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Editorial
The *AJCN* aims to provide a forum where debate and the exchange of views can take place. We welcome papers on contemporary professional policy or practice issues of concern and interest to cancer nurses.

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Cancer Nurses Society of Australia

Guest editorial
Planetary health, carbon zero healthcare and cancer nursing

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While nurses aspire to "promote health, prevent illness, restore health and alleviate suffering" (ICN Code of Ethics), it is important to recognise that in our efforts to improve the health of individuals and communities our actions may have a profound adverse impact on planetary health.

If healthcare were a country, it would be the fifth largest climate polluter in the world[1]. In Australia it accounts for approximately 7% of our greenhouse gas emissions. Of these, 17% arise from direct emissions (hospital/care facility and vehicle emissions and waste), 12% from indirect emissions from energy consumption (electricity, steam, heating and cooling), and 71% from indirect emissions from other industries which are directly related to healthcare activities (supply chain, consumables manufacture and transport, agriculture for catering and cotton, and pharmaceuticals and chemicals)[2].

In 2021, 14 countries, together with the World Health Organization, pledged to develop carbon-neutral health systems by 2050[3]. Sadly, Australia was not one of them, although, of note, Victoria has committed to 100% renewable energy for hospitals and educational facilities by 2025, and South Australia's new Women's and Children's Hospital will be the first 'all-electric' hospital[4].

So what can we do? While decarbonising healthcare requires collective action by multiple stakeholders across multiple complex systems and industries, and the support of government, we must not underestimate the significant impact we, as the largest healthcare professional group, can have. We should lobby our managers, Health Boards and governments to develop and implement environmentally sustainable policies and practices. We should continuously measure, monitor and report our carbon footprint. We must insist not only on the availability of clinical and financial data for treatment and care outcomes, but also the inclusion of environmental data, such as measurement of CO_2 equivalent emitted/QALY gained in assessments of our health systems. We should adopt evidence–based guidelines to ensure appropriate care, improve equity of access to public health measures and preventive healthcare, and avoid low-value care (over-testing, over-diagnosis and over-treatment). We should design our healthcare institutions to optimise natural lighting and green energy. We should fund electric healthcare vehicles and promote green transport for both patients and staff. We should remove carbon-intensive food (i.e. red meats and sugar) from healthcare menus, reduce food waste, and source agriculture products only from suppliers with sustainable practices. We should avoid unnecessary travel for meetings and education and, where possible, provide care virtually, in patients' homes and in healthcare facilities closer to where patients live. And we should reduce our paper usage, improve recycling practices, and support the creation of a circular economy of healthcare products[2,5–7].

The wellbeing of people relies on the wellbeing of the Earth. Accordingly, we should be equally concerned with the treatment and care of our planet as we are for our cancer patients.

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Predicting mental adjustment to the diagnosis of colon cancer: an application of outcome expectations in socio-cognitive theory

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Abstract

Context The diagnosis of cancer has the highest risk of changing psychological functioning. The assessment of patients' psychological needs has remained as a challenge throughout the cancer journey.

Aim This study aimed to investigate the contributions of optimism and uncertainty as outcome expectations drawn from socio-cognitive theory (SCT) theory toward predicting mental adjustment to the diagnosis of colon cancer.

Method Utilising a convergent parallel mixed-method approach, data were collected from 20 newly diagnosed colon cancer patients attending an outpatient oncology clinic at a Christchurch hospital at two time points – after surgery and 4–6 months later.

Results The participants with an optimistic view reported mostly 'Fighting spirit' and 'Fatalism' mental adjustment, while uncertain patients showed 'Anxious preoccupation', 'Hopelessness/helplessness' and 'Fatalism'.

Conclusion Interventions to improve adjustment to the diagnosis of cancer should include supporting cancer patients to recognise and restructure negative expectations about their illness and the future.

Background

Distress associated with the diagnosis and ongoing management of cancer has led to recognise it as the sixth vital sign in cancer care[1]. Psychological distress is a significant and ongoing problem for the diagnosis of cancer; however, this mental health issue has been neglected and not properly understood, and studies have shown that distress is under-recognised in cancer programs[2]. It is recommended that cancer patients should be screened for distress across the cancer trajectory – at the time of initial diagnosis, before treatment, during and after treatment, and at transition to end-of-life or palliative care. The assessment of distress level by health professionals involving in cancer care has many potential clinical benefits – facilitating communication, planning appropriate psychosocial and supportive care interventions, improving quality in clinical care, and ensuring early referral for those in need of more intensive psychological interventions[3].

The term 'mental adjustment' refers to cognitive and behavioural responses in the face of a diagnosis of cancer[4]. Bandura's socio-cognitive theory (SCT) has been used to enhance health behaviours and adjustment to chronic illnesses and it can be an effective framework in increasing and even maintaining positive health behaviour[5]. The three components of the SCT are self-efficacy, outcome expectations and self-regulation; they have been considered as the predictors of positive change in psycho-oncology and, in turn, quality of life[6].

Outcome expectations indicate beliefs about which consequences are most likely to happen if particular behaviours are performed[7]. Cancer patients assess their cancer experience, which is influenced by positive or negative expectations. Outcome expectations may be used to assess patients' expectations of coping behaviours. Measurement of outcome expectations may identify patients with negative expectations which limit using effective coping strategies and ability to adapt to illness[8].

The term mental adjustment is referred to as the coping styles of individuals in the face of a diagnosis of cancer, defined as the cognitive and behavioural responses made by an individual to the diagnosis of cancer. Five categories have been developed for

mental adjustment to cancer – known as the (mental adjustment to cancer) MAC Scale – including 'fighting spirit', 'cognitive avoidance', 'hopelessness/helplessness', 'fatalism' and 'anxious preoccupation'[9].

High levels of distress and psychological symptoms are common among people who receive a diagnosis of cancer[10]. Little research exists on the influence of outcome expectations on mental adjustment to cancer. An optimistic expectation has been shown to be associated with fewer anxious and depressive symptoms and less hopelessness[11]. Optimism has a direct effect on positive affect in cancer survivors, and adoption of a 'fighting spirit' was shown to be a significant mediator on this relationship[12].

Very few studies have addressed the effects of uncertain expectations on mental adjustment to cancer. One study indicated that cancer patients cope with uncertainty through avoidance, maintaining a normal life, comparing themselves favourably to others in a similar situation, and remaining positive[13]. In the cancer journey, uncertainty engenders anxiety and frustration and exacerbates associated fears[14]. The research into the field of exploring the contributions of optimism and uncertainty as outcome expectations toward predicting mental adjustment to the diagnosis of colon cancer is beneficial to improve adjustment to the diagnosis of cancer and restructure negative expectations about the illness and the future.

Methods

Study design

A convergent parallel mixed-methods approach was chosen and data were collected through a longitudinal design at two time points:

- -Time 1: post-surgery at the first appointment at the outpatient oncology clinic.
- -Time 2: 4–6 months after surgery.

Both qualitative and quantitative data were collected at the same time points and were analysed separately and then brought together. Using purposive sampling, patients newly diagnosed with colon cancer attending an oncology outpatient clinic of a large tertiary teaching and research hospital in New Zealand were invited to participate. The participants had a diagnosis of colon cancer, had completed their surgical care, and been referred to oncology for consideration of adjuvant chemotherapy. Ethical approval was granted by the University of Otago Human Ethics Committee.

Data collection

A purposive sample of 25 people newly diagnosed with colon cancer after surgery were invited to participate in this study. Sixteen participants took part in semi-structured interviews to explore the concepts of mental adjustment to cancer and outcome expectations. Each interview took approximately 30–45 minutes. Twelve of the 16 participants agreed to be interviewed again 4–6 months later in which the same areas were explored. All interviews were recorded and transcribed verbatim. A total of 20 participants completed a demographic questionnaire, the Mini-MAC Scale and the Revised Life Orientation Test (LOT-R) at both time points.

Demographic information

General information including gender, age, date of surgery, treatments received, marital status, living area, ethnic group, religious preference and household composition were collected.

Mini-MAC Scale

The Mini-MAC is a 29-item self-rating questionnaire developed in response to the limitation of the original MAC Scale. The Mini-MAC contains five subscales: 'fighting spirit' (four questions), 'hopelessness/helplessness' (eight questions), 'anxious preoccupation' (eight questions), 'fatalism' (five questions) and 'cognitive avoidance' (four questions). The internal reliability coefficients of the Mini-MAC subscales were reported to be satisfactory (α coefficients 0.62–0.88)[15].

Revised Life Orientation Test (LOT-R)

The LOT-R was used to measure optimism. This test has been used in several studies in health and personality psychology. The LOT-R is a self-report measure including eight items and four filler items. Responses are made on 5-point Likert scales ranging from 0 (strongly disagree) to 4 (strongly agree). It is reported a Cronbach's alpha of 0.76 and a test-retest correlation of 0.79 over a 4-week period[16]. This scale possesses adequate predictive and discriminant validity[17].

