

available at www.sciencedirect.com
journal homepage: www.europeanurology.com



Platinum Priority – Review – Prostate Cancer

Editorial by John Withington and Caroline M. Moore on pp. 347–348 of this issue

Systematic Review of Active Surveillance for Clinically Localised Prostate Cancer to Develop Recommendations Regarding Inclusion of Intermediate-risk Disease, Biopsy Characteristics at Inclusion and Monitoring, and Surveillance Repeat Biopsy Strategy

Peter-Paul M. Willemse^{a,*}, Niall F. Davis^{b,c}, Nikolaos Grivas^d, Fabio Zattoni^e, Michael Lardas^f, Erik Briers^g, Marcus G. Cumberbatch^h, Maria De Santis^{i,j}, Paolo Dell'Oglio^k, James F. Donaldson^{l,m}, Nicola Fossati^k, Giorgio Gandaglia^k, Silke Gillesen^{n,o,p}, Jeremy P. Grummet^q, Ann M. Henry^r, Matthew Liew^s, Steven MacLennan^t, Malcolm D. Mason^u, Lisa Moris^v, Karin Plass^w, Shane O'Hanlon^x, Muhammad Imran Omar^y, Daniela E. Oprea-Lager^z, Karl H. Pang^h, Catherine C. Paterson^{aa}, Guillaume Ploussard^{bb,cc}, Olivier Rouvière^{dd}, Ivo G. Schoots^{ee}, Derya Tilki^{ff,gg,hh}, Roderick C.N. van den Berghⁱⁱ, Thomas Van den Broeck^v, Theodorus H. van der Kwast^{jj}, Henk G. van der Poel^{kk}, Thomas Wiegel^{ll}, Cathy Yuhong Yuan^{mm}, Philip Cornfordⁿⁿ, Nicolas Mottet^{oo}, Thomas B.L. Lam^{l,m}

^a Department of Urology, Cancer Center, University Medical Center Utrecht, Utrecht, The Netherlands; ^b Department of Urology, Beaumont and Connolly Hospitals, Dublin, Ireland; ^c Royal College of Surgeons in Ireland, Dublin, Ireland; ^d Department of Urology, G. Hatzikosta General Hospital, Ioannina, Greece; ^e Urology Unit, Academic Medical Centre Hospital, Udine, Italy; ^f Department of Reconstructive Urology and Surgical Andrology, Metropolitan General, Athens, Greece; ^g Patient Advocate, Hasselt, Belgium; ^h Academic Urology Unit, University of Sheffield, Sheffield, UK; ⁱ Department of Urology, Charité Universitätsmedizin, Berlin, Germany; ^j Department of Urology, Medical University of Vienna, Austria; ^k Unit of Urology, Division of Oncology, Urological Research Institute, IRCCS Ospedale San Raffaele, Milan, Italy; ^l Academic Urology Unit, University of Aberdeen, Aberdeen, UK; ^m Department of Urology, Aberdeen Royal Infirmary, Aberdeen, UK; ⁿ Oncology Institute of Southern Switzerland, EOC, Bellinzona, Switzerland; ^o Università della Svizzera Italiana, Lugano, Switzerland; ^p University of Bern, Bern, Switzerland; ^q Department of Surgery, Central Clinical School, Monash University, Melbourne, Australia; ^r Leeds Cancer Centre, St. James's University Hospital and University of Leeds, Leeds, UK; ^s Department of Urology, Wrightington, Wigan and Leigh NHS Foundation Trust, Wigan, UK; ^t Academic Urology Unit, University of Aberdeen, Aberdeen, UK; ^u Division of Cancer and Genetics, School of Medicine Cardiff University, Velindre Cancer Centre, Cardiff, UK; ^v Department of Urology, University Hospitals Leuven, Leuven, Belgium; ^w EAU Guidelines Office, Arnhem, The Netherlands; ^x Department of Geriatric Medicine, St Vincent's University Hospital, Dublin, Ireland; ^y Academic Urology Unit, University of Aberdeen, Aberdeen, UK; ^z Department of Radiology and Nuclear medicine, Amsterdam University Medical Centers, VU Medical Center, The Netherlands; ^{aa} University of Canberra, School of Nursing, Midwifery and Public Health, Canberra, Australia; ^{bb} Department of Urology, La Croix du Sud Hospital, Quint Fonsegrives, France; ^{cc} Institut Universitaire du Cancer, Toulouse, France; ^{dd} Department of Radiology, Edouard Herriot Hospital, Lyon, France; ^{ee} Department of Radiology & Nuclear Medicine, Erasmus MC University Medical Center, Rotterdam, The Netherlands; ^{ff} Martini-Klinik Prostate Cancer Center, University Hospital Hamburg-Eppendorf, Hamburg, Germany; ^{gg} Department of Urology, University Hospital Hamburg-Eppendorf, Hamburg, Germany; ^{hh} Department of Urology, Koc University Hospital, Istanbul, Turkey; ⁱⁱ Department of Urology, Antonius Hospital, Utrecht, The Netherlands; ^{jj} Medicine Program and Princess Margaret Cancer Center, University Health Network, Toronto, Canada; ^{kk} Department of Urology, Netherlands Cancer Institute, Amsterdam, The Netherlands; ^{ll} Department of Radiation Oncology, University Hospital Ulm, Ulm, Germany; ^{mm} Department of Medicine, McMaster University, Hamilton, Canada; ⁿⁿ Department of Urology, Royal Liverpool and Broadgreen Hospitals NHS Trust, Liverpool, UK; ^{oo} Department of Urology, University Hospital, St. Etienne, France

* Corresponding author at: Department of Urology, Cancer Center, University Medical Center Utrecht, Utrecht, The Netherlands.
E-mail address: p.m.willemse-3@umcutrecht.nl (P.-P.M. Willemse).

<https://doi.org/10.1016/j.eururo.2021.12.007>

0302-2838/© 2021 The Authors. Published by Elsevier B.V. on behalf of European Association of Urology. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).



Article info

Article history:

Accepted December 2, 2021

Associate Editor:

James Catto

Keywords:

Systematic review
Active surveillance
Localised prostate cancer
Consensus statements
Criteria for inclusion and eligibility
Monitoring and reclassification
Positive cores
Core involvement
Per-protocol or untriggered repeat biopsies
Clinical practice guidelines and recommendations



www.eu-acme.org/europeanurology

Please visit www.eu-acme.org/europeanurology to answer questions on-line. The EU-ACME credits will then be attributed automatically.

Abstract

Context: There is uncertainty regarding the most appropriate criteria for recruitment, monitoring, and reclassification in active surveillance (AS) protocols for localised prostate cancer (PCa).

Objective: To perform a qualitative systematic review (SR) to issue recommendations regarding inclusion of intermediate-risk disease, biopsy characteristics at inclusion and monitoring, and repeat biopsy strategy.

