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Research article

Developing an electronic geriatric assessment to improve care of older adults with cancer receiving radiotherapy

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ABSTRACT

Older adults make up a substantial proportion of patients diagnosed with cancer. Gaps in evidence of care for older adults with cancer leads to treatment heterogeneity and poor outcomes. Medical and Surgical Oncology clinics throughout the world are increasingly using Geriatric Assessment (GA) based approaches to treatment that are beginning to improve care through treatment decision-making communication, health-related quality of life outcomes, and reducing chemotherapy toxicities. Yet, GA based approaches are not often used in radiation oncology clinics. This manuscript aims to describe the ongoing development of an electronic patient-reported GA with real-time data interpretation and recommendation delivery to help increase the use of a personalized GA based approach to the care of older adults within radiation oncology clinics. Future studies demonstrating the utility and benefit of GA based approaches to help older adults undergoing radiotherapy for their cancers are still sorely needed.

Introduction

The majority of people diagnosed with cancer in the 21st century will be 65 years of age and older [1]. Unfortunately, older adults historically have and continue to be under-represented in standard-setting clinical trials [2–5]. As older adult cancer patients often have unique clinical needs that can make standard treatments difficult to deliver, [6] clinicians are often left to make decisions for older adults without appropriate data [7]. Additionally, the majority of oncology providers have received no formal geriatric training [8]. The gap in geriatrics knowledge in Radiation Oncology training is likely even more pronounced as there is limited training in internal medicine and thus less experience taking care of the medical needs of older adults [9]. The lack of prospective data coupled with lack of training in how geriatric syndromes/challenges can often lead to the empiric omission of curative treatment [10], de-intensification of treatment, [11–15] or aggressive overtreatment[16] of older adults with cancer [17]. Not offering curative therapy to otherwise eligible older patients may introduce disparately poor outcomes in older adult populations. Similarly, attempting aggressive therapy on patients who cannot tolerate it can lead to an increased toxicity burden on this vulnerable population. Although there are ongoing efforts to improve geriatric education for radiation oncology trainees [18], tools are needed to help radiation oncologists outside of training within the clinic. Due to the local/regional nature of radiotherapy and it's associated lower rates of systemic toxicities compared to systemic therapies or general anesthesia, radiation oncologists are often referred older adults who are deemed ineligible for other curative intent treatments. A simple systematic patient-reported geriatric assessment (GA) could help standardize care of older patients in radiation oncology clinics, even in those lacking specific geriatric expertise.

The GA is a tool used by clinicians to evaluate an older person's functional status, co-morbidities, neurocognitive and psychological status, social support structure, nutritional adequacy, and medication exposures. In patients with cancer, GA can reveal a high prevalence of functional and memory impairment, co-morbidity, and malnutrition that often is not revealed by standard physician reported performance assessments [19]. Additionally, poor results on GA are associated with worse toxicity from chemotherapy [20] and surgery [21], disparities in quality of life outcomes after radiotherapy [22], and changes in planned treatment course in up to 20% of patients [17]. In non-oncology settings, GA based supportive care recommendations (i.e. interventions aimed at improving dys-

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function discovered on the GA, such as referrals to a geriatrician for polypharmacy) have been shown to reduce mortality [23,24], hospitalizations [25], and functional decline [23]. In the oncology setting, not only does GA predict for toxicity, but it also improves patient and caregiver satisfaction with their oncology care, communication about aging-related concerns [26], health-related quality of life, and can decreased toxicity from systemic therapy [27]. In radiation oncology clinics, specifically, studies have suggested that screening GA can help predict treatment completion [28], and health-related quality of life recovery [22]. However, studies on the ability of the GA to predict toxicity and tolerance to radiotherapy have mixed results, likely due to the heterogeneity and the small number of patients in the studies [29]. Unfortunately despite recommendations from several prominent oncology societies for the use of GA as part of the decision process for cancer care [30–32], the majority of radiation oncology clinics continue to underutilize this important tool. The purpose of this manuscript is to review the historical development of the abbreviated GA and describe how it continues to be developed within a radiation oncology department. This manuscript will also give specific examples of how the abbreviated GA is being used to help make treatment decisions and implement geriatric interventions to improve the multidisciplinary care of older adults in a community cancer center setting.