Data analysis

All interview data were imported into NVIVO 10 for Windows as data files. Data analysis of transcripts was conducted using the process of a directed (deductive) content analysis for mental adjustment to cancer. All transcripts were reviewed carefully and all text that appeared to describe mental adjustment to cancer were highlighted and coded using Greer & Watson's mental adjustment to cancer categorisation[9]. The directed approach allows for generation of new codes and any data that did not reflect these categories were labelled. After coding, the data for each category were examined to determine sub-categories. Participants' outcome expectations responses were analysed through a conventional (inductive) content analysis. The findings were reported by rank order of incidence of codes representing the mental adjustment to cancer and outcome expectations categories. The trustworthiness of the qualitative style of this research was explored in relation to credibility, dependability and transferability.

All quantitative data were entered into IBM SPSS statistics V22. Descriptive statistics were used to present participants'

demographic characteristics and scores of all questionnaires at both time points of the study. Paired t-tests were used to explore differences over time, and the relationship between outcomes expectations' sub-scales and measures on the mental adjustment to cancer were investigated using Pearson product-moment correlation coefficient. Prior to conducting the analysis, the assumption of normal distribution was estimated and the assumption was considered statistically satisfied.

Findings

Qualitative findings

Sixteen people were interviewed at Time 1 (post-surgery) and 12 at Time 2 (4–6 months later). All participants were New Zealand European, most were male (62% / 58%) and over 70 years old (56% / 58%). The majority of participants were married (56%) and living with their husband/wife or partner (44% / 50%). More than half of the sample showed a religious affiliation (56.25% / 58.32%). All data related to mental adjustment were coded using pre-determined categories based on the Mini-MAC Scale[9].

Mental adjustment to cancer

Fighting spirit

Eleven participants adopted a 'fighting spirit' post-surgery. Nine of these participants reported that they were still on a 'fighting spirit' adjustment 4–6 months later. This response was sub-categorised as 'active fighting spirit' including 'determined to fight illness', 'using spirituality', 'keeping busy', 'counting blessings', 'humour' and 'cognitive fighting spirit', including 'adopting positive attitude', 'compulsive confrontation' and 'at a challenge':

> *I'm determined I'm going to recover... I'm pig headed, optimistic, determined to beat it* [Patient number 9 showing active fighting spirit: determined to fight illness].
>
> *What else, I'm still mobile yeah, I might not be able to do or go where I want to but I do my best* [Patient number 10 showing cognitive fighting spirit / adopting a positive attitude].

Anxious preoccupation

'Anxious preoccupation' was reported by seven participants after surgery and four participants 4–6 months later. It was sub-categorised as 'difficulty believing', 'anxiety', 'fear', 'contact with others' 'uncertainty', 'preventing plans', 'seeking information' and 'anger':

> *I don't know what it's like basically...* [Patient number 11 showing uncertainty].
>
> *I was shocked, absolutely shocked... This sort of thing can't happen to me* [Patient number 7 showing difficulty believing].
>
> *Apprehensive is probably the right word, apprehensive about what the future holds* [Patient number 14 showing fear].

Hopelessness/helplessness

Six of the participants after surgery and four of them 4–6 months later described their mental adjustment response as 'at a loss'. They expressed a pessimistic attitude toward the future which they had no control over:

> *Well I feel it's probably the worst disease you can get analysed with or the one most people know about... I did want to sort of shout "Shit I've got cancer!" That sort of thing, how did I get it, yeah?* [Patient number 6].

Fatalism

Five participants after surgery and again 4–6 months later showed a 'fatalism' adjustment response towards cancer. The relevant responses were sub-categorised as 'taking one day at a time', 'passive acceptance', 'in the hands of God', 'left all to doctors' and 'fatalistic':

> *One day at a time... I try and take one day at a time. Taking one day at a time)* [Patient number 12].
>
> *Well it's all in the hands of the God, isn't it, yes? And the surgeons yes...* [Patient number 17 showing in the hands of God and left all to doctors].

Outcome expectations

Optimism

Nine participants after surgery and seven participants 4–6 months later reported a positive 'optimistic' attitude toward treatment and they were hopeful about the future. They pointed out that optimism was their own choice and there was no advantage in being negative about the future:

> *I think you have to be positive you know, it's no good being negative and it just drags you down so... I'm looking forward to getting this year over with, getting past all the chemo and then we can move on and start planning some more holidays yeah* [Patient number 7].

Uncertainty

Seven of 16 participants after surgery and five of 12 participants 4–6 months later expressed an 'uncertainty' toward the future. They were concerned about a recurrence of cancer after treatment ended. They reported how long they were going to live was beyond their control and even during remission it would always be uncertain about what might or might not happen:

> *You don't know how long you're going to live. They can give you a prognosis; if things turn to custard and they say "Well you know" but who knows they can say give you six months and you step outside the next day and a bus hit you* [Patient number 15].

Mental adjustment to cancer in correlation with outcome expectations

A comparison of mental adjustment to cancer responses was undertaken between optimistic and uncertain participants to find out how outcome expectations correlated with mental adjustment to cancer.

Participants who reported optimistic attitudes towards the future and expected to return to good health showed 'active fighting spirit' and 'cognitive fighting spirit' as the most common mental adjustment responses after surgery. Conversely, participants feeling uncertain about the future responded mostly with 'anxious preoccupation' and 'hopelessness/helplessness' responses after surgery. Optimistic participants mostly responded with 'cognitive fighting spirit' and 'fatalism' as their mental adjustment to cancer strategies 4–6 months after surgery while 'anxious preoccupation' and 'fatalism' were most common for participants uncertain about the future (Table 1).

Quantitative findings

Twenty participants completed three questionnaires at both time points. All of the participants were New Zealand European, 60% were male and 80% were over 60 years old. At the time of study, 55% of participants were married and 45% were living with their husband/wife or partner. 35% reported no religious affiliation and 80% of the participants received chemotherapy after surgery.

Following surgery, Time 1, the most frequently used adjustment strategies were 'fighting spirit' and 'fatalism' (mean 3.1 and 2.85, respectively), whereas the least used strategies were 'hopelessness/helplessness' and 'anxious preoccupation' (mean 1.5 and 2.1, respectively). At Time 2, 'fatalism' and 'fighting spirit' (mean 3.01 and 2.92, respectively) were shown to be the most frequently used adjustment strategies, and 'hopelessness/helplessness' and 'anxious preoccupation' (mean 1.3 and 1.75, respectively) were the least common mental adjustment responses. Except for 'fatalism', all scores decreased at Time 2 (Table 2).

The overall optimism score was calculated by summation of all item scores in the LOT-R; a higher score indicates a greater optimism. The mean (ffISD) Time 1 and Time 2 of optimism scores were 19.85 (ff12.96) and 18.7 (ff12.66) respectively. There were no significant differences between Time 1 and Time 2 scores (t (19)=1.61, p=0.124). The relationship of optimism (LOT-R) with measures of Mini-MAC sub-scales at two time points was explored using Pearson product-moment correlation coefficient (Table 3). The assumption of normality was tested and considered to be satisfied.

There was a large, negative correlation between optimism and 'fatalism' 4–6 months after surgery, r=–.542, n=20, p<0.05, with higher levels of optimism associated with lower levels of 'fatalism'. There was a strong, negative correlation between optimism and 'hopelessness/helplessness' 4–6 months after surgery, r=–.546, n=20, p<0.05. Higher levels of optimism were correlated with low levels of 'hopelessness/helplessness'.