Evidence acquisition: A protocol-driven, Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA)-adhering SR incorporating AS protocols published from January 1990 to October 2020 was performed. The main outcomes were criteria for inclusion of intermediate-risk disease, monitoring, reclassification, and repeat biopsy strategies (per protocol and/or triggered). Clinical effectiveness data were not assessed.

Evidence synthesis: Of the 17 011 articles identified, 333 studies incorporating 375 AS protocols, recruiting 264 852 patients, were included. Only a minority of protocols included the use of magnetic resonance imaging (MRI) for recruitment ($n = 17$), follow-up ($n = 47$), and reclassification ($n = 26$). More than 50% of protocols included patients with intermediate or high-risk disease, whilst 44.1% of protocols excluded low-risk patients with more than three positive cores, and 39% of protocols excluded patients with core involvement (CI) $>50\%$ per core. Of the protocols, $\geq 80\%$ mandated a confirmatory transrectal ultrasound biopsy; 72% ($n = 189$) of protocols mandated per-protocol repeat biopsies, with 20% performing this annually and 25% every 2 yr. Only 27 protocols (10.3%) mandated triggered biopsies, with 74% of these protocols defining progression or changes on MRI as triggers for repeat biopsy.

Conclusions: For AS protocols in which the use of MRI is not mandatory or absent, we recommend the following: (1) AS can be considered in patients with low-volume International Society of Urological Pathology (ISUP) grade 2 (three or fewer positive cores and cancer involvement $\leq 50\%$ CI per core) or another single element of intermediate-risk disease, and patients with ISUP 3 should be excluded; (2) per-protocol confirmatory prostate biopsies should be performed within 2 yr, and per-protocol surveillance repeat biopsies should be performed at least once every 3 yr for the first 10 yr; and (3) for patients with low-volume, low-risk disease at recruitment, if repeat systematic biopsies reveal more than three positive cores or maximum CI $>50\%$ per core, they should be monitored closely for evidence of adverse features (eg, upgrading); patients with ISUP 2 disease with increased core positivity and/or CI to similar thresholds should be reclassified.

Patient summary: We examined the literature to issue new recommendations on active surveillance (AS) for managing localised prostate cancer. The recommendations include setting criteria for including men with more aggressive disease (intermediate-risk disease), setting thresholds for close monitoring of men with low-risk but more extensive disease, and determining when to perform repeat biopsies (within 2 yr and 3 yearly thereafter).

© 2021 The Authors. Published by Elsevier B.V. on behalf of European Association of Urology. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Active surveillance (AS) has been proved to be an appropriate alternative to radical treatment options for low-risk prostate cancer (PCa) [1] with equivalent oncological outcomes [2–4]. Nevertheless, there is significant heterogeneity in terms of AS protocols. To address this, a multidisciplinary project (DETECTIVE study) [5] aimed to develop consensus statements and recommendations. It successfully achieved consensus in $>70\%$ of statements pertaining to the conduct of AS [5]. Certain key issues failed to achieve consensus, including inclusion of patients with intermediate-risk disease; optimal thresholds regarding biopsy characteristics and how they should influence inclusion, exclusion, and reclassification; and nature and frequency of repeat prostate biopsy during monitoring.

The objective of this study was to perform a further analysis of exploratory data from a systematic review (SR) incorporating all studies on AS published from 1990 until October 2020 focusing exclusively on the above key areas of controversy, in order to develop clinical practice recommendations.

2. Evidence acquisition

2.1. Search strategy and review elements

This protocol has been published previously [6]. The review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines [7], including all prospective and retrospective studies incorporating AS or any deferred active treatment. The main outcome measures are summarised in Table 1. Specifically,

Table 1 – Summary of review outcomes.

Eligibility criteria		Monitoring criteria	Reclassification criteria
Patient characteristics	Disease characteristics		
Age	PSA	Frequency of PSA testing	PSA (discrete level/kinetics)
Comorbidities	Clinical stage (TNM)	Frequency of DRE	Change in DRE
Life expectancy	Gleason score/ISUP grade		Changes in Gleason score/ISUP grade
	Risk category (ie, D'Amico)	Frequency and trigger of repeat biopsy	Changes in biopsy characteristics
	Biopsy characteristics: – Maximum % cancer involvement per core (CI/core) – Total number of positive cores – Proportion (%) of positive cores – How biopsy was performed (TRUS/targeted/template)	Frequency of MRI Frequency of MRI-targeted biopsy	Change in QoL Psychological factors
	mpMRI: – MRI-targeted biopsy – Negative mpMRI – mpMRI at diagnosis of PCa		Change in mpMRI – Upgrade in PIRADS grade – New lesion – Increase in index lesion – New PIRADS ≥3 lesion

CI = core involvement; DRE = digital rectal examination; ISUP = International Society of Urological Pathology; mpMRI = multiparametric MRI; MRI = magnetic resonance imaging; PCa = prostate cancer; PIRADS = Prostate Imaging Reporting and Data System; PSA = prostate-specific antigen; QoL = quality of life; TNM = tumour, node, metastasis; TRUS = transrectal ultrasound.

the SR focused on the following: (1) criteria for inclusion; (2) thresholds of prostate biopsy characteristics (ie, core positivity and core involvement [CI]) for inclusion, monitoring, and reclassification; and (3) strategies for repeat biopsy (ie, per protocol and/or triggered, and use of transrectal ultrasound [TRUS] or multiparametric magnetic resonance imaging [mpMRI] for targeted and/or systematic biopsies). As the aim was to summarise criteria and thresholds in AS protocols only, including prospective study protocols published a priori, clinical effectiveness data were not assessed.

2.2. Data extraction, data analysis, and risk of bias assessment

Data extraction and risk of bias (RoB) assessment were performed as described previously [6,8–10]. Results were summarised qualitatively. Sensitivity and subgroup analyses were planned based on the year of publication (2010 onwards), studies recruiting ≥240 patients (median of all included studies), studies with a follow-up duration of ≥39.5 mo (median of all included studies), studies with a low RoB across all domains, thresholds of core positivity, CI, and International Society of Urological Pathology (ISUP) grade group for inclusion and reclassification.

3. Evidence synthesis

3.1. Quantity of evidence identified

The study selection process is outlined in Figure 1. Out of 17 011 articles screened, 333 studies recruiting 264 582 patients were included.