Geriatric assessment

Geriatric assessment (GA) is a multidimensional evaluation and process used to assess the functional, medical, and psychosocial abilities of older adults [33]. There are several advantages to incorporating a GA in the management of older adults with cancer [33]. The GA has been shown to identify vulnerabilities, such as impairments in activities of daily living [dressing, eating, ambulating, toileting, hygiene] or falls, that go overlooked by traditional oncologic evaluations, but have been associated with increased mortality and chemotherapy toxicity [19,34]. The GA has demonstrated superior ability to identify frail patients, particularly amongst those that may have preserved performance status [35]. Performing a GA may improve prognostication of the risk of adverse outcomes including chemotherapy toxicity [36,37], surgical morbidity [21], and quality of life recovery following radiotherapy [22], which can all inform treatment decision-making when weighing the risks/benefits of treatment options [17,33].

A traditional comprehensive GA is performed by geriatricians in conjunction with a multi-disciplinary team and typically entails several hours of assessment. Abbreviated versions designed to be performed in busy oncology clinics which are primarily patient-reported have been developed specifically for use in older adults with cancer [21,37,38]. The GA has been demonstrated to be feasible in both academic and community sites as well as within the cooperative group setting [38–40]. Just as oncologists use imaging and clinical exams to stage cancer, the GA can be used to "stage the age" of a patient and assist in personalizing their treatment [41]. Many of the GA tools can be found online and performed in a clinic with a patient from these websites (www.mycarg.org/SelectQuestionnaire or www.moffitt.org/eforms/crashscoreform). Additionally, tools to calculate life expectancy for older adults are available at www.eprognosis.ucsf.edu and can be used to help guide decisions for patients regarding the benefit of certain treatments. However, the problem that many clinicians (especially those not trained in geriatrics) face, is how to interpret and what to do with the results of these assessments.

Often, the results of the abbreviated GA require interpretation and knowledge to apply to clinical care. The GA was not designed to give an overall score to define eligibility for certain treatments. Rather it was designed to give scores of each domain to guide clinicians in offering interventions for those items in which the patients had deficits. GA-guided care processes have been developed to address many identified impairments and vulnerabilities [42–44]. Until recently, no randomized trial had yet to demonstrate that GA-guided care interventions definitively improve outcomes in older adults with cancer, despite these interventions improving outcomes in older non-cancer populations [45]. However, at the 2020 ASCO virtual meeting, 3 randomized trials were presented and demonstrated GA-based interventions helped improve quality of life and toxicity rates among older adults receiving systemic therapy without decreasing expected survival [27,46,47]. Additionally, to help clinicians better identify frailty, a frailty index (scoring system) generated from the results of GA has been designed that is predictive of all-cause mortality, reduced health-related quality of life, and hospitalizations [48–50]. This scoring system, which takes the accumulation of deficits and scores them from 0 (no deficits) to 1 (all deficits) and then categorizes patients into fit (0–0.2), pre-frail (0.21–0.35), and frail (>0.35) is useful, but requires clinicians to understand how to translate individual dimensions into dichotomous categories (vulnerable vs not) and then divide the vulnerabilities by the overall number of dimensions assessed (see Table 1). This process is difficult and requires the commodity of time, which is often not available in busy radiation oncology clinics. These and several other hurdles likely contribute to the lack of use of the GA in most radiation oncology clinics.