Table 1. Mental adjustment responses to colon cancer at Time 1 and Time 2 by outcome expectations responses

Time 1: immediately after surgery (n=16)		Time 2: 4–6 months after surgery (n=12)	
Optimism (n=9)	**Uncertainty (n=7)**	**Optimism (n=7)**	**Uncertainty (n=5)**
Active fighting spirit (n=7)	Anxious preoccupation (n=6)	Cognitive fighting spirit (n=4)	Anxious preoccupation (n=4)
Cognitive fighting spirit (n=6)	Hopelessness/helplessness (n=5)	Fatalism (n=3)	Fatalism (n=2)
Fatalism (n=2)	Active fighting spirit (n=4)	Hopelessness/helplessness (n=3)	Cognitive fighting spirit (n=2)
Anxious preoccupation (n=1)	Cognitive fighting spirit (n=4)	Active fighting spirit (n=2)	Hopelessness/helplessness (n=1)
Hopelessness/helplessness (n=1)	Fatalism (n=3)		Active fighting spirit (n=1)

Table 2. Mean values, SD and range of scores on the Mini-MAC sub-scales at Time 1 and Time 2

	Time 1: immediately after surgery		Time 2: 4–6 months after surgery	
	Mean (SD)	**Range**	**Mean (SD)**	**Range**
Anxious preoccupation total*	16.85 (6.62)	8–31	14 (4.53)	8–24
Anxious preoccupation mean**	2.1 (0.83)	1–3.88	1.75 (0.57)	1–3
Cognitive avoidance total*	10 (3.31)	4–15	9.8 (3.6)	4–16
Cognitive avoidance mean**	2.5 (0.83)	1–3.75	2.45 (0.9)	1–4
Fatalism total*	14.25 (3.8)	5–20	15.2 (3.8)	8–20
Fatalism mean**	**2.85** (0.76)	1–4	**3.01** (0.75)	1.6–4
Fighting spirit total*	12.4 (2.72)	8–16	11.7 (3.11)	4–16
Fighting spirit mean**	**3.1 (0.68)**	2–4	**2.92** (0.88)	1–4
Hopelessness/helplessness total*	12 (5.6)	8–30	10.3 (3.2)	8–20
Hopelessness/helplessness mean**	1.5 (0.7)	1–3.75	1.3 (0.4)	1–2.5

* Ranges: Anxious preoccupation 8–31; Cognitive avoidance 4–16; Fatalism 5–20; Fighting spirit 4–16; Hopelessness/helplessness 8–30
** Mean scores ranges: 1–4 (mean calculated by dividing total sum with number of items)
Items in bold refer to the most frequently used adjustment strategies

Discussion

Cancer patients appraise their cancer experience with positive or negative expectations. The negative expectations may limit using effective coping strategies and an ability to adapt to disease[8]. In the present study, we found that optimistic expectations are linked to 'fighting spirit' and 'fatalism', whereas an uncertainty towards the future is responded to mostly by 'anxious preoccupation', 'hopelessness/helplessness' and 'fatalism' (Figure 1). Furthermore, our quantitative results confirmed significant negative correlations between optimism with 'hopelessness/helplessness' and 'fatalism'. Therefore, it seems that as long as participants showed optimistic attitudes towards cancer, they adopted a 'fighting spirit' adjustment strategy more frequently. Conversely, 'uncertainty' is accompanied by more negative mental adjustment such as 'anxious preoccupation' and 'hopelessness/helplessness'. The correlation between outcome expectations and 'fatalism' was unclear and there were disagreements between findings; to our knowledge there is no literature which explains this.

Excepting 'fatalism', the findings of the current study are consistent with Bandura's SCT which believes that positive outcome expectations result in healthy behaviour[5]. Several studies have explored the role of outcome expectations in physical and mental health.

It has been documented that optimism and mastery are two cognitive traits that contribute to positive expectations for the future and are important predictors of level of anxiety as well as coping strategies[18]. In the qualitative analysis in the present study, the participants' outcome expectation responses were categorised in terms of optimism and uncertainty. Optimism has been defined as the degree to which one expects positive outcomes in future[17]. The literature has confirmed that optimism among patients with advanced cancer is significantly associated with fewer anxious and depressive symptoms and less hopelessness[19]. Although the present study assessed early colon cancer patients, the findings are consistent with these results as we found a significant negative correlation between optimism with 'hopelessness/helplessness'. Optimistic expectations were linked to 'fighting spirit' in the present study. In the same way, literature has confirmed that more optimism is related to more problem-focused and adaptive copings, while less optimism is related to more avoidant copings[20].

In the present study, uncertainty was described in terms of an ambiguous future and the probability of recurrence after completion of the treatments. Being uncertain about outcome expectations was accompanied by 'hopelessness/helplessness' and 'anxious preoccupation'. Patients cope with uncertainty through avoidance, maintaining a normal life, comparing themselves favourably to others in a similar situation, and remaining positive[13]. Uncertainty can engender anxiety and frustration and exacerbate associated fears[14]. In spite of limited literature, our findings were not surprising because uncertainty about outcome expectations may predict more distress among cancer patients.

Limitations

Limitations exist with the small sample size and non-probability sampling technique. Particularly, the small number of subjects in the quantitative part calls for caution in drawing statistical conclusions. The directed content analysis has some inherent limitations in that the researcher collects data with an informed and strong bias. Therefore, supportive evidence is more likely rather than unsupportive. Moreover, participants might get cues to answer interview questions such as is suggested in Watson's mental adjustment categories even though they did not experience them[4].

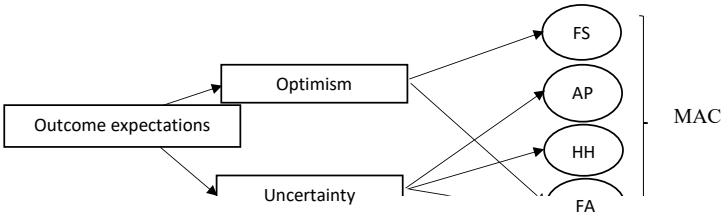

Figure 1. The correlations between outcome expectations and mental adjustment to cancer categories

FS: fighting spirit; AP: anxious preoccupation;
HH: hopelessness/helplessness; FA: fatalism

Table 3. Correlations between the optimism (LOT-R) scores and Mini-MAC sub-scales at Time 1 and Time 2

	Time 1: immediately after surgery		Time 2: 4–6 months after surgery	
	Pearson's r	p-value	Pearson's r	p-value
Anxious preoccupation	–.332	.153	–.302	.196
Cognitive avoidance	–.371	.108	–.255	.279
Fatalism	–.323	.165	**–.542***	.014
Fighting spirit	.152	.524	.071	.765
Hopelessness/helplessness	–.385	.093	**–.546***	.013

* Correlation is significant at the 0.05 level (2-tailed).

Conclusion and implications for nursing

This study revealed that outcome expectations influence the mental adjustment to cancer. This may have important implications for both the cancer screening policy and the healthcare system. After having diagnosis of cancer, the main focus was planning a surgery; however, there was a remarkable need for emotional support.

Distress is now considered as the '6th vital sign' and should be included in assessment, evaluation and monitoring of emotional distress in clients across the cancer trajectory. Regular nursing assessment of distress ensures early identification the need of additional support and planning interventions by the clinical team, and referral to psychosocial services for those at higher risk for negative health outcomes[3].

It seems clear that both physicians and nurses need to pay attention to the patient's psychological status at diagnosis time, and the psycho-oncology services should be organised to help at-risk patients. The policy-makers should allocate staffing resources for psychosocial care similar to many cancer clinics which offer psycho-oncological services to vulnerable patients[21].

An optimistic expectation was linked to 'fighting spirit' mental adjustment. People newly diagnosed with cancer may be helped to accept their situation realistically and learn to be content and trust health professionals to keep disease under control through treatments. Conversely, being uncertain about outcome expectations was accompanied by 'hopelessness/helplessness' and 'anxious preoccupation'. As a result, cancer patients should be encouraged to keep their follow-up visits, and learn what they can do for their health and what services are available to help them. Expressing feelings of fear or uncertainty with friends, family and professionals might be helpful to overcome uncertainty.

The limitations with the small sample size and non-probability sampling technique in this study suggests further studies with larger sample size to describe the goal of mental adjustment to cancer, such as getting back to pre-diagnosis functioning or defining a standard normality for cancer survivors. There is also a need to explore mental adjustment to advanced cancer with poorer prognosis.

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Conflict of interest

No conflict of interest to declare.

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Lymphoedema in patients treated for head and neck cancer and referral patterns to lymphoedema treatment services: a retrospective audit of electronic medical records

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Abstract

Background Surgery and radiation therapy of head and neck cancer (HNC), alone or in combination, results in damage to the lymphatic system, often evident as irreversible lymphoedema.

Objective To determine the prevalence of HNC treatment-related lymphoedema, the percentage of those patients referred to lymphoedema services, and who made those referrals.

Methods A retrospective audit of medical records of newly diagnosed HNC patients who presented to a tertiary cancer centre between January 2014 and December 2017.

Results Of 539 patient records audited, 20 records (3.7%) documented diagnosis of HNC-related lymphoedema. Of these, eight patients (40%) were referred to lymphoedema treatment services, with one referral made by a registered nurse, five by medical doctors, one by a speech pathologist, and one by a physiotherapist.

Conclusions In this audit, 3.7% of patients newly diagnosed with HNC had documented treatment-related lymphoedema. The referrals to lymphoedema services were interdisciplinary.