3.2. Characteristics of the included studies

Supplementary Table 1 presents the baseline characteristics of all included studies, consisting of 17 randomised controlled trials, 27 prospective nonrandomised comparative studies (NRCS), 24 retrospective NRCS, 158 prospective noncomparative case series (NCCS), and 107 retrospective

NCCS. There were 375 protocols in total, with some studies assessing multiple AS protocols in different databases. Data regarding recruitment, inclusion, and exclusion were

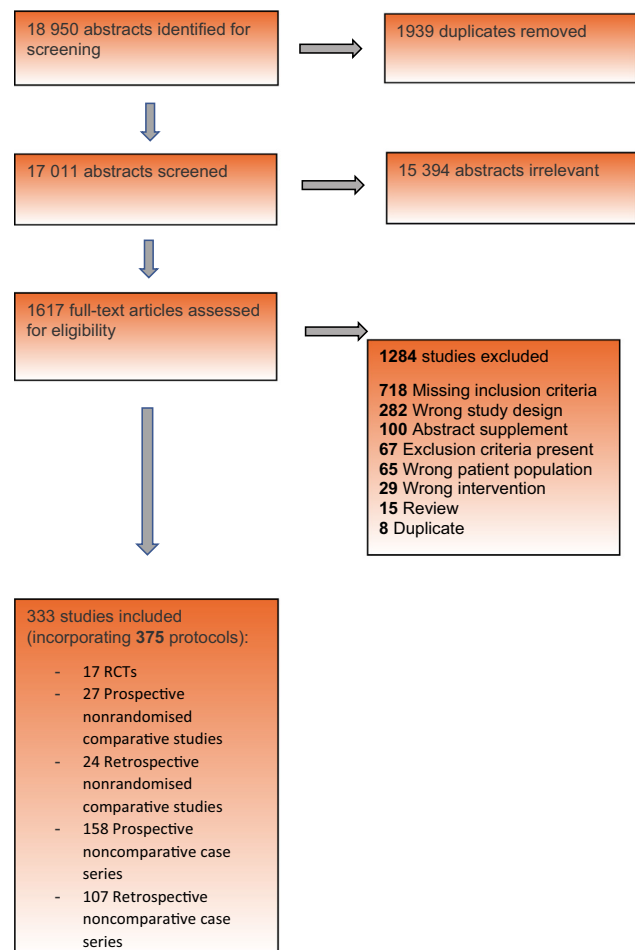


Fig. 1 – PRISMA flow diagram of the study selection process. PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-analyses; RCT = randomised controlled trial.

available from 371 protocols, whereas data for monitoring and follow-up, and reclassification were available from 343 protocols.

3.3. RoB assessment

Figure 2 shows the results of RoB assessment of included studies. Most studies (75%) adhered to an a priori protocol. However, >87% of studies were judged to have a high or an unclear RoB for recruitment and follow-up.

3.4. Summary of results

Tables 2–4 present a summary of thresholds used across studies for inclusion, monitoring, and reclassification.

3.4.1. Inclusion and exclusion criteria

Of the protocols, $\geq 50\%$ included patients with intermediate-risk disease, based on Prostate-specific antigen (PSA) ≤ 20 ng/ml (25%), ISUP 2 or 3 (28%), clinical stage cT2b/c (42%), and/or direct use of D'Amico risk grouping of intermediate-risk or above (51%). PSA density was not used often (26%); mpMRI was used as an inclusion tool in only 17 studies (5.1%). Regarding biopsy characteristics, 44% of protocols excluded patients with more than three positive cores, and 39% excluded patients with CI $>50\%$ per core.

3.4.2. Monitoring and follow-up criteria

The majority of protocols tested PSA ≤ 6 monthly (83%) and performed digital rectal examination (DRE) ≤ 12 monthly (60%). Only 34 protocols (9.1%) described the use of mpMRI during monitoring, and the majority (68.0%) used it only if triggered clinically. Of the protocols, 85% ($n = 233$) mandated a confirmatory untriggered TRUS biopsy, with 55% of protocols performing this within 1 yr and 24% within 2 yr; 72% of protocols ($n = 189$) mandated per-protocol surveillance repeat biopsies after the confirmatory biopsy, with 50 protocols performing the repeat biopsies annually, 69 performing this within every 2 yr, and 70 having other biopsy frequencies. Only 27 protocols (10%) performed triggered biopsies, triggered only in 4.6% and combined with per protocol in 5.7%. Of the triggered biopsy protocols, 74% were only based on MRI progression or changes. Of the protocols using MRI-based triggers of repeat biopsies ($n = 20$), 50% used a combination of systematic and targeted biopsies ($n = 4$) or either systematic and/or targeted biopsies ($n = 6$). Other triggers of repeat biopsies included PSA progression ($n = 6$), PCA3 changes ($n = 1$), or a combination ($n = 2$). The majority of protocols (70%) did not specify the

Table 2 – Summary of thresholds used by studies for inclusion and recruitment.

Inclusion criterion	Threshold	No. of protocols using threshold (%; $n = 371$) ^a
Serum PSA	≤ 10 ng/ml	193 (52)
	≤ 20 ng/ml	94 (25)
	Other	13 (3.5)
Gleason sum score	NR	71 (19)
	$\leq 3 + 3$	259 (70)
	$\leq 3 + 4$	73 (20)
	$\leq 4 + 3$	30 (8.1)
Clinical T stage	NR	9 (2.4)
	$\leq T1c$	47 (13)
	$\leq T2a$	130 (35)
	$\leq T2b$	57 (15)
	$\leq T2c$	98 (26)
Number of positive cores	NR	39 (11)
	≤ 2	125 (34)
	≤ 3	39 (11)
	Other	37 (10)
Cancer involvement per core	NR	170 (46)
	$\leq 30\%$	24 (6.5)
	$\leq 50\%$	120 (32)
PSA density	NR	227 (61)
	≤ 0.15 ng/ml ²	42 (11)
	≤ 0.20 ng/ml ²	55 (15)
D'Amico risk group	NR	274 (74)
	Low risk	92 (25)
	Intermediate risk	70 (19)
	High risk	120 (32)
Use of mpMRI	Missing value	89 (24)
		17 (4.6)

mpMRI = multiparametric magnetic resonance imaging; NR = not reported; PSA = prostate-specific antigen; SR = systematic review.
^a The total number of studies was 276, with studies having multiple protocols; hence, the total number of protocols included in our SR was 375; 371 protocols reported on thresholds for inclusion and recruitment. Most studies with multiple protocols within the same study had different inclusion criteria.

number of biopsy cores that should be taken during repeat biopsies.

3.4.3. Reclassification criteria

For reclassification, the commonest trigger (87%) was histological upgrading. An increase in the number of positive cores was also a reason for reclassification in 136 studies (50%). Of these, 56 studies (41%) defined a cut-off of three or more positive cores, 33 studies (24%) defined a cut-off of four or more positive cores, and 47 studies (35%) used other cut-off values. Changes in serum PSA and PSA dou-

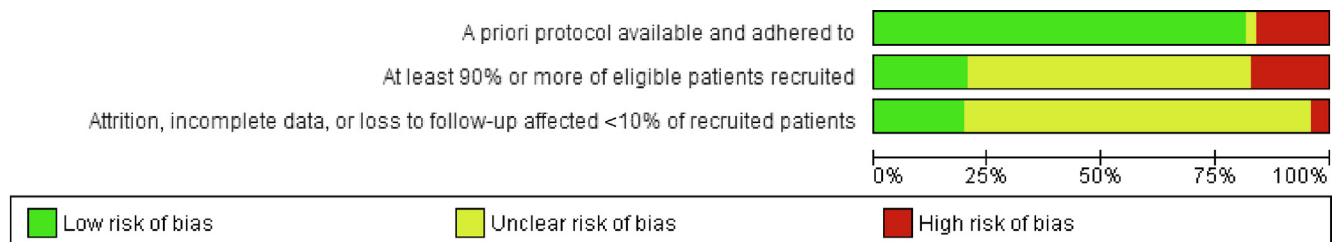


Fig. 2 – Risk of bias assessment of included studies.