Translation into a radiation oncology clinic

Electronic versions of the GA which directly input the data into Electronic Medical records (EMRs) and can quickly calculate frailty indices and make intervention recommendations could significantly increase the potential benefit of GA while decreasing its burden on busy clinics. Many previous studies that both implemented and validated the use of GA within oncology clinics used paper forms completed by the patients [36,38,39]. However, several studies used electronic versions of GA that were also found to be feasible within busy oncology and radiation oncology clinics [22,51]. Thus far none of these studies have utilized the inherent potential of electronic forms to also interpret and display calculated results and consensus recommendations [44].

In an ongoing effort at the authors' institutions, a version of the patient-reported GA developed and implemented at the University of Alabama Birmingham (UAB) [52] was converted into an electronic version through a validated electronic Patient Reported Outcomes platform already in clinical use at the West Cancer Center and Research Institute. This platform known as the Patient Care Monitor (PCM) is a cloud-based system designed for the collection of patient-reported surveys and was one of the earliest developed and validated in clinics for patients undergoing anti-neoplastic treatments [53–55]. The PCM has since been deployed in over 130 sites including community oncology, academic, and hospital-based clinics. In radiation oncology, we currently use the PCM to ask cancer-specific toxicity questions before patient's weekly visits with their radiation oncologists. The platform allows for the design of easy to read and easy to answer questions. This cloud-based system allows the results of questionnaires to immediately upload into EMRs and for customized notification results to be sent providers which allow results to be interpreted and acted upon in real-time. In our current work-flow plan, patients complete the GA questions at their first consult on a computerized tablet either on their own or with the help of their care-givers or radiation oncology nurse, during the nurse's evaluation. The form takes between 15–20 minutes to complete. The electronic results of the GA are

Table 1
Example of a Deficit Accumulation approach to Frailty Index Creation [71,72].

Item	Deficit Definition	Points
Falls	≥ 1	1
Walk one block	= limited a lot	1
I-ADL mobility	(unable to/with some help)	1
I-ADL shopping	(unable to/with some help)	1
I-ADL meal prepare	(unable to/with some help)	1
I-ADL housework	(unable to/with some help)	1
I-ADL medication	(unable to/with some help)	1
I-ADL money	(unable to/with some help)	1
I-ADL get in and out of bed	(unable to/with some help)	1
ADL dress	(unable to/with some help)	1
ADL bath	(unable to/with some help)	1
Global Health	Good	0.5
	Fair/Poor	1
Global Quality of Life	Good	0.5
	Fair/Poor	1
Global Physical Health	Good	0.5
	Fair/Poor	1
Global Mental Health	Good	0.5
	Fair/Poor	1
Global satisfaction with social activities and relationship	Good	0.5
	Fair/Poor	1
Global everyday activities	Moderately	0.5
	A little/not at all	1
Global anxiety/depression	Sometimes	0.5
	Often/always	1
Global Fatigue	Moderate	0.5
	Severe/very severe	1
Global Pain	4–6	0.5
	7–10	1
Global Social Activities and Role	Good	0.5
	Fair/Poor	1
Weight loss (3 or 6 months)	≥ 5%	1
Food intake less than usual	Yes	1
Activities and function	≥ 2	1
Anxiety PROMIS	T score > 60	1
Depression PROMIS	T score > 60	1
Impaired Cognition	T score < 40	1
Daily Medications	≥9	1
Social Activity Interference	Some of the time	0.5
	Most/All of the time	1
Comorbities	Eyesight = Fair/Poor/Blind	1
	Hearing = Fair/Poor/Deaf	1
	Other Cancers	1
	Arthritis	1
	Glaucoma	1
	Emphysema or chronic bronchitis	1
	Hypertension	1
	Heart Disease	1
	Peripheral Vascular Disease	1
	Diabetes	1
	Stomach or Intestinal Disorders	1
	Osteoporosis	1
	Chronic Liver or Kidney Disease	1
	Stroke	1
	Depression	1