Introduction

Head and neck cancer (HNC) is the seventh most diagnosed cancer in Australia[1]. Treatment of HNC is often aggressive and multimodal, including surgery, chemotherapy and/or radiation to enhance survival rates. However, there is a potential to cause debilitating late effect complications[2] such as damage to the lymph nodes and the associated lymphatic vasculature within the head and neck region, which then impairs lymphatic drainage[3]. This lymphatic system impairment leads to chronic accumulation of interstitial fluid within extracellular spaces, causing tissue

swelling[4]. When this swelling persists for more than 3 months, it is recognised as a common co-morbidity of cancer treatment referred to as cancer-related lymphoedema or, in the case of HNC patients, head and neck lymphoedema[3].

Common locations for the development of HNC lymphoedema are the base of the tongue, submental and neck regions[5,6] and, as such, it can lead to the internal compression of the pharynx and larynx, which may impact airway patency[2]. Other physical symptoms include limitations to neck and shoulder movement, speech, mastication and swallowing deficits, and pain[5,7,8]. Persistent retention of interstitial fluid can activate inflammatory mediator responses resulting in fibrosis and adipose deposition within the skin and subcutaneous tissue[9]. This further impairs the lymphatic vasculature, causing greater morbidity for the patient[2]. Cancer-related lymphoedema can impact a patient's body image perception, precipitate mental health issues, reduce socialisation, and decrease quality of life[6,9]. However, these morbidities are avoidable as cancer-related lymphoedema is preventable with early referral to lymphoedema treatment services. These referrals are crucial for effective management and prevention of HNC treatment-related lymphoedema[5,7].

Some studies have assessed the referral patterns of patients with head and neck lymphoedema to lymphoedema services[9–11]; however, these studies did not identify who made the referrals. Nurses typically spend more time with patients compared to any other health professionals[12] and it is within their scope of practice to refer patients to lymphoedema treatment clinics[13]. Such intervention, combined with educating patients on identifying early cancer-related lymphoedema symptoms, enhance cancer survivorship[13]. An exploratory audit was undertaken to understand the prevalence of lymphoedema related to HNC treatment and to investigate the referral patterns of this patient population to treatment services in a major Australian tertiary cancer centre.

Materials and methods

Ethical considerations

Ethics was granted for this study (Ethics approval number 18/35R) and following the guidelines of the National Health and Medical Research Council Australia.

Design and settings

A retrospective audit was conducted on electronic medical records of new patients who underwent treatment for HNC between January 2014 and December 2017 at a large tertiary cancer treatment centre. The RECORD (REporting of studies Conducted using Observational Routinely collected Data)[14] statement was used to enhance the transparency of reporting the audit data. This statement, which is an extension to STROBE statement[15], supports research using routinely collected health data.

Participants

A purposive sample of all new patients (n=821) treated for HNC between January 2014 and December 2017 was reviewed.

Data tool development and validation

The cancer-related lymphoedema audit tool was formulated by the authors after a comprehensive literature search. The tool was uploaded to the REDCap™ database to facilitate data collection[16]. The tool consists of 30 items that pertain to five main categories: 1) patient demographic data; 2) HNC diagnosis (including the location, type and stage of cancer, and the date of diagnosis); 3) type of treatment undergone by the patient (surgery, chemotherapy, radiation or multimodal and if any lymph nodes were removed); 4) documentation of cancer-related lymphoedema, including time of identification, site of cancer-related lymphoedema documented; 5) referral information to lymphoedema-specific services, including the date of referral and who made the referral. Each question also provided the option of 'other' if the answer was not listed in the audit tool or 'not documented' if the data was not recorded in the medical record.

Internal validity of the tool was established by crosschecking 100 randomly selected cases between all authors using the joint-probability agreement method to determine the inter-rater reliability (IRR) as means to indicate 95%, acceptable consistency within the auditing process[17].

Data collection and analysis

Eligible patients were identified using diagnostic codes for HNC from the 10th International Classification of Diseases[18]. This included malignant and benign neoplasms of the lip, oral cavity, pharynx, larynx, nasal cavity, middle ear, salivary glands, thyroid gland, parathyroid gland, tonsils, and skin, connective and soft tissue of the head and neck region. Secondary and unspecified malignant neoplasm of lymph nodes, bone and bone marrow in the head and neck region were also included. Brain and eye neoplasms were excluded from this study. This yielded a total of 821 files containing HNC diagnosis. Once the duplicates were removed (n=179), 642 records were audited. The inclusion criteria required patients to be aged 18 years or over, have a confirmed diagnosis of HNC, and have had treatment for HNC. Of the 642 records, further exclusion included cases not having a confirmed diagnosis of HNC (n=89), had no documented treatment (n=3) or were not for treatment (n=8), and being lost to follow-up (n=3). This resulted in an end total of 539 cases included for data analysis (Figure 1). All medical records with documented cancer-related lymphoedema were cross-checked by one individual on the research team to maintain consistency.

The audit was undertaken between November 2017 and August 2019. Data were entered into the 30-item cancer-related lymphoedema audit tool using REDCap™ software[16] at the time of audit. At the completion of the audit, the data were exported from REDCap™ and analysed with Microsoft® Excel® for Mac 2019 (Version 16.36)[16]. Descriptive statistics were performed to summarise the distribution of the study variables and percentage calculations were used to summarise the categorical (e.g. gender)

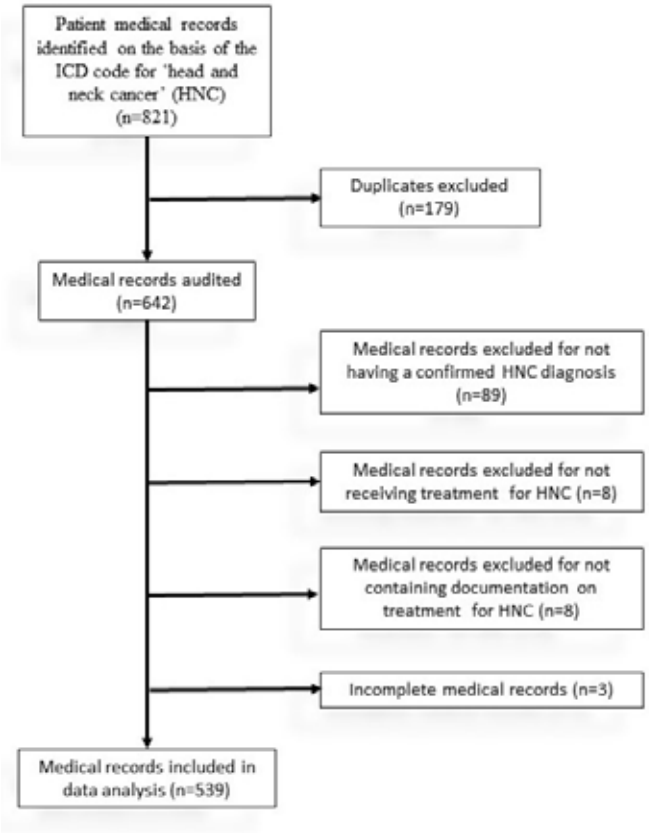

Figure 1. STROBE diagram identifying eligible study patients from the hospital's medical records

and ordinal data (e.g. cancer stage). Data are presented as mean ffl standard deviation or counts and percentages.

Misclassification bias

There is no gold standard for the diagnosis of cancer-related lymphoedema. To reduce any misclassification bias that may occur, the sample population inclusion criteria were strictly applied. If there was no documentation of cancer-related lymphoedema, it was not assumed that cancer-related lymphoedema was absent. Rather, the data was recorded as 'not documented'. This prevented an over-estimation of the prevalence of cancer-related lymphoedema and as such the results presented may be a conservative estimate.

Results

HNC treatment-related lymphoedema tool validation

A randomised selection of 100 medical records was subjected to an internal validity check. The IRR for each of the 30 items was between 80–100% across the research team, with an overall IRR of 95%. This indicated that all researchers interpreted each item in the same manner and there was high consistency in the data collection process[17].

Demographic characteristics

A total of 539 cases were included in this audit (Table 1). The mean participant age was 68 ffl16 years (range 22–100 years). The cohort consisted of 389 (72.2%) males, 148 (27.5%) females and two (0.3%) with no documented gender. A total of 313 (58.1%) participants lived in metropolitan areas, 220 (40.8%) lived in regional areas and five (0.9%) lived in remote areas. One patient's address (0.2%) was not documented.

Squamous cell carcinoma (SCC) was the most prominent cancer type within the cohort, with 360 (66.8%) documented cases; 68 (12.6%) records did not contain information on the type of cancer. Of the 360 SCC records, 72 (20.0%) were diagnosed as stage I cancer, 87 (24.2%) were diagnosed as stage II cancer, 38 (10.6%) were diagnosed as stage III cancer and 52 (14.4%) were diagnosed as stage IV cancer; 16 (4.4%) cases could not be staged. Twenty-five (7.0%) SCC records had recurrent cancer and 70 (29.4%) of the records did not contain information on cancer staging.

