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Detection of prostate cancer in unselected young men: prospective cohort nested within a randomised controlled trial

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ABSTRACT

Objective To investigate the feasibility of testing for prostate cancer and the prevalence and characteristics of the disease in unselected young men.

Design Prospective cohort nested within a randomised controlled trial, with two years of follow-up.

Setting Eight general practices in a UK city.

Participants 1299 unselected men aged 45-49.

Intervention Prostate biopsies for participants with a prostate specific antigen level of 1.5 ng/ml or more and the possibility of randomisation to three treatments for those with localised prostate cancer.

Main outcome measures Uptake of testing for prostate specific antigen; positive predictive value of prostate specific antigen; and prevalence of prostate cancer, TNM disease stage, and histological grade (Gleason score 6-10).

Results 442 of 1299 men agreed to be tested for prostate specific antigen (34%) and 54 (12%) had a raised level.

The positive predictive value for prostate specific antigen was 21.3%. Ten cases of prostate cancer were detected (2.3%) with eight having at least two positive results in biopsy cores and three showing perineural invasion. One tumour was of high volume (cT2c), Gleason score 7, with a positive result on digital rectal examination; nine tumours were cT1c, Gleason score 6, and eight had a negative result on digital rectal examination. Five of the nine eligible participants (55%) agreed to be randomised. No biochemical disease progression occurred in two years of follow-up.

Conclusions Men younger than 50 will accept testing for prostate cancer but at a much lower rate than older men. Using an age based threshold of 1.5 ng/ml, the prevalence of prostate cancer was similar to that in older men (3.0 ng/ml threshold) and some cancers of potential clinical significance were found.

Trial registration Current Controlled Trials ISRCTN20141297

INTRODUCTION

Few population based studies of testing for prostate specific antigen have been done in men younger than 50. We carried out a nested study in men aged 45-49 to investigate the uptake of testing, the prevalence of prostate cancer, and characteristics of the disease.

METHODS

Since 2001 unselected men aged 50-69 registered in randomly selected centres in nine UK cities have been invited to take part in the prostate testing for cancer and treatment (ProtecT) study. Full details are published elsewhere.^{1,2} Between November 2003 and August 2005 we carried out a nested study of men aged 45-49 registered with eight general practices in Sheffield, England. At enrolment clinics nurses explained the risks and benefits of testing to invited men and provided details of the study. Participants were tested and additional consent was sought for processing the test.

Participants with a prostate specific antigen value of 1.5 ng/ml or more were invited for prostate biopsy of 10 core specimens, repeat testing, and a digital rectal examination. We selected a threshold for biopsy of 1.5 ng/ml to optimise cancer detection while reducing the number of unnecessary biopsies. A second biopsy was offered to those with high grade prostatic intraepithelial neoplasia, atypical small acinar proliferation, a negative biopsy result but a persistently raised prostate specific antigen level, or a palpable abnormality on digital rectal examination. We also offered annual tests to those with a negative biopsy result. Participants with localised prostate cancer were eligible for randomisation to radiotherapy, prostatectomy, or active monitoring, with follow-up every 3-6 months for all arms according to treatment and study protocols (mean follow-up 24 months).

Data were collected on participants' characteristics, including previous results for prostate specific antigen.

Urologists reported the biopsy and disease results. We classified the results of digital rectal examinations as positive if there was a palpable abnormality. Tumours were assessed by histopathological grading using the Gleason scoring system (6-10); tumour staging using the 2002 TNM classification; and a nomogram for predicting indolent disease in men aged 50 or more.³ We calculated the positive predictive value of the prostate specific antigen test, with the biopsy as the reference test.

RESULTS

Overall, 524 of 1299 unselected men (40%) aged 45-49 invited attended for enrolment; 473 (36.4%) were included in the study (see bmj.com). Fifty one were excluded for various reasons, leaving 442 (34%), who consented to the processing of their prostate specific antigen test.

The mean age of participants was 48 and 413 were white (98%). Ten participants had prostate cancer. These participants were white and did not report a family history of the disease compared with 22 of 442 (5%) participants without cancer. None of the 18 participants who had been previously tested for prostate specific antigen (4%) had a diagnosis of prostate cancer. Three hundred and fifty three participants (97%) reported that urinary symptoms had little or no effect on their life.