Table 3 – Summary of thresholds used by studies for monitoring.

Monitoring criterion	Threshold	No. of protocols using threshold (%; n = 263) ^a	
PSA testing frequency	Every 3–4 mo	130 (50)	
	Every 6 mo	88 (34)	
	Every 12 mo	9 (3.4)	
	NR	36 (14)	
DRE examination frequency	Every 3–4 mo	42 (16)	
	Every 6 mo	100 (38)	
	Every 12 mo	15 (5.7)	
Nature of TRUS rebiopsy	NR	106 (40)	
	Per-protocol biopsy (ie, untriggered)	208 (79)	
	Triggered biopsy	12 (4.6)	
	Combined untriggered and triggered biopsy [4]	15 (5.7)	
Type of untriggered biopsy	NP	28 (11)	
	Only confirmatory	34 (13)	
	Confirmatory and then surveillance biopsies	189 (72)	
Timing of confirmatory biopsy	NP	40 (15)	
	Within 6 mo	13 (5.0)	
	At 12 mo	132 (50)	
	At 18 mo	23 (8.7)	
	At 24 mo	40 (15)	
	At 36 mo	9 (3.4)	
	At 48 mo	1 (0.4)	
	NP	45 (17)	
Frequency of surveillance biopsies	Every year	50 (19)	
	Every 1–2 yr	30 (11)	
	Every 18 mo	10 (3.8)	
	Every 2 yr	29 (11)	
	Once after 2 yr	6 (2.3)	
	Every 3 yr	10 (3.8)	
	After 4 and 7 yr	18 (6.8)	
	After 4, 7, and 10 yr	4 (1.5)	
	Other frequency	32 (12)	
	NP	74 (28)	
	Type of triggered biopsy	MRI triggered	18 (6.8)
		PSA density triggered	3 (1.1)
PSA density & MRI		2 (0.8)	
Other		4 (1.6)	
Number of cores taken on rebiopsy	NP	236 (90)	
	6–10	29 (11)	
	12	28 (11)	
	Other (ie, <6 or >12)	21 (8.0)	
	NR	185 (70)	

DRE = digital rectal examination; MRI = magnetic resonance imaging; NP = not performed; NR = not reported; PSA = prostate-specific antigen; TRUS = transrectal ultrasound.

^a The total number of protocols which reported on monitoring thresholds was 263.

bling time may have triggered further evaluation, but were rarely ($n = 2$) the only cause for reclassification. The majority of studies (90%) did not specify patient preference as a reason for reclassification. MRI was used to define reclassification in 26 studies (7.8%) only.

3.4.4. Sensitivity and subgroup analyses

Sensitivity analyses based on studies recruiting from 2010 onwards ($n = 50$), studies recruiting >240 patients

Table 4 – Summary of thresholds used by studies for reclassification.

Reclassification criterion	Threshold	No. of protocols using threshold (%; n = 271) ^a
Serum PSA	≥10 ng/ml	35 (13)
	≥20 ng/ml	9 (3.3)
	Other	9 (3.3)
Gleason sum score	NR	218 (80)
	≥3 + 4	179 (66)
	≥4 + 3	40 (15)
	≥4 + 4	15 (5.5)
Clinical T stage	NR	37 (14)
	≥T2a	6 (2.2)
	≥T2b	24 (8.9)
	≥T3a	47 (17)
	Other	4 (1.5)
PSA doubling time	NR	190 (70)
	≤2 yr	15 (5.5)
	≤3 yr	51 (19)
	Other	4 (1.5)
Number of positive cores	NR	201 (74)
	≥3	56 (21)
	≥4	33 (12)
	Other	47 (17)
Cancer involvement per core	NR	135 (50)
	>20%	12 (4.4)
	>50%	74 (27)
Use of mpMRI for reclassification	Other	22 (8.1)
	NR	163 (60)
Patient preference	Yes	26 (9.6)
	NR	201 (74)

mpMRI = multiparametric magnetic resonance imaging; NR = not reported; PSA = prostate-specific antigen.

^a The total number of protocols which reported on reclassification thresholds was 271.

($n = 156$), studies with a follow-up duration of ≥39.5 mo ($n = 120$), studies with a low RoB across all domains ($n = 34$), subgroup analysis on thresholds of disease extent based on biopsies for inclusion, and reclassification based on ISUP 1 ($n = 245$ for inclusion; $n = 196$ for reclassification) and ISUP 2 ($n = 51$ for inclusion; $n = 41$ for reclassification) did not significantly alter the main findings regarding inclusion and progression thresholds, and monitoring and follow-up criteria.

3.5. Discussion

3.5.1. Principal findings

The results of this SR should be juxtaposed with those of the DETECTIVE study [5]. This report focused on addressing the remaining areas of uncertainty in order to issue recommendations based on a combination of expert opinion by a multidisciplinary panel underpinned by exploratory data from an SR. Only a minority of included studies (14%) described the use of mpMRI in their protocols; consequently, the recommendations derived from this SR should apply only to AS protocols where the use of mpMRI is either not mandatory or absent.

3.5.1.1. Should intermediate-risk localised disease be considered for AS? Since >50% of AS studies have included patients with intermediate-risk localised disease, we believe that AS can be considered in selected patients with single elements of intermediate-risk disease, but excluding ISUP 3 disease.

From the SR, the majority of candidates with intermediate-risk disease had only one intermediate-risk characteristic. The monitoring schedule should be more intensive, given the significantly higher risk of progression, development of regional or distant metastases, and death compared with low-risk disease [11]. In the future, tissue-based genetic risk scores may be helpful in stratifying these patients [12].

3.5.1.2. *What is the maximum biopsy tumour extent appropriate for inclusion into AS?* A total of 202 AS protocols (67%) used histological biopsy core information as a threshold for inclusion. Biopsy tumour extent expressed as the number of positive cores, proportion of positive cores, or maximum cancer CI is a strong predictor of grade reclassification [1,3,10,13,14], adverse pathological outcomes [13,15], biochemical progression [13], and biochemical recurrence following delayed radical treatment [10]. In our SR, 164 protocols (44%) used a maximum threshold of three positive cores as an inclusion criterion; another 144 protocols (39%) used a maximum threshold of CI >50% as an inclusion criterion. Consequently, we conclude that the most suitable maximum threshold for inclusion in systematically obtained biopsies is either three positive cores or 50% cancer involvement per core of ISUP 1 PCa; beyond these thresholds, patients could still be included, but they should be monitored closely due to a higher risk of adverse oncological outcomes. Patients with ISUP 2 and high core positivity (more than three positive cores) and/or cancer involvement (>50% CI per core) should be excluded.