Prevalence of HNC treatment-related lymphoedema

Within the cohort of 539 patients, 20 (3.7%) patients had a documented presence of HNC treatment-related lymphoedema post-cancer treatment (Table 2). The records of 519 (96.3%) patients did not contain documentation of the presence or absence of cancer-related lymphoedema.

From the cohort of 20 (100%) patients who had documented the development of cancer-related lymphoedema after treatment, 11 (55.0%) patients were treated with a combination of surgery, chemotherapy and radiotherapy. Four (20.0%) of the patients underwent a combination of chemotherapy and radiotherapy, while four (20.0%) underwent surgery and radiotherapy. One patient (5.0%) was treated with surgery alone.

Ten patients (50.0%) developed cancer-related lymphoedema within a 3–6-month period after HNC treatment. Six patients (30.0%) developed cancer-related lymphoedema between 6–12 months post-treatment and two patients (10.0%) developed cancer-related lymphoedema between 12–24 months. One patient (5.0%) developed cancer-related lymphoedema beyond 24 months of HNC treatment, while one patient (5.0%) did not have the onset of cancer-related lymphoedema documented.

Cancers of the oral cavity (seven of 182, 3.8%), throat (five of 103, 4.9%), nasal cavity (two of 26, 7.7%), salivary gland (two of 52, 3.8%), skin (two of 59, 3.4%), cheek muscle (one of 6, 16.7%) and posterior neck (one of 9, 11.1%) were identified as the locations of HNC where cancer-related lymphoedema developed. Eighteen (90.0%) patients with documented cancer-related lymphoedema development had a SCC.

Referral of HNC treatment-related lymphoedema cases to lymphoedema-related services

When the 20 cases of documented cancer-related lymphoedema were examined for referral pathways, eight (40.0%) contained documentation of being referred to lymphoedema-specific services. Of the eight referrals, five (62.5%) were made by medical doctors, one (12.5%) referral was made by a nurse, one (12.5%) by

Table 1. Patient demographic characteristics

Characteristics	n (%)
Age (mean ffISD)	**68±16**
Sex (n=539)	
Male	389 (72.2)
Female	148 (27.5)
Not documented	2 (0.3)
Residential area (n=539)	
Metropolitan	313 (58.1)
Rural	220 (40.8)
Remote	5 (0.9)
Not documented	1 (0.2)
Type of cancer (n=539)	
SCC	360 (66.8)
Non-SCC	28 (5.2)
Not documented	68 (12.6)
Other	83 (15.4)
Documented stage of SCC cancer at diagnosis (n=360)	
Not documented	70 (19.4)
Could not be staged	16 (4.4)
Stage 1	72 (20.0)
Stage 2	87 (24.2)
Stage 3	38 (10.6)
Stage 4	52 (14.4)
Recurrent	25 (7.0)
Documented stage of non-SCC cancer at diagnosis (n=28)	
Not documented	8 (28.6)
Could not be staged	0 (0)
Stage 1	6 (21.4)
Stage 2	5 (17.9)
Stage 3	4 (14.3)
Stage 4	1 (3.6)
Recurrent	4 (14.3)
Documented stage of other cancers at diagnosis (n=83)	
Not documented	38 (45.8)
Could not be staged	1 (1.2)
Stage 1	14 (16.9)
Stage 2	9 (10.8)
Stage 3	6 (7.2)
Stage 4	10 (12.0)
Recurrent	5 (6.0)

a speech pathologist and one (12.5%) by a physiotherapist. Of those that were referred, three had developed cancer-related lymphoedema 3–6 months after treatment, four had developed cancer-related lymphoedema 6–12 months after treatment, and one had developed cancer-related lymphoedema 12–24 months after treatment.

Discussion

In this exploratory audit, the objectives were to determine the prevalence of HNC treatment-related lymphoedema and to investigate the referral patterns for HNC treatment-related lymphoedema patients to lymphoedema treatment services in a major tertiary cancer centre in Australia. The data tool developed for this purpose facilitated a high degree of consistency amongst researchers when collecting pertinent information. Based on the documented diagnosis of cancer-related lymphoedema, this study suggests a prevalence rate of 3.7% (n=20 of the 539 patients that underwent treatment for HNC) in this patient cohort.

Reported HNC treatment-related lymphoedema prevalence rates are widely varied throughout the literature. For example, one study found that 73.5% of HNC patients developed lymphoedema[5], while another study reported approximately 90% of participants experienced some form of lymphoedema[19]. However, a prevalence of 3.7% in this study is similar to that reported in a systematic review, which reported of HNC treatment-related lymphoedema prevalence to be 4.0%[13]. Congruent with previous findings, this study reports that the most common cancer locations with documented HNC treatment-related lymphoedema development were the throat (4.9%, n=5) and the oral cavity (3.8%, n=7)[20]. In our study, 90% of lymphoedema cases were associated with SCC, which is consistent with previously reported literature[5]. The most common HNC treatment associated with HNC treatment-related lymphoedema was a combination of surgery, chemotherapy and radiotherapy (n=11, 55%). This result is also consistent with previous research reporting that multimodal treatments were more likely to lead to the greater prevalence of HNC treatment-related lymphoedema[11]. Furthermore, our data support earlier observations that the most common onset time for HNC lymphoedema development was 3–6 months after treatment (n=10, 50%)[8,10].

Research indicates that HNC treatment-related lymphoedema is often unrecognised and undertreated by clinicians[19]. Additionally, HNC lymphoedema development has a long latency period, yet lymphoedema assessment is not a required component of routine examinations in follow-up appointments[5]. While the data set reported here is relatively small, our study suggests that referral patterns are a multi-disciplinary effort. Only one patient in the cohort reported here was referred to lymphoedema services by a registered nurse. Some patients in this audit seem to not be referred at all. This may be a result of referrals not being part of routine practice for many clinicians[3], uncertainty around whose responsibility it is to make these referrals, time restraints on clinical appointments, and/or challenges associated with recognising HNC-related lymphoedema. Furthermore, some clinicians may not be aware that lymphoedema may arise post-HNC treatment and that referring patients to lymphoedema treatment services for treatments available reduces the likelihood of the condition worsening[21].

Table 2. Characteristics associated with HNC treatment-related lymphoedema development

Characteristics	n (%)
Documented presence of HNC-related lymphoedema (n=539)	
Documented presence of HNC-related lymphoedema	20 (3.7)
No documented presence of HNC-related lymphoedema	519 (96.3)
Type of cancer where HNC-related lymphoedema was identified (n=20)	
Squamous cell carcinoma	18 (90)
Non-squamous	1 (5.0)
Not documented	1 (5.0
Anatomical location of HNC where lymphoedema developed (n=20)	
Oral cavity	7 (35.0)
throat	5 (25.0)
Nasal cavity	2 (10.0)
Salivary gland	2 (10.0)
Thyroid/parathyroid	0
Skull based	0
skin	2 (10.0)
Sarcoma of HN	1 (5.0)
paraganglioma	0
other	1 (5.0)
Not documented	0
Ear	0
HNC-related lymphoedema location (n=20)	
neck	3 (15.0)
submental triangle	5 (25.0)
epiglottis	1 (5.0)
cervical	2 (10.0)
nasal mucosa	1 (5.0)
larynx	1 (5.0)
Submental triangle + upper jugular + lower jugular	2 (10.0)
Cheeks	1 (5.0)
cheeks + cervical	2 (10.0)
cheeks + submental triangle + cervical	1 (5.0)
upper jugular + lower jugular + trapezius	1 (5.0)
Treatment type (n=20)	
Surgery only	1 (5.0)
Radiotherapy only	0
Chemotherapy only	0
Surgery and Radiotherapy	4 (20.0)
Surgery and Chemotherapy	0
Radiotherapy and Chemotherapy	4 (20.0)
Surgery and Chemotherapy and Radiotherapy	11 (0.55)
HNC-related lymphoedema Type (n=20)	
Combined	1 (5.0)
External	2 (10.0)
Internal	2 (10.0)
Not documented	15 (75.0)
HNC-related lymphoedema Staging (n=20)	
Not documented	20 (100.0)
First identification of HNC-related lymphoedema after treatment (n=20)	
3-6 months	10 (50.0)
6-12 months	6 (30.0)
12-24 months	2 (10.0)
>24 months	1 (5.0)
Not documented	1 (5.0)
Referral to lymphoedema services (n=20)	
Yes	8 (40.0)
Not documented	12 (60.0)
Referring clinician (n=8)	
Medical doctor	5 (62.5)
Nurse	1 (12.5)
Speech pathologist	1 (12.5)
Physiotherapist	1 (12.5)

Unlike cancer-related lymphoedema following breast cancer treatment where referrals are a part of routine nursing practice, awareness around the assessment and management of cancer-related lymphoedema in HNC by nurses is reported to be less common, evident with referrals to lymphoedema clinics generally occurring on a case-by-case basis[3]. This means that under-assessment and under-diagnosis of cancer-related lymphoedema may occur for this patient group. Where this may be the case, these patients are at risk of not receiving early interventional treatment for HNC treatment-related lymphoedema, thus worsening their symptom burden, and impacting their quality of life[22]. This highlights the necessity for improved education and training for the nursing workforce managing HNC patients, which may enhance their ability to recognise and assess HNC treatment-related lymphoedema during follow-up appointments for HNC patients at cancer survivorship clinics[21].