Detection of prostate cancer

The mean prostate specific antigen value was 0.9 (SD 0.75) ng/ml, and the median was 0.7 ng/ml (see bmj.com). Fifty four participants had raised levels (12.2% of those enrolled) and 47 underwent a biopsy (87%). Twelve participants had repeat biopsies after consultation with the urologist and two after findings of high grade prostatic intraepithelial neoplasia. In those men who did not have a further biopsy after an

Clinical characteristics of participants with a diagnosis of prostate cancer

Case No	Prostate specific antigen level (ng/ml)		Digital rectal examination result	TNM stage	Gleason score*	Biopsy positive cores†	Total tumour length (mm)	Perineural invasion
	Initial result	Second result						
1	2.5	0.3	Positive	cT2c	7	5	22	Yes
2	2.0	3.0	Negative	cT1c	6	5	24	Yes
3	1.7	1.3	Negative	cT1c	6	4	10	No
4	3.5	2.8	Negative	cT1c	6	4	8	No
5	3.8	3.3	Negative	cT1c	6	4	4	No
6	1.6	2.0	Negative	cT1c	6	2	6	No
7	1.7	1.6	NA	cT1c	6	2	4	No
8	1.9	1.8	Negative	cT1c	6	2	2	No
9	1.8	1.3	Negative	cT1c	6	1	3	Yes
10	1.6	1.4	Negative	cT1c	6	1	<0.5	No

cT2c=tumour palpable in both lobes on digital rectal examination; cT1c=non-palpable tumour found in needle biopsies carried out because of raised prostate specific antigen levels. NA=not available.

*6=somewhat resembling normal tissue, 7=barely normal tissue, mostly low grade but with some high grade areas.

†10 cores were taken from each participant.

initial negative result, 10 were rereferred to their doctors, five declined a biopsy, one had an unavailable result, and eight elected to undergo further testing at 12 months.

Nine cases of prostate cancer were detected at the first biopsy and one at the second; the initial values for prostate specific antigens were all less than 4.0 ng/ml. The detection rate for prostate cancer was 2.3% and the prevalence of disease in participants with raised antigen levels was 21.3% (95% confidence interval 7.4% to 29.6%). The positive predictive value of the test was 21.3% (25.6% when corrected for those who did not undergo a biopsy).

Clinical and disease features of the cancers

Eight participants had two or more positive biopsy core or specimen results and five had four or more positive results. Tumour length ranged from less than 0.5 mm to 24 mm (table). Perineural invasion occurred in three cases. Nine participants had cT1c tumours, with a Gleason score 6, of whom eight had a negative digital rectal examination result (one was unavailable). One participant had a cT2c tumour, with a Gleason score of 7 and a positive digital rectal examination result. Five cases were classified as potentially indolent using a nomogram and five were classified as of potential clinical significance.³

Five participants agreed to be randomised (55%); one to active monitoring and two each to radiotherapy and surgery. One participant changed from surgery to radiotherapy. Two participants chose active monitoring, one radiotherapy, one brachytherapy. The comorbidities of one participant precluded randomisation and he received radiotherapy. Disease stage was organ confined with no evidence of nodal metastases (pT2aN0Mx) for the participant who received a radical prostatectomy (Gleason score 6) and the surgical margins were negative. No biochemical failure in the form of a rising prostate specific antigen level was detected in nine of the 10 cases over a mean of 24 months' follow-up (one participant was lost to follow-up).

DISCUSSION

Overall, 34% of unselected men aged 45-49 underwent testing for prostate specific antigen and the prevalence of prostate cancer was 2.3%. Five of the 10 cancers were classified as potentially clinically significant.