3.5.1.3. *What is the most appropriate strategy of repeat prostate biopsies during monitoring?* The DETECTIVE study reached consensus on several issues regarding confirmatory and repeat biopsies during monitoring. However, there was no consensus on the role of per-protocol repeat biopsies. We found that more than half of included studies (55%) performed confirmatory biopsy within 1 yr of starting AS, and 79% performed it within 2 yr. The purpose of initial repeat biopsy is to account for understaging and undersampling at diagnosis, especially in the absence of mpMRI [16–18], and to detect potentially missed high-grade cancers. The vast majority of included studies (86%) did not report the use of MRI, where the risk of undergrading is approximately 20% on initial biopsy. Patients who are likely to progress are usually detected within the first 2 yr [19]. With the introduction of new and more accurate diagnostic modalities such as mpMRI at the outset of AS, the risk of undergrading at inclusion is likely to have decreased. However, this risk is not insignificant, as such per-protocol confirmatory biopsy may still be important [20,21]. Consequently, we recommend per-protocol confirmatory biopsies within 2 yr of commencing AS for non-mpMRI-based protocols.

The increasing use of mpMRI in contemporary AS protocols is leading to new standards. A recent SR and meta-analysis on the reliability of serial prostate MRI to detect PCa progression during AS [22] showed significant heterogeneity on MRI progression between included studies, and the pooled measured positive and negative predictive values were 0.50 and 0.85, respectively. The authors concluded that MRI progression alone should not be used as the sole

trigger for repeat biopsy. This underlines the importance of frequent PSA and DRE measurements as well as per-protocol surveillance repeat biopsies during the entire duration of AS.

Regarding the per-protocol surveillance repeat biopsies in non-mpMRI-based AS protocols, >70% of included studies performed surveillance repeat biopsies after the initial confirmatory biopsy. Almost 60% of included protocols performed surveillance repeat biopsies at least once every 3 yr throughout the duration of AS. We therefore recommend per-protocol surveillance repeat biopsies at least every 3 yr for the first 10 yr, if mpMRI is not available.

3.5.1.4. *What histological characteristics on repeat systematic biopsies should lead to a change in management?* The DETECTIVE study issued recommendations on the use of histological characteristics for reclassification. However, no consensus was reached regarding whether tumour extent on repeat biopsies should lead to reclassification, nor on the thresholds. We found that 67% of included studies used ISUP 2 or 3 on repeat systematic biopsies as a reclassification criterion. Of the protocols, 21% and 12% used, respectively, three or more and four or more positive cores as a reclassification criterion. Of the protocols, 27.3% defined CI >50% as a reclassification criterion. Results from the PRIAS study showed that 17% of patients had an increase in tumour volume, with the increasing number of baseline positive cores being an independent predictor (odds ratio [OR] 2.2; 95% confidence interval [CI] 1.67–2.81; $p < 0.001$) for reclassification [12] on multivariate analysis. Similar results have been shown by Klotz et al [11]. Tosoian et al [23] have also shown that the number and percentages of positive cores are predictors of pathological upgrading. The appropriate thresholds to guide management however remain unclear, whilst several retrospective studies provide compelling evidence. Truong et al [13] analysed clinical and pathological variables, and built a nomogram for recruiting patients with low-risk disease into an AS protocol. The authors found that the number of positive cores >3 (OR 1.23; 95% CI 1.05–1.45; $p = 0.01$) and % maximum CI >30% (OR 1.02; 95% CI 1.005–1.035; $p = 0.009$) were significantly associated with histological upgrading at radical prostatectomy on multivariate analysis. Other studies showed that a higher number of positive cores (more than three) were associated with higher rates of progression to treatment [24], whilst a lower number of cores at diagnostic biopsy showed a significant association with reduced need for active treatment [25]. An increase in the percentage of CI in low-risk PCa significantly increases the progression rate (adjusted hazard ratio 1.6; 95% CI 1.2–2.4; $p = 0.02$) for CI >38% during a median follow-up of 2.2 yr [26]. Half of men with CI >25% were reclassified within 2 yr. The percentage of needle biopsy cores and surface area positive for cancer were the strongest predictors of pathological stage and tumour volume in 207 consecutive patients who subsequently underwent radical prostatectomy [27]. The percentage of core positivity has also been associated with pathology progression [28,29].

In summary, there is sufficient evidence indicating that biopsy characteristics from repeat systematic biopsies

should drive future management if certain thresholds are exceeded, although the data are insufficient to make conclusions regarding reclassification for low-risk disease. Consequently, we recommend that thresholds of more than three positive cores or CI >50% per core obtained via repeat systematic biopsy (ie, when no MRI-targeted biopsies have been performed) for low-risk disease from previously low core positivity and/or low CI at diagnosis should be used as the criteria to monitor closely for evidence of adverse characteristics, including intermediate-risk disease, especially when no mpMRI is available. For patients with ISUP 2 disease recruited into AS, increase in core positivity and/or CI to such thresholds based on systematic repeat biopsies should be considered as a marker of reclassification.

Our SR did not find sufficient data on mpMRI to address whether mpMRI use could potentially supersede other clinical triggers of change in management during monitoring, such as changes in PSA, DRE, and histological characteristics of repeat biopsies. However, data from other studies may potentially be useful. The SR and meta-analysis by Rajwa et al [22] found that the incorporation of serial mpMRI scans does not reduce the importance of clinical and pathological staging during AS, primarily because MRI is not yet accurate enough to exclude disease progression during AS. Therefore, the thresholds identified in our SR including clinical T stage and core positivity and CI from repeat systematic biopsies are all likely to remain relevant, even for protocols involving mpMRI. However, the role of per-protocol repeat systematic biopsies and how they should be incorporated into AS protocols involving regular use of mpMRI during monitoring remain unclear.

