MOBILE PHONES AND THE RISK FOR BRAIN TUMOURS

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Abstract

In a case-control study on mobile phone use we included 1617 patients with brain tumour. One matched control to each case was selected. Exposure was assessed by a questionnaire. Analogue phone users had an increased risk, OR=1.3 (95%CI=1.02-1.6). With a tumour induction period of >10 years the risk increased further to OR=1.8, CI=1.1-2.9. The risk was increased for tumours located in the temporal area on the same side of the brain that was used during phone calls, for analogue cellular telephones OR=2.5, CI=1.3-4.9. The highest risk was found for acoustic neurinoma with OR=3.5, CI=1.8-6.8 among analogue cellular telephone users.

Introduction

The increasing use of cellular telephones has caused concern of an increased risk for brain tumours. In Sweden the analogue (Nordic Mobile Telephone System; NMT) was introduced in 1981 operating at 450 MHz. Typically in the beginning these phones were used in a car with external antenna, but from 1984 the first portable analogue phones were available. The analogue 900 MHz system started in 1986, but was closed down in 2000 in Sweden. The digital system (Global System for Mobile Communication; GSM) started in 1991 and grew commercially from 1992 to be the most common phone at the end of the 1990's in Sweden. The first cordless phones were available in Sweden in 1988. Initially the analogue system in the 800-900 MHz RF range was used. Now digital cordless telephones that operate at 1 900 MHz are available.

We have previously done a case-control study on brain tumours including 233 patients and 466 control, and an increased risk was reported for tumours in temporal and occipital brain area in patients with ipsilateral use of a cellular phone, i.e., in the highest exposed parts of the brain [1], [2], [3]. Adjusting for other risk factors, i.e., medical diagnostic X-ray investigation of the head and neck and laboratory work, the risk was significantly increased with odds ratio (OR) 2.62, 95% confidence interval (CI) 1.02-6.71.

We have now performed a new larger study with longer latency period for tumour development relating to microwave exposure from cellular or cordless telephones.

Materials and Methods

The study area was the middle part of Sweden and encompassed patients diagnosed during January 1, 1997 to June 30, 2000. Only incident cases of both sexes with brain tumour were included aged 20-80 years at the time of diagnosis. One criterion was that they should have a histopathology diagnosis and be alive at the study start. One control matched for sex and age to each case was drawn from the population register.

Assessment of Exposure

Exposures was assessed by a postal 21-pages questionnaire including among other things lifetime work history, exposure to ionising radiation, different agents such as organic solvents, pesticides, asbestos. Regarding mobile phones they were asked on type of phone, years of use and brand name. Specific questions were made for each type of telephones, analogue 450 MHz or 900 MHz cellular phones, digital phones and cordless phones. Mean number of daily calls and minutes were asked for and cumulative use in hours for all years was calculated. The ear most frequently used during mobile phone calls was asked for, or if both sides were equally used.

Histopathology was obtained from the cancer registry. The anatomical site in the brain of the tumour was not always given in the cancer registry. To get a correct diagnosis, year for diagnosis, and tumour localization copies of reports of neuroradiology investigations were requested from the radiology units after informed consent from the cases. Cases with a radiology diagnosis of the tumour prior to the study period were excluded, e.g., slowly growing tumours that were operated only some years after diagnosis. No patient without a histopathology diagnosis was included in the study. All coding of anatomical area for the tumour was done without knowing if the subject was exposed to cellular or cordless phones.

Statistical Methods

Conditional logistic regression analysis for matched studies was used to calculate odds ratios (OR) and 95 % confidence intervals. Only complete pairs (1:1) were used. Thereby the risk for use of the analogue and digital system as well as cordless phones was calculated separately. The matched control was assigned the same anatomical localization as for the corresponding case in the calculations of laterality of exposure.

Results

In total 2 561 cases were reported from the regional cancer registries. The largest exclusion was being deceased, 544 cases. Metastasis or other localisation than brain based was found for 232 cases. Many were not capable of particpating for medical reasons. The final inclusion had 1 617 (63%) cases that fulfilled the inclusion criteria. Of these 1617 cases 1429 (88%) and of the 1617 controls 1470 (91%) answered the questionnaire, in total 1243 men and 1656 women. The results were based on 1303 complete pairs.

Exposure to analogue phones was reported by 247 (17.3%) cases and 218 (14.8%) controls, digital 423 (29.6%) cases and 433 (29.5%) controls, cordless 402 (28.1%) cases and 396 (26.9%) controls.

Table 1 gives the results for use of cellular phones. A significantly increased risk was found for analogue telephones with OR=1.3, CI=1.02-1.6 increasing to OR=1.4, CI=1.04-1.8 with >5 year tumour induction period and OR=1.8, CI=1.1-2.9 with >10 year latency period. No increased risk was found for digital telephones whereas the risk was non-significantly increased for cordless phones with increasing latency period.

Anatomical localisation of the tumour was available for 1 358 patients. Increased risk was found for cases with analogue phone use with a tumour in the temporal with OR=2.0, CI=1.3-3.1 increasing to OR=2.6, CI=0.9-7.3 in the group with >10 year latency period, Table 2. For digital telephones increased risk was found for >5 year latency period with OR=3.0, CI=0.8-11.1 No subjects were exposed with a latency period of >10 years. Cordless telephones yielded an increased risk for tumours in the temporal area with latency >5 years with OR=1.9, CI=1.1-3.5. Very few subjects had used a cordless phone with >10 year latency time.

