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Survival after a diagnosis of testicular germ cell cancers in Germany and the United States, 2002–2006: A high resolution study by histology and age

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ABSTRACT

Introduction: The aim of this study was to provide detailed age-specific (5-year age groups) and histology-specific (histologic subtypes of seminoma and nonseminoma) relative survival estimates of testicular germ cell cancer patients in Germany and the United States (U.S.) for the years 2002–2006 and to compare these estimates between countries. *Methods*: We pooled data from 11 cancer registries of Germany and used data from the U.S. (SEER-13 database) including 11,508 and 10,774 newly diagnosed cases (1997–2006) in Germany and the U.S., respectively. We estimated 5-year relative survival (5-year-RS) by histology and age based on period analysis. *Results*: 5-year-RS for testicular germ cell tumors was 96.7% and 96.3% in Germany and the U.S., respectively. 5-Year-RS for spermatocytic seminoma was close to 100% in both countries. 5-Year-RS for nonseminoma was lower than for classical seminoma in Germany (93.3% versus 97.6%) and the U.S. (91.0% versus 98.2%). Among nonseminomas, choriocarcinomas provided the lowest 5-year-RS in both countries (Germany 80.1%, U.S. 79.6%). Age-specific 5-year-RS for seminoma showed only little variation by age. 5-Year-RS for nonseminomas tended to be lower at higher ages, especially for malignant teratoma. *Discussion*: This is the first study that provides up-to-date survival estimates for testicular cancer by histology and age in Germany and the U.S. Survival after a diagnosis of testicular cancer is very comparable between Germany and the U.S. 5-Year-RS for spermatocytic seminoma was close to 100% and the lowest 5-year-RS occurred among choriocarcinoma. Higher age at diagnosis is associated with a poorer prognosis among nonseminoma patients.

1. Introduction

Information on survival of cancer patients is an important indicator of cancer control, besides the numbers of new cases (incidence) and deaths (mortality). Survival information is needed for estimating how many cancer survivors are alive at any one time in order to plan health services [1]. With modern therapeutic approaches, 5-year survival after the diagnosis of testicular cancer exceed 90% in many countries [2]. Several prognostic factors of testicular cancers have been identified including histologic group, extent of disease, and age at diagnosis. However, the independent prognostic relevance of these factors controlling for confounders has been disputed until recently [3].

A recent large cohort study based on the surveillance epidemiology and end results database (SEER 17) of the U.S. examined for the first time the effect of age on testicular cancer-specific observed mortality while taking into account diseases characteristics (extent of disease: localized or metastasized, i.e. regional or distant metastases), treatment factors (radiotherapy, retroperitoneal lymph node dissection), and sociodemographic variables by use of multivariable regression techniques. An important finding of this study was the adverse effect of age at diagnosis (<40 years versus 40+ years) on testicular cancer-specific mortality within both subgroups of testicular germ cell

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tumors, seminoma and nonseminoma. As in many other studies, this study used broad categories of histology (seminoma versus nonseminoma) and age (<40 years versus 40+ years) [4].

Many previous studies reported relative survival (RS) of testicular cancer. However, many reports did not even distinguish between seminoma and nonseminoma and also included testicular tumors other than germ cell tumors [1,2,5–13]. Some studies distinguished by histology but only in broad terms by providing separate RS estimates for seminoma and nonseminoma [14–19]. Age stratification of RS estimates – if any – either was not reported or was based on broad categories especially in the age range 15–40 years [1,2,6,7,10,12,14,16,18].

The aim of our study was to provide detailed age-specific (10-year age groups) and histology-specific (histologic subtypes of seminoma and nonseminoma) relative survival estimates of testicular germ cell cancer patients in Germany and the United States (U.S.) for the years 2002–2006 and to compare these estimates between countries.

2. Material and methods

2.1. German Cancer Registry data

A collaborative study of cancer survival in Germany was initiated by the German Cancer Research Center and the Association of Epidemiological Cancer Registries (GEKID) in 2009. Details of the project have been published recently [20]. Briefly, we pooled data from 11 cancer registries of Germany covering a population of 33 million people (Table 1). The estimated completeness of cancer registration was over 80% in all registries and over 90% in most registries in 2004–2006. Follow-up was performed by linkage to death certificates of the respective state and in some registries additional linkage to population registries to get information about deaths or migration to other states. Two of the smallest cancer registries covering urban populations (Hamburg and Bremen) registered out-migrations of cancer patients (any cancer) by record linkage with population registries. Out-migration rates leading to the loss of follow-up were 1.7% in Hamburg and 2.8% in Bremen [20].