3.5.2. Implications of study findings for clinical practice and research

Table 5 summarises the additional recommendations on AS derived from our SR. These findings can be compared with those of other studies with similar or overlapping aims. Kinsella et al [30] aimed to report on contemporary worldwide AS practices for PCa and what clinical triggers were important in recommending radical treatment. Only studies with a minimum of 18 mo of follow-up were included ($n = 13$). The authors found consistency amongst the studies to include patients with only localised low- or intermediate-risk disease. Monitoring protocols reported only on PSA surveillance, DRE, and rebiopsy strategies. Triggers for intervention across studies were inconsistent and not universally applied. Additionally, Bruinsma et al [31] demonstrated that AS protocols varied widely, but stated that the patients most suitable for AS were those with pretreatment cT1c or cT2 tumours, serum PSA levels <10 ng/ml, biopsy ISUP 1, a maximum of two tumour-positive biopsy core samples, and/or a maximum CI of 50% per core. Komisarenko et al [32] systematically summarised the current literature on AS strategies published by international guidelines and major institutions. They found minimal consensus on inclusion criteria, surveillance schedules, and intervention thresholds. Unlike our study, none of those reviews were protocol driven or PRISMA adherent, covering all essential domains, including inclusion/exclusion, monitoring, and reclassification thresholds. Recently, a new ran-

domised trial of AS in PCa (PCASTt/SPCG-17) was designed to evaluate the safety of an MRI-based AS protocol and PSA testing, comparing standardised triggers for repeat biopsy and curative treatment [33], in order to reduce the number of biopsies, improve quality of life, and reduce overtreatment of PCa without compromising oncological outcomes. Basic follow-up consists of biannual PSA testing, annual clinical examination and MRI scan, and quality of life questionnaire every 2nd year. Biopsies are taken only if standardised triggers are reached, including increase in PSA density and MRI progression. Curative intent is recommended only if standardised triggers are reached (ie, MRI progression of lesions with confirmed Gleason pattern 4 and pathological progression). It is worth noting that less invasive and less stringent follow-up protocols such as ProtecT appear not to disadvantage patients significantly, with cancer-specific mortality of 1% over 10 yr [34].

3.5.3. Strengths and limitations

The work is strengthened by utilising robust methods based on an a priori, PRISMA-adhering protocol. It is the largest and most comprehensive SR on AS to date, including 333 studies (375 protocols). Lastly, the study findings were interpreted in conjunction with those from the DETECTIVE study [5]. The main limitation is the lack of reported data on the role mpMRI. However, the fact that mpMRI may improve the identification of intermediate- and high-risk disease on biopsy should be taken into account, since many of them may have been included in historic cohorts. We emphasise that the recommendations from this study are based on low levels of evidence, being derived from a qualitative SR that did not have any clinical effectiveness data and instead relied on exploratory data from the literature, and interpreted using expert opinion from the panel. Consequently, we stress the interim nature of the guidance provided by the recommendations, being subject to a review when higher levels of evidence emerge.

4. Conclusions

Based on our SR, we are able to formulate the following recommendations for AS protocols in which the use of mpMRI is either not mandatory or absent: (1) AS can be considered in selected patients with low-volume ISUP 2 disease or other single intermediate-risk features (except ISUP 3, which is strictly excluded), only if strict monitoring is followed due to the higher risk of progression; (2) at recruitment, patients with low-risk but more extensive disease based on systematic biopsies, defined as more than three positive cores or maximum CI >50% per core, should be monitored closely, whereas patients with ISUP 2 but similarly high core positivity and/or CI should be excluded; (3) per-protocol confirmatory prostate biopsies should be performed within 2 yr, and per-protocol surveillance repeat biopsies should be performed at least once every 3 yr for the first 10 yr; and (4) patients with low-volume, low-risk disease at recruitment in whom repeat systematic biopsies have revealed an increase in core positivity to three or more positive cores or maximum CI >50% per core, especially when no MRI-targeted biopsies are performed and/or no

Table 5 – Summary of additional recommendations for active surveillance for localised prostate cancer based on SR

Domain	Current EAU PCa 2020 guideline recommendations	Additional recommendations based on SR	
		Recommendation	Strength of recommendation
Inclusion criteria	1. Perform mpMRI prior to inclusion to ensure that appropriate biopsies have been taken and to stage disease	1. Favourable ISUP 2 grade group disease (ie, PSA <10 ng/ml, clinical stage \leq cT2a, and a low number of positive cores [ie, \leq 3 positive cores, or maximum CI \leq 50% per core]), or any single element of intermediate-risk disease (eg, PSA 10–20 ng/ml) accompanied by other favourable features (eg, ISUP 1 grade group, cT2a), can be included; however, ISUP 3 is excluded	Weak
	2. ISUP 1 disease	2. ISUP 2 with high core positivity (>3 cores) and/or high CI (>50% per core) should be excluded	Weak
	3. PSA <10 ng/ml	3. Patients with low-risk disease but >3 positive cores or maximum CI >50% per core should be monitored more closely than those with smaller disease extent	Weak
	4. T1 and T2a disease		
	5. Offer AS to highly selected patients with ISUP grade group 2 disease (ie, <10% pattern 4, PSA <10 ng/ml, <cT2a, low disease extent on imaging and biopsy) accepting the potential increased risk of metastatic progression		
Monitoring criteria	1. PSA at least every 6 mo	1. For AS protocols not using mpMRI, per-protocol confirmatory biopsies should be performed within the first 2 yr	Weak
	2. DRE at least every 6 mo	2. For AS protocols not using mpMRI, repeat systematic biopsies should be performed at least once every 3 yr for 10 yr	Weak
	3. There is no need for confirmatory biopsies if upfront mpMRI followed by systematic and targeted biopsies have been performed	3. For protocols not using mpMRI, patients with low-volume, low-risk disease at recruitment, if repeat systematic biopsies reveal >3 positive cores or maximum CI >50%/core, should be monitored closely for evidence of adverse features (eg, upgrading), especially in the absence of surveillance mpMRI	Weak
	4. If repeat biopsies are needed, mpMRI should be performed prior to repeat biopsies	4. Patients with low-volume ISUP 2 disease at recruitment with increased core positivity (>3 cores) and/or core involvement (>50% per core) on repeat systematic biopsies should be reclassified	Weak

CI = cancer involvement; DRE = digital rectal examination; EAU = European Association of Urology; ISUP = International Society of Urological Pathology; mpMRI = multiparametric magnetic resonance imaging; PCa = prostate cancer; PSA = prostate-specific antigen; SR = systematic review.

mpMRI is available, should be monitored closely for adverse features, including presence of intermediate-risk disease; patients with ISUP 2 disease with increased core positivity and/or CI to similar thresholds should be reclassified. Although important, we acknowledge the strength of recommendations as weak, being based on data with low levels of evidence; consequently, these are subject to some uncertainty and must be interpreted accordingly.

Author contributions: Peter-Paul M. Willemse had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Willemse, MacLennan, Mason, Cornford, Mottet, Lam.

Acquisition of data: Willemse, Davis, Grivas, Zattoni, Lardas, Dell'Oglio, Donaldson, Gandaglia, Liew, Pang, Paterson, Yuan.

Analysis and interpretation of data: Willemse, Davis, Grivas, Zattoni, Lardas, Lam.

Drafting of the manuscript: Willemse, Davis, Grivas, Lam, Mottet, Cornford.