Table 1. Odds ratio (OR) and 95% confidence interval (CI) for use of mobile or cordless telephones. Number of exposed cases (Ca) and controls (Co) is given.

	>1 year latency			**>5 year latency**			**>10 year latency**		
	Ca/Co	OR	CI	Ca/Co	OR	CI	Ca/Co	OR	CI
Analogue	188/148	1.3	1.02-1.6	120/88	1.4	1.04-1.8	46/26	1.8	1.1-2.9
Digital	224/228	0.98	0.8-1.2	33/36	0.9	0.6-1.5	-	-	-
Cordless	238/242	0.98	0.8-1.2	102/77	1.3	0.99-1.8	6/3	2.0	0.5-8.0

Regardless of type of phone used increased risk was found for tumour in the brain hemisphere with ipsilateral (same side) exposure; analogue phones OR=1.8; CI=1.3-2.5, digital phones OR=1.3, CI=0.99-1,8, and cordless phones OR=1.3, CI=1.01-1.8. For the temporal area and analogue phones the risk increased for ipsilateral use of the phone to OR=2.5, CI=1.3-4.9.

The only significant result was an increased risk for acoustic neurinoma and analogue phone use with OR=3.5, CI=1.8-6.8. All these tumours are located in the temporal area of the brain.

Table 2. Odds ratio (OR) and 95% confidence interval (CI) for tumours in the temporal area for exposure >1 year before diagnosis. Number of cases with different tumor localisation and exposed cases (Ca) and controls (Co) are given.

	Analogue			Digital			Cordless		
	Ca/Co	OR	CI	Ca/Co	OR	CI	Ca/Co	OR	CI
Temporal (389)	65/32	2.0	1.3-3.1	53/56	0.95	0.7-1.4	71/71	1.0	0.7-1.4
>5 year latency	38/20	1.9	1.1-3.3	9/3	3.0	0.8-11.1	33/17	1.9	1.1-3.5
>10 year latency	13/5	2.6	0.9-7.3	-	-	-	2/2	1.0	0.1-7.1

Discussion

Phone interviews and coding of the data were made blinded as to case or control status in order to reduce observational bias. The material was coded and analysed twice in two separate datasets. Thereby the same results were obtained. Only living cases that were judged to be able to answer the questionnaire were included so as to get as high data quality as possible. Excluding deceased cases might bias the results if a risk factor is associated with a more aggressive tumor type with bad prognosis..

The main result in this study was an increased risk for brain tumours associated with the use of analogue cellular phones, findings similar as previously reported by us [1], [2], [3]. Similar results were also reported in a recent Finnish register study [4 where a significant twofold increase in risk for gliomas among NMT users was found.

In the present study the risk increased further with tumour induction period. Also for cordless phones an increased risk was found if tumour induction period of >5 years was applied. Furthermore these results were strengthened when tumours in the temporal area were analysed. Thereby also digital mobile phones increased the risk if >5 year latency period was used,. but digital phones have not been used for as long period as the analogue ones, which would be of importance for carcinogenesis. This was exemplified in our study with median time of use (tumour induction period) of 7 years for analogue phones, 3 years for digital phones and 5 years for cordless phones.

Regarding different tumours the highest risk was found for acoustic neurinoma in cases with analogue phone use. This is a tumour type located in an anatomical area exposed to microwaves when a phone is used on that particular ear.

During a mobile phone call the highest microwave exposure occurs on the same side of the head as the phone is used with the highest exposure in the ipsilateral temporal area. There is a rapid decline in dose and the other side of the brain is exposed to a lower degree. OR was calculated for ipsilateral, contralateral or both ipsi- and contralateral exposure to microwaves from a mobile phone by combining data for both sides of the head. Interestingly increased risk was found for tumours in the hemisphere with highest exposure to microwaves (ipsilateral) regardless of phone type used. Consistently no risk was found for contralateral exposure (except for temporal lobe and analogue phones).

In a case-control study it is always possible that cases report more exposure than controls. This could be the situation in a study on mobile phones and the risk for brain tumours. However, cordless phones have almost not at all been discussed in this context, so our findings with an increased risk also for such use indicates that recall bias was not a major problem in the study. Also the finding of highest risk in the anatomical area most exposed, increasing risk with tumour induction period and cumulative exposure argue against recall bias. This was further strengthened by the analyses of the distribution of tumours on right or left hand side for NMT users and non-users. It was found that for the users more people had tumours on the right hand side wheras among non-users the distribution was equal. It is known that people are more often using the right hand than the left hand for mobile phone calls.

Nyligen publicerades en finsk registerstudie där en signifikant överrisk sågs för gliom (Auvinen et al, 2002).

Patients do usually not have exact information of the tumour localization and concepts of latency and dose-response effect are not well understood in the population. Recall bias can of course never be completely excluded in a case-control study. As to reporting of ear during calls in relation to tumour site, some recall bias may have existed since several effect estimates were below unity for contralateral exposure.

In summary our present study showed an increased risk for brain tumours among users of analogue cellular telephones. For digital cellular phones and cordless phones the results were less clear.

References:

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