and economic evaluation. Such studies are likely to require the use of cluster randomisation methods. The studies should employ CGA intervention in its entirety (assessment and optimisation), and focus on the determination of which particular component of the intervention has the most impact on outcome measures, so as to investigate the so-called 'black box' effect of complex interventions.

Although the results of this narrative synthesis are not conclusive, a pragmatic interpretation of the available literature is necessary. Clinicians should consider establishing collaborative services for older surgical patients with a patient-centred pathway at the core. This may require multidisciplinary input from surgeons, anaesthetists, geriatricians, organ-specific physicians, therapists, nurses and patients as well as local managers and commissioning groups. Resources to facilitate this include the American College Surgeons National Surgical Quality Improvement Programme (ACS NSQIP®)/American Geriatrics Society Best Practice Guidelines *Optimal Preoperative Assessment of the Geriatric Surgical Patient* [24], the British Geriatrics Society Best Practice Guide *Perioperative care for older patients undergoing surgery* [25] and the Association of Anaesthetists of Great Britain and Ireland guidelines *Peri-operative care of the elderly* presented in this supplement [26].

Competing interests

No external funding or competing interests declared.

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Appendix

Search strategy used

1. (exp Geriatric Assessment/), 2. (cga.mp. [mp = title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]), 3. ((comprehensive adj2 geriatric assessment).mp), 4. (multicomponent intervention*.mp), 5. (multi-component intervention*.mp), 6. (exp Patient Care Team/), 7. (liaison.mp.), 8. (collaborat*.mp.), 9. (multidisciplinary.mp.), 10. (multi-disciplinary.mp.), 11. (exp Aging/), 12. (exp Aged/or exp "Aged, 80 and over"/), 13. (exp Geriatrics/), 14. (geriatr*.mp.), 15. (ag?ing.mp.), 16. (exp Specialties, Surgical/), 17. (Surgical Procedures, Elective/),18. (exp Surgical Procedures, Operative/), 19. (surg*.mp), 20. (exp Perioperative Care/), 21. (exp Perioperative Period/), 22. (peri-operative.mp.), 23. (perioperative.mp.), 24. (Preoperative Care/), 25. (pre-operative.mp.), 26. (preoperative.mp.), 27. (postoperative.mp.), 28. (post-operative.mp.), 29. (elective.mp.), 30. ((planned adj10 surg*).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]), 31. (1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10), 32. (11 or 12 or 13 or 14 or 15), 33. (16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28), 34. (29 or 30), 35. (31 and 32 and 33 and 34), 36. (limit 35 to english language).