Critical revision of the manuscript for important intellectual content: Briers, Cumberbatch, De Santis, Fossati, Gillessen, Grummet, Henry, Moris, O'Hanlon, Omar, Oprea-Lager, Ploussard, Rouvière, Schoots, Tilki, van den Bergh, van den Broeck, van der Kwast, van der Poel, Wiegel, Yuan, Cornford, Mottet, Lam.

Statistical analysis: Willemse, MacLennan, Lam.

Obtaining funding: None.

Administrative, technical, or material support: Willemse, Plass, Yuan.

Supervision: Cornford, Mottet, Lam.

Other: None.

Financial disclosures: Peter-Paul M. Willemse certifies that all conflicts of interest, including specific financial interests and relationships and affiliations relevant to the subject matter or materials discussed in the manuscript (eg, employment/affiliation, grants or funding, consultancies, honoraria, stock ownership or options, expert testimony, royalties, or patents filed, received, or pending), are the following: Professor Dr. Nicolas Mottet is a company consultant for Janssen, GE, BMS, Sanofi, and Astellas; has received speaker honoraria from Astellas, Pierre Fabre, Steba, Janssen, and Ferring; and has received fellowships and travel grants from Astellas, Ipsen, Sanofi, Janssen, and Roche. Professor Dr. Philip Cornford is a company consultant for Astellas, Ipsen, and Ferring; has received company speaker honoraria from Astellas, Janssen, Ipsen, and Pfizer; has participated in trials run by Ferring; and has received fellowships and travel grants from Astellas and Janssen. Dr. Erik Briers has received grants and research support from IPSEN, the European Association of Urology, and Bayer; is an ex officio board member for Europa UOMO; is an ethics committee and advisory group member for REQUITE; is a patient advisory board member for PAGMI; and is a member of SCA and EMA PCWP. Professor Dr. Maria De Santis is a company consultant for Amgen, Astellas, AstraZeneca, Bayer, Bristol-Myers Squibb, Celgene, Dendreon, Eisai Inc., ESSA, Ferring, GSK, Incyte, Ipsen, Janssen Cilag, Merck, MSD, Novartis, Pfizer, Pierre Fabre Oncologie, Roche, Sanofi Aventis, SeaGen, Shionogi, Syn-

thon, Takeda, Teva, OncoGenex, and Sandoz; receives speaker honoraria from Amgen, Astellas, AstraZeneca, Bayer, Bristol-Myers Squibb, Ferring, GSK, IPSEN, Janssen Cilag, Merck, MSD, Novartis, Pfizer, Pierre Fabre Oncologie, Roche, Sanofi Aventis, Synthron, and Takeda; participates in trials run by the Technical University Munich, Amgen, Astellas, AstraZeneca, Bayer, Bristol-Myers Squibb, Celgene, Dendreon, Eisai Inc., Ferring, GSK, IPSEN, Incyte, Janssen Cilag, Merck, MSD, Novartis, Pfizer, Pierre Fabre Oncologie, Roche, Sanofi Aventis, SOTIO, and Cancer Research UK; participates in various trials as a member of the EORTC GU Group; and has received research grants from Pierre Fabre Oncologie, and travel grants from Amgen, Astellas, AstraZeneca, Bayer, Bristol-Myers Squibb, Celgene, Dendreon, Ferring, GSK, IPSEN, Incyte, Janssen Cilag, Merck, MSD, Novartis, Pfizer, Pierre Fabre Oncologie, Roche, Sanofi Aventis, SeaGen, Shionogi, Synthron, Takeda, and Teva/OncoGenex. Professor Dr. Silke Gillissen is a company consultant for AAA International, Astellas Pharma, Bayer, Bristol-Myers Squibb, Clovis, CureVac, Ferring, Innocrin Pharmaceuticals, Janssen Cilag, MaxIVAX SA, Orion, Roche, Sanofi Aventis Group, Nectar, and ProteoMediX; has received speaker honoraria from Janssen and Novartis; and participates in multiple trials sponsored by different companies. Professor Dr. Jeremy P. Grummet has received a speaker honorarium from Mundipharma, a travel grant from Astellas, and a research grant from Cancer Australia; and is the owner of MRI PRO Pty Ltd., an online training platform. Professor Dr. Ann M. Henry is a company consultant for Nucletron-Elektra; participates in trials by Cancer Research UK and the National Institute of Health Research (UK); has received travel grants from the Medical Research Council, the National Institute of Health Research (UK), and Cancer Research UK; and has received research grants from Cancer Research UK and the Sir John Fisher Foundation. Dr. Thomas B.L. Lam is a company consultant for and has received company speaker honoraria and travel grants from Pfizer, GSK, Astellas, IPSEN, and Consilient Health. Professor Dr. Malcolm D. Mason is a company consultant for Ellipses Pharma and Oncotherics. Professor Dr. Shane O'Hanlon received travel grants from SIOG and ESMO, and research support from Slaintecare. Professor Dr. Guillaume Ploussard is a company consultant for Janssen, Takeda, Ferring, Ipsen, Astellas, and Koelis; received company speaker honorarium from Janssen, Takeda, Ferring, Ipsen, Astellas, and Bayer; and received research support from Ferring. Professor Dr. Derya Tilki has received speaker honoraria from Astellas and a travel grant from Janssen. Olivier Rouvière received speaker honorarium from EDAP-TMS, travels grants and research support from Philips, and participated in clinical trials by EDAP-TMS and Vermon. Theodorus van der Kwast received research support from Google Inc. Professor Dr. Henk G. van der Poel is a company consultant for Intuitive Surgical; has participated in trials for Astellas and Steba Biotech; and has received grant and research support from Astellas. Professor Dr. Thomas Wiegel is an advisory board member for Ipsen; receives company speaker honoraria from Ipsen and Hexal; is a member of the Janssen Steering Committee; and has participated in the ATLAS/AUO trial. Dr. Thomas Van den Broeck, Dr. Ivo G. Schoots, Dr. Michael Lardas, Mr. Matthew Liew, Dr. Giorgio Gandaglia, Dr. Nicola Fossati, Mr. Marcus Cumberbatch, Dr. Roderick C.N. van den Bergh, Dr. D. Oprea-Lager, Dr. Lisa Moris, Dr. Andrea Farolfi, Dr. Peter-Paul M. Willemse, Dr. Nikos Grivas, Dr. Y. Yuan, Mr. N.F. Davis, Dr. C.C. Paterson, Dr. P. Dell'Oglio, Dr. M.I. Omar, and Dr. S. MacLennan have nothing to disclose.

Funding/Support and role of the sponsor: None.

Peer Review Summary

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.eururo.2021.12.007>.