To date, we have not identified Australian-specific studies that address the needs of oncology nurses concerning education on cancer-related lymphoedema. However, a recent scoping review suggests that there may be confusion on what constitutes an oncology nurses' scope of practice in the identification, management and treatment of cancer-related lymphoedema[23]. A clear definition of nursing scope of practice may help nurses managing HNC patients to proactively assess for early stages of HNC treatment-related lymphoedema and provide early referrals to lymphoedema services. This may help reduce the risk of life-long patient disability and complications, including infections

and chronic inflammation, since the early stages of cancer-related lymphoedema are reversible[24,25]. Consequently, reducing associated morbidities would also likely reduce the associated costs to the healthcare system[3,7,26].

Limitations

The major limitation of this study was that documentation of many components of HNC characteristics and cancer-related lymphoedema development were either absent or incomplete. The lack of documented referral pathways in the data may reflect that most patients may have been referred to lymphoedema services in the community by their general practitioner, community nurse or community-based allied health practitioner, thus potentially bypassing hospital-based lymphoedema clinics. Another explanation is that some oncology nurses and other clinicians may lack awareness, confidence and training to identify cancer-related lymphoedema or may not be using available cancer-related lymphoedema measurement tools as part of routine practice when patients are seen in the cancer survivorship clinics. As part of the education given to the nursing workforce, risk factors for cancer-related lymphoedema development in HNC patients could be highlighted to encourage early identification and timely referral. This includes education that patients are more at risk of developing cancer-related lymphoedema if they undergo multimodal treatments, had a SCC, or had treatment for cancer in the throat or oral cavity[3,7,10,26,27].

To better understand the relationship between HNC treatment and subsequent development of HNC treatment-related lymphoedema, including the role of clinicians in early identification, referral and management of HNC-related lymphoedema, a prospective study following patients post-treatment study at a scale beyond one tertiary centre and mapping care to primary healthcare providers would be required. Such study would assist in determining if HNC-related lymphoedema is an under-recognised and/or underdiagnosed condition. Furthermore, it would help heighten awareness of the condition, thus increasing the awareness that lymphoedema treatments exist and, if made promptly, could help improve patient outcomes.

Conclusion

This exploratory audit reports a documented prevalence rate of 3.7% (n=20) for cancer-related lymphoedema development post HNC treatment, with 40% of patients having documented referral to lymphoedema services. The referral pattern indicates a multi-disciplinary approach to referrals. Due to the progressive nature of cancer-related lymphoedema, early referrals are important. Although the data set in this study is small, low HNC-related lymphoedema referrals may be attributed to a lack of awareness around HNC-related lymphoedema development and its associated symptom burden, or inadequate training of nursing, allied health and medical staff to recognise and assess HNC-related lymphoedema. Further research on referral pathway and patterns for HNC-related lymphoedema patients to lymphoedema treatment clinics within the community would be useful to identify alternative referral pathways in an Australian context, as well as what role the nursing workforce may play in reducing the impact of HNC-related lymphoedema on a patient's quality of life.

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Author contributions

ZT and GB conceived and developed this project. All authors participated in collection of data, data analysis and interpretation. EM and ZT wrote the first draft of the manuscript. Thereafter all listed authors participated in manuscript refinement to final draft. ZT supervised the commencement, duration and completion of this project.

Conflict of interest

The authors have no conflict of interest to disclose.

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Peripheral intravenous catheters in the care of oncology and haematology patients

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Abstract

Aim To determine peripheral intravenous catheter (PIVC) characteristics, complications and risk factors among patients in cancer units.

Methods A secondary analysis of a global, cross-sectional study (127 hospitals in 24 countries). Participants (≥18 years) admitted to cancer units were assessed once for PIVC characteristics and the presence of complications. Variables included patient demographics, device characteristics, treatment details, and device and/or site complications. PIVC characteristics were presented using qualitative descriptors; mixed-effects logistic regression models determined risk factors for PIVC complications.

Results: In total, 1,807 participants (1,812 PIVCs) were included; 12% (n=215) of PIVCs presented with complications. Risk factors included: insertion by doctors; insertion in ED and ambulance/other locations; poor PIVC dressing integrity; dwell time ≥49 hours; and administration of colloids/blood products and antiemetics.

Conclusions At least one in ten PIVCs in cancer units present with complications; regular PIVC assessment and improved dressing integrity is likely to reduce risk and improve outcomes.

Introduction

The prevalence of cancer is a growing burden upon healthcare systems, with approximately 14 million new cases identified each year worldwide[1]. Cancer survivors are also an expanding population; in the United States alone, this number is soon expected to reach 18 million[2], with 61% aged ≥65 years[3]. For many patients with cancer, vascular access devices are an essential lifeline during treatment and beyond.

Peripheral intravenous catheters (PIVCs) are regularly used to administer intravenous (IV) infusates, including blood, chemotherapy, fluids and supportive care drugs, in the treatment of cancer[4]. These devices are indicated for short-term, peripherally-compatible IV treatments[5] but have garnered concern, particularly in relation to extravasation risk following infusion of anti-neoplastic agents[6]. A recent study found 35% of PIVCs within an oncology/haematology population failed, due to mechanical (i.e. infiltration / occlusion) and/or infective and inflammatory (i.e. local or bloodstream infection (BSI) / phlebitis) complications[4]. Despite being common, PIVC failure may have dire consequences. The chronic nature of cancer and the frequency of treatment required often results in venous depletion due to recurrent cannulation attempts[7]. Moreover, these patients often present with risk factors such as immunosuppression, malnutrition and complex treatment needs, potentially increasing the likelihood of severe complications such as BSI[8,9].

While central venous access device (CVAD) use is common among oncology and haematology patients for long-term IV treatments and high-risk or peripherally-incompatible infusates (e.g. parenteral nutrition),[6] PIVC use is often a practical and unavoidable solution for emergent treatments and when drug incompatibilities exist[10]. However, there is a paucity of research investigating PIVC characteristics among this cohort. To address this evidence gap, we conducted a secondary analysis of data collected from a large multi-national, cross-sectional PIVC study[11]. Our goal was to identify characteristics of PIVCs and both modifiable and non-modifiable risk factors of PIVC complications, specific to inpatients in acute hospital cancer units.

Methods

Objectives

- To determine the characteristics of PIVCs in patients admitted to cancer units internationally.
- To establish risk factors (both modifiable and inherent) for presence of PIVC complications.

Sample population

The One Million Global Catheters (OMG) study was an international cross-sectional study of PIVC characteristics and use conducted between 1 June 2014 and 31 July 2015[11]. This large project collected data from 40,620 PIVCs (38,161 patients) in 51 countries[11]. All patients (and PIVCs) admitted to cancer units (oncology and haematology), regardless of underlying diagnosis, were eligible for this sub-analysis. Individual patient level data was not collected; therefore, aspects such as admitting diagnosis or underlying oncological or haematological condition could not be ascertained.

Ethical considerations

Human Research Ethics Committee approval for the sub-analysis was provided by Griffith University (2019/437). As de-identified data was sourced from an existing (ethically approved) dataset, patient consent was not required.

Variables

The OMG study used a point-prevalence design where participant and device characteristics, and signs and symptoms of PIVC site complications were observed for each patient at each site at a single point in time. Variables included:

- Participant characteristics: age (in years); gender; treatment (e.g. fluids, medications) administered on the assessment day.
- Insertion setting: location of patient (e.g. ward, emergency); time of day (e.g. Monday–/Friday; weekend; day; evening).
- Device characteristics: inserting clinician; reason for insertion; gauge/size; insertion site (e.g. forearm, hand); PIVC dwell time (in hours) at time of assessment.
- Device and site assessment: signs and symptoms of complications related to phlebitis and infection; malfunction; and skin reaction.
- Patient satisfaction: patient's experience with PIVC, scored on an 11-point numerical rating scale (0, worst; 10, best).

The data collection form/s are publicly available[11].