Men aged 45-49 had a significantly lower uptake of testing (34.0%, 95% confidence interval 31.2% to 36.3%) than those aged 50-69 (50%, 49.7% to 50.3%) in the main prostate testing for cancer and treatment study.⁴ The uptake of testing was 25%-46% in the European randomised screening for prostate cancer trial with older participants and 32% in an Austrian study with younger men.^{5,6} The American high risk cohort of younger men was recruited by using a press release so the response rate is unknown.⁷

The detection rate for prostate cancer in the prostate testing for cancer and treatment study was broadly similar in younger (2.3%, 0.9% to 3.7%) and older men (2.9%, 2.7% to 3.0%).⁴ If all participants had been offered biopsies using the same antigen threshold, however, a greater difference may have emerged, as the threshold for the older men was 3.0 ng/ml but prostate specific antigen values between 2.0 and 3.0 ng/ml are also associated with a slightly increased risk of prostate cancer.⁸ The prevalence of prostate cancer reported here was higher than the Austrian studies in younger men^{6,9} and comparable to the American high risk cohort.⁷ However, we used 10 core biopsies (adding two lateral biopsies per side), which are more optimal for cancer detection than the previously used sextant biopsy scheme (three biopsies per side including base, middle, and apex of the prostate).¹⁰ Data on prevalence were also less accurate in previous cohort studies as only about 50% of men with a raised prostate specific antigen level received a biopsy.^{6,7} It is noteworthy that those with the highest antigen values were not found to have cancer (see *bmj.com* and table), confirming the low specificity of the test.

The prognosis of screen detected prostate cancers is a critical problem with results from the European randomised screening for prostate cancer trial indicating that about half of the cancers are clinically indolent.³ Half the cancers were categorised as potentially indolent in our study, although the nomogram used in the European trial has yet to be validated in this age range. All cases were clinically localised in the younger men compared with 76% in men aged 50-69 in the prostate testing for cancer and treatment study,⁴ but more accurate assessment of disease data was not possible in those receiving non-surgical treatments. The 26 cancers detected in the American study were clinically localised whereas disease staging showed that 18 of 24 tumours (78%) were organ confined.¹¹ Biochemical disease progression occurred in six cases (24%) over two years' follow-up, but this period did not permit comparison of outcome between younger and older men.¹² In the smaller Austrian study, five tumours were localised.⁹

Our study has several strengths but also some limitations. The major strength is the prospective design using an unselected population with minimal contamination of the prevalence data by previous testing for prostate specific antigen, which is not routinely recommended in the United Kingdom.¹³ Study results were also enhanced by the high uptake for biopsy, the use of a systematic 10 core biopsy protocol, detailed histology, and standardised diagnosis algorithms.

The limitations were that testing was done within the context of a clinical trial, which, along with exclusion criteria, probably reduced uptake. Enrolment in clinical trials is higher in older age groups,¹⁴ probably because of the perceived additional demands of time and visits to research centres. Although the study was

WHAT IS ALREADY KNOWN ON THIS TOPIC

Screening for prostate cancer, when undertaken, usually starts at age 50 in the absence of risk features

A lower age limit has recently been adopted in the United States on the basis of two retrospective cohorts, which found that prostate specific antigen levels in the fourth decade predicted prostate cancer

WHAT THIS STUDY ADDS

The uptake of testing for prostate specific antigen by men aged 45-49 was 34% and the prevalence of prostate cancer was 2.3%

Younger men were less likely to subscribe to testing than those older than 49

One in two cancers detected is potentially clinically important but the prognosis is currently unknown

population based there may have been self selection criteria by participants who may have attended because of minor health problems, general anxiety, or misconceptions about the disease and its implications, but these were not related to urinary symptoms, which were infrequently reported. The study population was predominately white so the results may not be applicable to other ethnic groups where the prevalence of prostate cancer differs.¹³ Finally, we could not determine the performance of the test in this age range (beyond the positive predictive value) or the population prevalence of prostate cancer as biopsies were not offered to all participants.

Previous long term studies in men mostly younger than 50 included two retrospective cohorts with stored serum and at least 10 years' follow-up, which showed that baseline levels of prostate specific antigen were predictive of risk for prostate cancer.^{15,16} Degradation of prostate specific antigen in archived serum, however, can introduce bias in predicting prostate cancer unless specific procedures are used for serum processing and storage.¹⁷

Potential benefits and harms of prostate cancer testing

This study shows that men invited to testing will attend, but at a much lower rate than older men, and so if screening was introduced greater efforts would have to be made to maximise uptake in this age group. This study also confirms that a prostate specific antigen threshold of 1.5 ng/ml results in a comparable detection rate for prostate cancer to that in older men with a threshold of 3.0 ng/ml. At present, however, it is not possible to determine which tumours would result in clinically significant disease and which represent indolent disease.