I-ADL: Instrumental Activities of Daily Living, ADL: Activities of Daily Living, PROMIS: Patient-Reported Outcomes Measurement Information System.

then made available to the physicians before they enter the patient's room. These real-time results being designed for the GA will not only report the answers to the specific questions but also calculate a frailty index [48], as well as guideline-recommended interventions (see Table 2). The result printouts are modeled to be similar to tumor molecular testing results which are delivered both with the relevant mutated and non-mutated genes as well as the systemic agents that may target those mutations [56]. This program would thus make it easier for radiation oncologists without training in geriatrics to interpret and react to the results of the GA appropriately. Additionally, based on the results of the GA different treatment paradigms could be suggested.

Example of a treatment paradigm based on frailty status

We have previously offered three examples of data-driven treatment paradigms that could be changed based on frailty status for Early Stage Breast Cancer, Glioblastoma Multiforme, and Head and Neck Cancers [57]. Another potential functional status based treatment paradigm may be offered within older adults being treated for rectal cancers [58]. Rectal cancer commonly occurs in adults 70 years of age and older, and for patients with mesorectal involvement or nodal involvement is standardly treated with trimodality therapy (chemotherapy, radiation, and surgery). For several decades the standard of care treatment in many countries has been to treat with a neoadjuvant course of either long course chemoradiation or short-course radiotherapy followed by surgical resection and adjuvant chemotherapy [59–62]. More recently, several trials have begun to demonstrate the potential role of a total neoadjuvant therapy (TNT) approach by offering induction/consolidative full systemic therapy first with chemoradiation or short-course radiotherapy followed by full systemic therapy all before surgical resection. [63,64] The total neoadjuvant approach has thus far demonstrated improved pathologic complete response (pCR) rates and tolerability compared to previous standards [65–67]. Several ongoing/completed trials also use this approach to test other novel agents (NRG GI002), or de-escalate therapy such as radiotherapy (PROSPECT) or surgery (OPRA). However, the benefit of this approach in older or frail adults is still very unclear. Previous treatment algorithms for older adults with rectal cancer based on functional status have not taken the TNT approach into their proposed algorithms [58]. The GA can be used to estimate frailty[68] and/or chemotherapy toxicity[36] and direct treatment approaches based on the frailty status of the individual patient. In patients deemed "fit", with low or average chemotherapy toxicity scores a TNT approach could be recommended. In patients that are deemed "pre-frail" or who have higher than average chemotherapy toxicity scores a standard neoadjuvant radiotherapy based approach may be more feasible. Other approaches that attempt to de-escalate therapy including radiotherapy or surgery may also be appropriate (though these approaches often require chemotherapy and highly dependent on treatment response). For patients deemed frail or unable to tolerate chemotherapy or surgery, a palliative approach using radiotherapy alone may be the most appropriate depending on the level of the patient's vulnerabilities. This is just one of several possible examples of a method to use the GA to "stage the age" of the patient in a way that can help radiation oncologists make personalized treatment choices.

Future directions

Significant work is still needed to demonstrate the benefit of the above-proposed approaches. Although several studies have demonstrated potential improvement in the care of older adults when GA interventions are used in the medical oncology setting [26], to date, no studies have demonstrated the same improvements in radiation-based treatments. It is also not clear that GA based recommendations will be acted upon by busy radiation oncologists. Prospective studies demonstrating improvements in radiation toxicity and outcomes will likely be needed to convince busy clinicians to begin to use these assessments as part of their routine practice. These trials are often quite difficult to design. GA-based assigned treatments may not improve easy to understand outcomes such as overall survival [69]. Rather the purpose of the GA-based recommendations is to personalize the risk–benefit ratio and thus combined endpoints that include both toxicity and efficacy may be better outcomes to assess in prospective studies. One example of such an endpoint is the "Overall Treatment

Table 2
Examples of GA Components and Triggers for Intervention [42–44].