Outcomes

The primary outcome of interest was a composite measure of the presence of PIVC complications including any of:

- Signs and symptoms of phlebitis and infection: this included pain/tenderness, redness/erythema, swelling, palpable cord, vein streak, extravasation/infiltration, induration/hardness, and/or purulence, AND/OR
- Signs of malfunction: including leakage or partial/complete dislodgement.

For the purposes of the analysis, other reported complications such as blood in line, bruising/dried blood, and skin reactions (itch/rash, blistering/skin tears) were presented descriptively but not included in the multivariable analyses as *complications*.

Analysis

PIVC insertion and treatment characteristics and presence of complications were reported descriptively (using absolute numbers and proportions). Missing data were not imputed as they were not assumed to be missing at random given the data

collection method. Mixed-effects logistic regression models were used to assess predictors of complications, accounting for the clustering of the data within hospitals and regions. Odds Ratio (OR) with 95% Confidence Intervals (CI) were reported. Variables significant at p<0.2 in the univariable modelling were included in the multivariable model. Clinically relevant variables selected *a priori* were included in multivariable modelling irrespective of statistical significance at univariable analysis, including patient age, PIVC location (anatomical position), and PIVC gauge/size[12,13]. Data were analysed using Stata (V13; StataCorp, College Station, TX).

Results

Oncology and haematology participants made up 4.7% (n=1,807/38,161) of the total OMG study population, representing 24 countries and accounting for 4.5% (n=1,812/40,620) of the included PIVCs. There was a low incidence of concurrent (multiple) PIVC use (<1%).

Participants had a median age of 61 years (IQR, 49–72) and 53% were male (Table 1). PIVCs were most frequently inserted in the general ward setting (75%) and the emergency department (12%). A majority of PIVCs were inserted by nurses (80%), with fewer inserted by doctors (8%) or IV teams (3%). The most common insertion sites were the forearm (37%) and hand (34%), followed by the wrist (12%) and antecubital fossa (12%). Only 17% of PIVCs were used for chemotherapy administration, and 8% were used for administration of blood products. The administration of fluids

Table 1. Patient and device insertion characteristics

Participants (n=1,807)	Oncology/ haematology n (%)
Age, median (IQR), years	61 (49–72)
Male, gender, n(%)	939 (53)
Devices (n=1,812)	
Primary insertion area n (%) (*n=1,793)	
General ward/unit/clinic	1,350 (75)
Emergency department	215 (12)
Operating theatre	54 (3)
Radiology/procedure room	37 (2)
Intensive/critical care unit	14 (1)
Ambulance/emergency services	13 (1)
Other	4 (0)
Unknown	106 (6)
Primary inserter, n (%)	
Nurse	1,458 (80)
Doctor	146 (8)
IV team	53 (3)
Technician	33 (2)
Unknown	122 (7)
Other	0 (0)
Time of the day inserted n (%)	
Mon-Fri 7–5	689 (38)
Evening/night	347 (19)
Weekend 7–5	165 (9)
Unknown	611 (34)
PIVC dwell at assessment (Median (IQR), hours)	24 (4–51)
PIVC dwell at assessment n (%)	
0–24 hours	583 (32)
24–48 hours	249 (14)
48–72 hours	127 (7)
>72 hours	195 (11)
Unknown	658 (36)

Devices (n=1,812)	Oncology/ haematology n (%)
Reasons for PIVC insertion n (%)^	
IV medications	1,159 (64)
IV fluids	1,055 (58)
Chemotherapy	304 (17)
Blood product transfusion	146 (8)
Taking blood	65 (4)
Parenteral nutrition	41 (2)
Unstable/requiring resuscitation	25 (1)
Unknown	71 (4)
Primary PIVC size n (%)	
14G	5 (0)
16G	12 (0)
18G	126 (7)
20G	482 (27)
22G	660 (36)
24G	478 (26)
26G	2 (0)
Other	7 (0)
Unknown	40 (2)
Primary insertion site, n (%)	
Forearm	672 (37)
Hand	620 (34)
Wrist	221 (12)
Antecubital fossa	209 (12)
Upper arm	53 (3)
Foot	17 (1)
Other	15 (1)
Unknown	5 (0)

*Sample size <1,812 where missing data existed
^Multiple selections could be made.

(58%) and other IV medications (64%) was more common. PIVCs were predominantly sized between 20G–24G (89%), with the preferred size being 22G (36%).

Signs and symptoms of complications were present in 12% of PIVCs (Table 2). The most common symptom of PIVC complication was pain/tenderness at the site of insertion (6%). Nine percent of PIVCs in cancer units were idle (i.e. not in use on the day of assessment). Dwell-time had the highest rate of missing data, with 36% of PIVC insertion times undocumented.

Cancer units from various geographic regions (Africa, Asia, Australia/New Zealand, Europe, North America, and South America) were compared for differences in PIVC characteristics and complications; no notable differences were found. No cancer units in the Middle East or South Pacific contributed data to the larger study.

Multivariable modelling

In multivariable logistic models (Table 3), PIVC insertion by a doctor, compared with nurse-led insertion, was significantly associated with an increase in the presence of PIVC complications (OR 2.78, 95% CI 1.29–6.00, p≤0.01). PIVC insertions in emergency departments (OR 2.15, 95% CI 1.07–4.31, p=0.03) and ambulance/other/unknown units (OR 3.22, 95% CI 1.43–7.23, p≤0.01) vs. ward placement was were also associated with PIVC complications. Treatment factors, including the administration of colloids/blood products (OR 2.20, 95% CI 1.09–4.43, p=0.03) and IV anti-emetics (OR 1.94, 95% CI 1.18–3.18, p≤0.01), along with poor observed dressing integrity (not clean, dry and/or intact) (OR 3.58, 95% CI 2.30–5.58, p≤0.01) were also associated with increased risk of PIVC complications. Finally, incremental increases in dwell time from 49–72 hours (OR 6.55, 95% CI 3.03–14.18, p≤0.01) and >73 hours (OR 2.22, 95% CI 1.07–4.63, p=0.03), compared with those dwelling less than 24 hours, were associated with increased risk of PIVC complications.

A documented PIVC assessment (in the previous 24 hours before study observation) was associated with *decreased* risk of PIVC complications (OR 0.60, 95% CI 0.39–0.99, p≤0.04), as did male gender (OR 0.56, 95%CI 0.37–0.86, p=<0.01).

Table 2. Device and patient outcomes

Complications (n=1,812)	Oncology/ haematology n (%)
Group size	n=1,812
No clinical symptoms	1,597 (88)
With clinical symptoms	215 (12)
Phlebitis and infection	
Pain/tenderness	102 (6)
Redness (>1cm)	30 (2)
Swelling (>1cm)	25 (1)
Palpable cord	5 (<1)
Vein streak	7 (<1)
Extravasation/infiltration	4 (<1)
Induration/hardness (>1cm)	4 (<1)
Purulence	0 (0)
Malfunction	
Blood in line	77 (4)
Bruising/dried blood	42 (2.3)
Leaking	12 (<1)
Partial/complete dislodgement	4 (<1)
Skin reaction	
Itch/rash	6 (<1)
Blistering/skin tears	1 (<1)
PIVC not in use (on day of assessment)	157 (9)

Discussion

This sub-analysis is the first international study to demonstrate the state of PIVC characteristics and complications among hospitalised adults in cancer units. Overall, 12% of PIVCs in the cancer setting had signs and symptoms of complications. Pain and/or tenderness was the most common PIVC complication reported at the time of assessment (5.6%); this is consistent with a recent study identifying tenderness as the most frequently reported PIVC complication[14]. Notably, extravasation and infiltration (key concerns for the cancer population)[7] were identified in four PIVCs (<1%). We cannot be certain, however, that extravasation injuries would not have occurred later, as the data report one time-point of assessment. Unfortunately, the true incidence of extravasation remains unclear; a review (2013) found reported rates of 0.1–39%[15]; it is likely these rate differences stem from definition inconsistencies, or poor documentation and reporting[16].

Several modifiable risk factors were associated with an increased risk of PIVC complications. PIVC insertion by doctors demonstrated poorer outcomes compared with insertion by nurses. It is difficult to draw conclusions from this, however, as practices for 'inserter' ranged greatly, not only between facilities but also geographic regions, with some reporting a majority of doctor-inserted devices (e.g. Australia/New Zealand, 45%) compared with other regions where doctor-led insertions are rare (e.g. Europe, 9%)[11]. Furthermore, 'vascular access specialists,' hypothesised to improve PIVC insertion success and other outcomes[17], were not differentiated in the larger study data.