One study¹⁸ advocated that screening for prostate cancer should start at age 45. If the estimated 2 236 000 men aged 45-49 in the UK population were to undergo screening for prostate specific antigen it can

be projected from our data that 272 905 men would have a raised prostate specific antigen level and, of these, 51 449 would have prostate cancer. Some of these cancers may benefit from treatment although this has to be set against the possible distress caused to the 221 456 men with negative biopsy results, and the risks of overtreatment and associated side effects to those with a diagnosis of cancer.

Some of these issues may be resolved by the development of robust prognostic nomograms and biomarkers to reliably identify clinically significant disease. Furthermore, current randomised trials should resolve the controversies around the testing for and treatment of prostate cancer.

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Public information needs after the poisoning of Alexander Litvinenko with polonium-210 in London: cross sectional telephone survey and qualitative analysis

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ABSTRACT

Objectives To identify public perceptions of the risk to health after the poisoning of Alexander Litvinenko with polonium-210 (²¹⁰Po) in London and to assess the impact of public health communications.

Design Cross sectional telephone survey and qualitative interviews.

Setting London, United Kingdom.

Participants 1000 people completed the cross sectional survey and 86 potentially exposed people completed the qualitative interviews.

Main outcome measures Perception of risk to personal health after the ²¹⁰Po incident. Qualitative interviews were analysed with an emphasis on information needs.

Results 11.7% of the survey sample (n=117) perceived their health to be at risk. Aside from personal variables the main predictors of perceived risk to health were believing that the incident was related to terrorism (odds ratio 2.7, 95% confidence interval 1.5 to 4.6) rather than to espionage, that it was targeted at the wider public rather than one person (5.9, 3.2 to 10.9), and that it could affect people who had not been in the contaminated area (3.2, 2.1 to 5.1). Participants in the qualitative interviews were generally satisfied with the information they had received, although they would have preferred more information about their individual risk of exposure, the results of their urine tests, and the health implications of the incident.

Conclusions Perceptions of the public that the ²¹⁰Po incident in London 2006 was related to espionage helped to reassure them that the risks to personal health were low. In the event of future incidents it is important to ensure that detailed, comprehensible information about the risks of any exposure is available.

INTRODUCTION

During major incidents that impact on public health, agencies often need to reassure the public about the risk involved, advise on measures being taken to

safeguard health, and specify what personal actions can minimise risk.¹⁻³ This communication can be challenging.

We assessed the public's perceptions of risk from the release of polonium-210 (²¹⁰Po) in London when Alexander Litvinenko was poisoned.⁴ We also assessed the public's knowledge and perceptions of the communication strategies used at that time by the UK's Health Protection Agency. We did a telephone survey of a representative sample of adult Londoners to test whether knowledge about ²¹⁰Po or perceptions of the incident were associated with a reduced perception of risk. Qualitative interviews were also carried out with people who had been in two areas contaminated during the incident to assess factors associated with increased anxiety and how effective the information provided by the Health Protection Agency was.

METHODS

After the death of Litvinenko in November 2006 from ²¹⁰Po poisoning, the Health Protection Agency responded by assessing risk to potentially exposed people.⁴ Investigations centred on a restaurant and a hotel bar. People were advised to telephone NHS Direct if they had been in either venue on 1 November, and were asked about symptoms. The Health Protection Agency returned phone calls when requested by callers and offered a urine test if indicated. On 7 December this protocol changed after several of the hotel's staff tested positive for ²¹⁰Po: people were now asked to contact the Health Protection Agency if they had been in the bar between 31 October and 2 November, and were offered a test. The Health Protection Agency produced information almost daily.

Cross sectional telephone survey

Between 8 and 11 December 2006 Ipsos MORI carried out a telephone survey of 1000 adult Londoners representative of London's population for