References

- [1] Tosoian JJ, Mamawala M, Epstein JI, et al. Intermediate and longer-term outcomes from a prospective active-surveillance program for favorable-risk prostate cancer. *J Clin Oncol* 2015;33:3379–85.
- [2] Klotz L. Active surveillance: the Canadian experience. *Curr Opin Urol* 2012;22:222–30.
- [3] Bul M, Zhu X, Valdagni R, et al. Active surveillance for low-risk prostate cancer worldwide: the PRIAS study. *Eur Urol* 2013;63:597–603.
- [4] Tosoian JJ, Trock BJ, Landis P, et al. Active surveillance program for prostate cancer: an update of the Johns Hopkins experience. *J Clin Oncol* 2011;29:2185–90.
- [5] Lam TBL, MacLennan S, Willemse PM, et al. EAU-EANM-ESTRO-ESUR-SIOG Prostate Cancer Guideline Panel consensus statements for deferred treatment with curative intent for localised prostate cancer from an international collaborative study (DETECTIVE study). *Eur Urol* 2019;76:790–813.
- [6] Willemse PM, Lardas M, Davis N, et al. Systematic review of deferred treatment with curative intent for localised prostate cancer to explore heterogeneity of definitions, thresholds and criteria and clinical effectiveness. *Prospero* 2018.
- [7] Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71.
- [8] Dalziel K, Round A, Stein K, Garside R, Castelnuovo E, Payne L. Do the findings of case series studies vary significantly according to methodological characteristics? *Health Technol Assess* 2005;9:iii–iv (p. 1–146).
- [9] Viswanathan M, Ansari MT, Berkman ND, et al. Assessing the risk of bias of individual studies in systematic reviews of health care interventions. *Methods guide for effectiveness and comparative effectiveness reviews*. Rockville, MD: Agency for Healthcare Research and Quality (US); 2012.
- [10] van den Bergh RC, van Casteren NJ, van den Broeck T, et al. Role of hormonal treatment in prostate cancer patients with nonmetastatic disease recurrence after local curative treatment: a systematic review. *Eur Urol* 2016;69:802–20.
- [11] Klotz L, Vesprini D, Sethukavalan P, et al. Long-term follow-up of a large active surveillance cohort of patients with prostate cancer. *J Clin Oncol* 2015;33:272–7.
- [12] Klotz L. Active surveillance in intermediate-risk prostate cancer. *BJU Int* 2020;125:346–54.
- [13] Truong M, Slezak JA, Lin CP, et al. Development and multi-institutional validation of an upgrading risk tool for Gleason 6 prostate cancer. *Cancer* 2013;119:3992–4002.
- [14] Soeterik TFW, van Melick HHE, Dijkman LM, Biesma DH, Witjes JA, van Basten JA. Active surveillance for prostate cancer in a real-life cohort: comparing outcomes for PRIAS-eligible and PRIAS-ineligible patients. *Eur Urol Oncol* 2018;1:231–7.
- [15] da Silva V, Cagiannos I, Lavallée LT, et al. An assessment of Prostate Cancer Research International: Active Surveillance (PRIAS) criteria for active surveillance of clinically low-risk prostate cancer patients. *Can Urol Assoc J* 2017;11:238–43.
- [16] Porten SP, Whitson JM, Cowan JE, et al. Changes in prostate cancer grade on serial biopsy in men undergoing active surveillance. *J Clin Oncol* 2011;29:2795–800.
- [17] Inoue LYT, Lin DW, Newcomb LF, et al. Comparative analysis of biopsy upgrading in four prostate cancer active surveillance cohorts. *Ann Intern Med* 2018;168:1–9.
- [18] King AC, Livermore A, Laurila TA, Huang W, Jarrard DF. Impact of immediate TRUS rebiopsy in a patient cohort considering active surveillance for favorable risk prostate cancer. *Urol Oncol* 2013;31:739–43.
- [19] Al Otaibi M, Ross P, Fahmy N, et al. Role of repeated biopsy of the prostate in predicting disease progression in patients with prostate cancer on active surveillance. *Cancer* 2008;113:286–92.
- [20] Bjurlin MA, Wysock JS, Taneja SS. Optimization of prostate biopsy: review of technique and complications. *Urol Clin North Am* 2014;41:299–313.
- [21] Osses DF, Drost FH, Verbeek JFM, et al. Prostate cancer upgrading with serial prostate magnetic resonance imaging and repeat biopsy in men on active surveillance: are confirmatory biopsies still necessary. *BJU Int* 2020;126:124–32.
- [22] Rajwa P, Pradere B, Quhal F, et al. Reliability of serial prostate magnetic resonance imaging to detect prostate cancer progression

- during active surveillance: a systematic review and meta-analysis. *Eur Urol* 2021;80:549–63.
- [23] Tosoian JJ, Mamawala M, Patel HD, et al. Tumor volume on biopsy of low risk prostate cancer managed with active surveillance. *J Urol* 2018;199:954–60.
- [24] Leong JY, Capella C, Teplitsky S, et al. Impact of tumor regional involvement on active surveillance outcomes: validation of the cumulative cancer location metric in a US population. *Eur Urol Focus* 2020;6:235–41.
- [25] Marengi C, Alvisi MF, Palorini F, et al. Eleven-year management of prostate cancer patients on active surveillance: what have we learned? *Tumori* 2017;103:464–74.
- [26] Sampurno F, Earnest A, Millar J, et al. Population-based study of grade progression in patients who harboured Gleason 3 + 3. *World J Urol* 2017;35:1689–99.
- [27] Sebo TJ, Bock BJ, Chevillet JC, Lohse C, Wollan P, Zincke H. The percent of cores positive for cancer in prostate needle biopsy specimens is strongly predictive of tumor stage and volume at radical prostatectomy. *J Urol* 2000;163:174–8.
- [28] Venkitaraman R, Norman A, Woode-Amisshah R, et al. Predictors of histological disease progression in untreated, localized prostate cancer. *J Urol* 2007;178(3 Pt 1):833–7.
- [29] Ng MK, Van As N, Thomas K, et al. Prostate-specific antigen (PSA) kinetics in untreated, localized prostate cancer: PSA velocity vs PSA doubling time. *BJU Int* 2009;103:872–6.
- [30] Kinsella N, Helleman J, Bruinsma S, et al. Active surveillance for prostate cancer: a systematic review of contemporary worldwide practices. *Transl Androl Urol* 2018;7:83–97.
- [31] Bruinsma SM, Bangma CH, Carroll PR, et al. Active surveillance for prostate cancer: a narrative review of clinical guidelines. *Nat Rev Urol* 2016;13:151–67.
- [32] Komisarenko M, Martin LJ, Finelli A. Active surveillance review: contemporary selection criteria, follow-up, compliance and outcomes. *Transl Androl Urol* 2018;7:243–55.
- [33] Ahlberg MS, Adami HO, Beckmann K, et al. PCASTt/SPCG-17—A randomised trial of active surveillance in prostate cancer: rationale and design. *BMJ Open* 2019;9:e027860.
- [34] Hamdy FC, Donovan JL, Lane JA, et al. Active monitoring, radical prostatectomy and radical radiotherapy in PSA-detected clinically localised prostate cancer: the ProtecT three-arm RCT. *Health Technol Assess* 2020;24:1–176.