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Survival patterns in teenagers and young adults with cancer in the United Kingdom: Comparisons with younger and older age groups ☆

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Abstract ***Aims:*** We aimed to describe and compare survival in teenagers and young adults (TYAs) with cancer to that of younger children and older adults, to identify sub-populations at greater or lesser risk of death.
Methods: We compared survival in cancer patients diagnosed in the United Kingdom aged 13–24 years (TYAs) to those aged 0–12 (children) and 25–49 years (adults) using the National Cancer Data Repository. All cases had a first cancer diagnosis between 1st January 2001 and 31st December 2005 with censor date 31st December 2010 or death if earlier.
Results: We found six distinct statistically significant survival patterns. In pattern 1, the younger the age-group the better the 1- and 5-year survival (acute lymphoid leukaemia, carcinoma of ovary and melanoma). In pattern 2, TYAs had a worse 5-year survival than both children and young adults (bone and soft tissues sarcomas). In pattern 3, TYAs had a worse 1-year survival but no difference at 5-years (carcinoma of cervix and female breast). In pattern 4, TYAs had better 1-year survival than adults, but no difference at 5 years (carcinoma of liver and intrahepatic bile ducts, germ cell tumours of extra-gonadal sites). In pattern 5, the

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younger the age-group the better the 5-year survival, but the difference developed after 1-year (acute myeloid leukaemia, carcinoma of colon and rectum). In pattern 6, there was no difference in 1- and 5-year survival between TYAs and adults (testicular germ cell tumours, ovarian germ cell tumours and carcinoma of thyroid).

Conclusion: TYAs with specific cancer diagnoses can be grouped according to 1- and 5-year survival patterns compared to children and young adults. To further improve survival for TYAs, age-specific biology, pharmacology, proteomics, genomics, clinician and patient behaviour studies embedded within clinical trials are required.

1. Introduction

In people aged 13–24 years, cancer is the leading cause of non-accidental death in the UK [1]. While some cancer types (such as Hodgkin's disease, germ cell tumours and melanoma) have excellent survival, others (such as sarcomas and central nervous system (CNS) tumours) have much poorer results [2–4]. Although cancer outcomes have improved, teenagers and young adults (TYAs) may not have seen the dramatic improvements seen in younger children and older adults [5].

Our aim was to estimate 5-year survival rates for TYAs aged 13–24 years with cancer in the UK and identify survival patterns, in comparison with younger children and older adults, to identify sub-populations at greater or lesser risk of death. This can direct hypotheses underpinning the outcomes observed. We also aimed to partition survival rates over follow-up time. In cancers where prognosis with prompt treatment at an early point in the disease history is good, comparatively lower 1-year survival may be due to advanced stage at diagnosis, deaths from peri-operative or treatment toxicity and (rarely in young people) co-morbidity [6]. Lower 5-year survival conditional upon surviving 1-year indicates clinical deterioration after initial successful therapy, and therefore differences in the longer-term effectiveness of patient management; differences due to variation in biology between age-groups or in treatment, pathways of care, clinician or patient behaviour [7,8].

2. Materials and methods

We analysed survival at 1 and 5 years from diagnosis for TYAs between the ages of 13 and 24 years by cancer diagnosis, and compared with survival of younger children (0–12 years) and older adults (25–49 years) for the 17 most common cancer diagnostic groups affecting TYAs in the UK; acute lymphoid leukaemia, acute myeloid leukaemia, non-Hodgkin's lymphoma, Hodgkin's disease, CNS tumours, bone tumours, soft tissue sarcomas, testicular germ cell tumours, ovarian germ cell tumours, germ cell tumours of non-gonadal sites, melanoma, carcinoma of thyroid, carcinoma of colon and rectum, carcinoma of liver and of sites in gastro-intestinal (GI) tract, carcinoma of ovary, carcinoma of cervix, carcinoma of female breast. We examined the 5-year survival conditional upon surviving 1 year after diagnosis, i.e. removing deaths within the first year, maintaining consistency with earlier work looking at early and late survival [6,8].

One- and five-year survival estimates were based on cancer registration data for all patients resident in the United Kingdom aged between 0 and 49 years, with a first malignant neoplasm diagnosis or a diagnosis of borderline or benign CNS tumour, between 1st January 2001 and 31st December 2005. The censoring date was 31st December 2010, or earlier death. The dataset includes all diagnosis information held by the National Cancer Data Repository (NCDR) excluding identifiable data. The NCDR is a compilation of all cancer registry data undertaken by National Cancer Intelligence Network (NCIN). It was obtained through North West Cancer Intelligence Service (NWCIS) which is the lead registry for cancer in TYAs in England. Diagnoses were grouped using ICD-0-2 topography [9] and morphology codes TYA classification scheme [7].

Death certificate-only registrations (1.9% across all ages), any case with a date of diagnosis equal to date of death and individuals with a previous cancer diagnosis prior to 2001 were excluded. A diagnostic group was excluded if the number of new cases with that diagnosis per year was fewer than 10 to avoid unstable results. Where the total number of cases in a single age-group was less than 5, no data are shown to preserve confidentiality. Ascertainment of those aged under 15 years diagnosed with cancer in 2003–2004 is almost complete [10], while no formal evaluation of the completeness of registration of cancer in 15–24 year olds was conducted. At the level of main diagnostic categories (per the Birch et al. classification [7]), 98% of cancer registrations are sufficiently detailed to be allocated to the main categories. In the UK cancer registries receive weekly copies of death certificates of all individuals who died in their region on whose death certificate cancer is mentioned. Registries also receive monthly copies of death certificates of any patient registered with cancer by that registry if the death certificate does not mention cancer or the patient died in another region.