PIVCs inserted in geographic locations where conditions may preclude optimal insertion technique, such as emergency and ambulance/other, were associated with more complications, compared with ward-inserted PIVCs. The authors postulate this may relate to urgency of insertion, and limitations on prospective and considered device selection (e.g. PIVC v. CVAD) based on the treatment required[18]. Increased dwell time was similarly associated with an increased risk of complications, as increased dwell time offers greater days of exposure to develop complications. High-

Table 3. Logistic multivariable regression modelling (univariable and multivariable)

Variables	Complications n(%)	Univariable OR (95%CI)	p value	Multivariable (n=1,560) OR (95%CI)	p value
Age: mean(SD) (n=1,798)	57.03 (18.46)*	0.99 (0.98–1.00)	NS	0.99 (0.99–1.01)	NS
Inserted by (n=1,812)					
Nurse	109 (7.5)	Reference (group)		Reference (group)	
Doctor	24 (16.4)	2.83 (1.51–5.32)	<0.01	2.78 (1.29–6.00)	<0.01
Other	26 (12.5)	2.02 (1.15–3.53)	0.02	1.56 (0.76–3.20)	NS
Where it was inserted (n=1,793)					
General ward	97 (7.2)	Reference (group)		Reference (group)	
ED	22 (10.2)	1.83 (1.05–3.19)	0.03	2.15 (1.07–4.31)	0.03
ICU/OT/radiology	18 (17.1)	1.93 (0.99–3.76)	0.05	1.83 (0.81–4.16)	NS
Ambulance/other/unknown	22 (17.9)	3.41 (1.89–6.19)	<0.01	3.22 (1.43–7.23)	<0.01
Gender (n=1,803)					
Female	91 (10.5)	Reference (group)		Reference (group)	
Male	66 (7.0)	0.63 (0.44–0.90)	0.01	0.56 (0.37–0.86)	<0.01
PIVC position (n=1,807)					
Hand/wrist	71 (8.4)	Reference (group)		Reference (group)	
Lower arm	57 (8.5)	1.02 (0.69–1.51)	NS	1.13 (0.71–1.81)	NS
CF	22 (10.5)	1.10 (0.62–1.93)	NS	0.78 (0.39–1.57)	NS
Upper arm	9 (10.6)	1.44 (0.65–3.19)	NS	1.77 (0.71–4.42)	NS
Gauge (n=1,772)					
14–18G	19 (13.3)	1.25 (0.69–2.26)	NS	0.73 (0.34–1.56)	NS
22–24G	101 (8.8)	Ref		Reference (group)	
Bigger than 24G	36 (7.4)	0.88 (0.49–1.55)	NS	1.15 (0.58–2.28)	NS
PIVC assessment documented in the last 24 hours (n=1,812)					
No	85 (10.2)	Reference (group)		Reference (group)	
Yes	74 (7.5)	0.66 (0.43–1.01)	NS	0.60 (0.39–0.99)	0.04
PIVC dressing assessment (n=1,757)					
Clean, dry and intact	95 (6.6)	Reference (group)		Reference (group)	
Not clean, dry and intact	63 (20.3)	3.73 (2.54–5.49)	<0.01	3.58 (2.30–5.58)	<0.01
Colloid/blood product fluids today (n=1,756)					
No	136 (8.3)	Reference (group)		Reference (group)	
Yes	18 (16.1)	2.15 (1.19–3.87)	0.01	2.20 (1.09–4.43)	0.03
Anti-emetic medication today (n=1,725)					
No	106 (7.8)	Reference (group)		Reference (group)	
Yes	44 (12.3)	1.58 (1.03–2.41)	0.04	1.94 (1.18–3.18)	<0.01
Chemotherapy medication today (n=1,725)					
No	134 (9.4)	Reference (group)		Reference (group)	
Yes	16 (5.3)	0.54 (0.30–0.96)	0.04	0.71 (0.36–1.41)	NS
Time of the day inserted (n=1,812)					
Mon-Fri 7–5	47 (6.8)	Reference (group)		Ref	
Weekend 7–5	21 (12.7)	2.08 (1.13–3.83)	0.02	1.38 (0.68–2.80)	NS
Evening/nights	31 (8.9)	1.48 (0.87–2.51)	NS	1.18 (0.63–2.18)	NS
Unknown	60 (9.8)	1.50 (0.97–2.33)	NS	1.26 (0.31–5.13)	NS
Dwell time (n=1,812)					
0–24 hours	27 (4.6)	Reference (group)		Ref	
25–48 hours	21 (8.4)	1.88 (1.00–3.51)	0.05	1.27 (0.62–2.60)	NS

Variables	Complications n(%)	Univariable OR (95%CI)	p value	Multivariable (n=1,560) OR (95%CI)	p value
49–72 hours	25 (19.7)	6.43 (3.36–12.32)	<0.01	6.55 (3.03–14.18)	<0.01
>73 hours	22 (11.3)	2.83 (1.48–5.39)	<0.01	2.22 (1.07–4.63)	0.03
Unknown	64 (9.7)	2.30 (1.38–3.83)	<0.01	1.18 (0.28–4.89)	NS

* Mean(SD); NS Not significant <0.05

level evidence continues to suggest that clinically indicated replacement, rather than routine replacement at dedicated time-points (e.g. 72 or 96 hours), should be incorporated as best practice[19]. Essential to this practice is consistent PIVC site-monitoring and early removal where complications exist[20]. This is supported by our study which found the risk of complications decreased where a PIVC site assessment had been completed and documented in the last 24 hours.

The one-time dressing assessment found 18% of PIVCs to be 'not clean, dry and/or intact.' Arguably, dressing and securement integrity is one of the most important risk factors for PIVC failure, and one that is easily amenable to improvement. While PIVC dressing and securement methods are diverse and the optimal method is unknown[21], focusing on integrity and early intervention for sub-optimal dressing and securement should be paramount in nursing practice.

Treatment factors including colloid/blood product and anti-emetic administration were associated with PIVC complications; there may be several causes for this. Blood products, as a result of their viscosity (estimated to be 4.5 times standard normal saline viscosity), decrease flow rate through infusion tubing and peripheral catheters[22], therefore, inadequate flushing following infusions may have resulted in later PIVC complications. Interestingly, this contrasted with findings of one study that found blood products *prolonged* PIVC dwell time, citing the possibility that pH balance played a role[23]. Further investigation is required to assess the impact of IV treatments on PIVC failure to better inform device selection and/or best practice for PIVC care. Finally, male gender was the single non-modifiable risk factor associated with a *decreased* risk of PIVC complications; this is consistent with previous research findings[12,13,24], perhaps reflecting males' larger veins and therefore smaller catheter-to-vessel ratios.

Overall, the authors found a moderate rate of idle PIVCs in this cohort (9%). Despite being lower than the larger study cohort (14%),[11] this is nonetheless concerning. While there is little evidence for the exact rate of PIVC-related BSI in a cancer population, overall risk of BSI and downstream complications is nevertheless extremely high, particularly among neutropenic patients[25]. As identifying modifiable sources of infection is key in BSI prevention[25], prompt removal of invasive devices should be considered by all clinical staff caring for cancer patients. Similarly, staff should be aware of the implications of blood in PIVC lines, identified in 4% of devices, such as the development of fibrin sheath (and thrombosis) which enable establishment of bacteria on internal surfaces of polyurethane catheters[26] and pose additional risk to an already vulnerable population.

Results may be limited as: (i) patients receiving care for cancer are not exclusively treated in cancer units; (ii) similarly, patients *not* receiving treatment for cancer may be placed in these units; and (iii) as an altered definition of complications was used, direct comparison cannot be made to the larger OMG study. Despite these limitations, results present an important, large-scale description of the state of care in cancer units and may be used to inform future rigorous research into the improvement of PIVC care in this specific, high-risk population.

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Authorship and manuscript preparation

The authors agree to meeting all International Committee of Medical Journal Editors criteria for authorship. EL, GRB, CF, NM, EA, VC and CR wrote the grant application. GRB and EA provided the de-identified data-sets. MT was the data analyst. EL drafted the first manuscript. All authors provided final approval of the final submitted manuscript.

Conflicts of interest

EL's employer/affiliates (Griffith University and the University of Queensland) have received, on her behalf, from manufacturers of vascular access device products: an investigator-initiated research grant from Eloquest Healthcare and a scholarship for conference attendance supported by Angiodynamics. GRB reports investigator-initiated research grants, speaker fees and consultancy payments provided to Griffith University by product manufacturers (3M, Becton Dickinson) and education providers (Ausmed, Wolters Kluwer). NM reports that Griffith University or The University of Queensland has received on her behalf: investigator-initiated research grants and unrestricted educational grants from Becton Dickinson, Cardinal Health and Eloquest Healthcare, and consultancy payments for educational lectures/expert advice from Becton Dickinson and 3M. CMR's employers (Griffith University or The University of Queensland) have received on her behalf: investigator-initiated research or educational grants from Becton Dickinson-Bard, Cardinal Health,

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