2.2. SEER-13 database

In addition, we extracted testicular cancer cases diagnosed in 1997–2006 of the SEER-13 (surveillance epidemiology and end results) database for comparative analysis [21]. Patients with testicular cancer diagnosed in 1997–2006 who were at least 15 years old at the time of diagnosis were included in the analysis.

SEER employs resource intensive follow-up to capture the last date of contact for each cancer case, with standards specifying that active follow-up be conducted for 95% of cases [22]. Cases are matched to the National Death Index, Social Security, Medicare and Medicaid data as well as records of contact with physicians, pathology labs and hospital registries. If persons with cancer moved out of a registry area, follow-up was tracked no matter where they moved within the U.S. We excluded cases diagnosed at autopsy and death certificate only cases (DCO).

2.3. Coding and grouping of morphology codes

All registries coded cancer topography, morphology and behavior according to ICD-O-3 (International Classification of Diseases for Oncology) [23]. These codes were converted into ICD-10 (International Classification of Diseases) using the rules of the International Association of Cancer Registries (IACR) [24]. All registries recorded cancer cases according to the rules of the International Agency for Research on Cancer. We used ICD-O morphology codes to classify the tumors. Morphology codes 9060–9062 and 9064 identified classical seminomas. Code 9063 identified spermatocytic seminomas. Nonseminoma without mixed germ cell tumors included codes 9065, 9070–9072, 9080–9084, and 9100–9102 while code 9085 identified mixed germ cell cancers. Specific nonseminoma entities included embryonal carcinoma (9070), yolk sac tumors (9071), malignant teratoma (9080–9084, 9102), and choriocarcinoma (9100–9101). Germ cell tumors coded as 9065 are nonseminomatous germ cell tumors without further specification.

Starting in the late 1980s, a provisional field code for mixed germ cell tumor morphology (MGCT) was introduced into the 1st and 2nd versions of the ICD-O [23]. The MGCT morphology code (9085/3) became a standard morphology code in the ICD-O 3rd version [25]. Incidence trend analyses of testicular cancer in the U.S. and Germany suggest that the ICD-O code "mixed germ cell cancer" is being used for all mixed histologies, whether they are tumors with combinations of nonseminoma histologies or tumors with both seminomatous and nonseminomatous elements [26].

3. Statistical methods

We estimated 5-year relative survival (5-year-RS) which is the ratio of the observed probability of survival and the probability that would have been expected if the cancer patients had only experienced the normal (background) mortality of the general population in which they live, given the same distribution of factors such as age, sex, geographic area, and calendar period. Expected survival was estimated according to the Ederer II method

Table 1
Overview of participating cancer registries in the present analysis.

Registry	Population (million) covered in 2006	Diagnosis period	% DCO (excluded)[a]	Testicular cancer cases	Median age at diagnosis	Microscopically confirmed cases (%)
Bavaria[b]	8.13	2002–2006	2.3	1732	36	100.0
Brandenburg	2.55	1997–2006	1.5	1217	37	99.5
Bremen	0.66	1998–2006	3.4	228	34.5	99.6
Hamburg	1.75	1997–2006	3.2	734	35	95.6
Mecklenburg-Vorpommern	1.69	1997–2006	1.8	921	36	99.5
Lower Saxony	7.98	2001–2006	4.4	2175	36	99.5
North Rhine-Westphalia[b]	2.62	1997–2004	1.7	929	35	98.9
Rhineland-Palatinate[b]	0.52	1998–2006	0.9	213	35	100.0
Saarland	1.04	1997–2006	0.6	488	36	100.0
Saxony	4.25	1997–2006	1.9	2081	37	99.0
Schleswig-Holstein[b]	1.85	1999–2006	3.1	790	36	99.9
Total	33.04		2.5	11,508	36	99.2

[a] DCO for testicular cancer overall. No autopsy only cases.
[b] Selected administrative districts only.