GA-Domain	Test	Overall Score Range	Dichotomized Score	Intervention Triggered
Physical Function	Timed up and go Test	(seconds), higher score = lower function	≥14 seconds = dysfunction	Referral to Physical Therapy (PT)
	I-ADL	0–14, 14 no limitations	limitations in 2 or more of the 7 items assessed	Referral to Occupational Therapy (OT)
	ADL	0–7, 7 no limitations	<7 (i.e. any limitations)	Referral to PT/OT
	Falls		≥ 1	Referral to PT/OT Home Safety Assessment
Cognition	PROMIS Cognitive Function	t-score 0–100	≤40 = dysfunction	Referral to Geriatrician
Comorbidity	Number of Comorbidities/ Eyesight/Hearing		≥ 4, or if eyesight/hearing = fair/ poor/total blind/deaf	Referral to Geriatrician
	Polypharmacy		≥ 9 prescription medications	Referral to Geriatrician
Anxiety	PROMIS Anxiety	t-score 0–100	≥60	Referral to Psychologist and Social Worker
Depression	PROMIS Depression	t-score 0–100	≥60	Referral to Psychologist and Social Worker
Social Support	MOS Social Support Survey (Physical and Emotional subscales)		"None" or "a little' or "Some of the time" as the response to any item per physical or emotional subscales	Referral to Social Worker
Nutrition	Unintentional Weight Loss in the Last 3 and 6 months	0–99%	3% weight loss within 3 months or 6% weight loss within 6 months	Referral to Nutritionist

I-ADL: Instrumental Activities of Daily Living, ADL: Activities of Daily Living, PROMIS: Patient-Reported Outcomes Measurement Information System, MOS: Medical Outcomes Study.

Table 3
Overall Treatment Utility Definitions [62].

	Good OTU	Intermediate OTU		Poor OTU
Clinician Score	Benefit	No Benefit	Benefit	No Benefit
	and	and	and	and
Patient Satisfaction	Satisfied	Satisfied	Dissatisfied	Dissatisfied
	and		or	or
Toxicity	No Major	No Major	Yes Major	Yes Major
	and		or	or
Quality of Life	No Drop	No Drop	Yes Drop	Yes Drop

OTU: Overall Treatment Utility.

Utility" (OTU) as used in the GO2 trial [70]. The OTU was a combined endpoint of benefit, satisfaction, and toxicity as assessed by both the clinician and the patient (see Table 3). Future studies designed to test the impact of GA based recommendations and interventions to improve the OTU of older adults with rectal cancer (for example) will be necessary before the above-proposed treatment algorithm could be considered standard of care.

Additionally, to create future clinicians who are comfortable with GA-based approaches significant work is also needed on the education of practicing radiation oncologists and trainees [9]. Current international efforts on the creation of formal training curricula will hopefully lead to the development of generations of new radiation oncologists more open to the GA based approach [18]. Other formal training programs in geriatric oncology including the International Society of Geriatric Oncology (SIOG –Treviso course https://www.siog.org/content/siog-2019-advanced-course-treviso-italy) and informal information including textbook chapters [57] and guidelines (NCCN and ASCO) [30,31] are available for those interested. Ultimately, to increase the use of GA-based approaches in radiation oncology clinics both prospective data and improved training will be needed.

Conclusion

A GA-based approach to personalized treatment of older adults with cancer has become the recommended approach in multidisciplinary settings including medical oncology and surgical oncology clinics but is still not readily used in radiation oncology clinics. Electronic patient-reported GA questionnaires with real-time result interpretation and recommendations are currently being designed and implemented to help improve the use of the GA within busy radiation oncology clinics. Prospective studies and improved educational efforts on a GA based approach will hopefully increase interest among radiation oncologists and ultimately lead to improved care of older adults with cancer receiving combined modality therapy.

Disclosures

NV: Advisory Board for Concerto HealthAI. GRW: Consultant for Carevive Systems.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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