High-dose-rate brachytherapy boost for elderly patients with intermediate to high-risk prostate cancer: 5-year clinical outcome of the PROSTAGE cohort

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ABSTRACT

Purpose: To analyze the oncological outcome in elderly (>70 years) prostate cancer after high-dose rate brachytherapy (HDB) boost.

Materials/methods: In this retrospective study, patients with intermediate (IR) and high-risk (HR) prostate cancer underwent external beam radiation therapy (EBRT) followed by HDB boost with/without androgen deprivation therapy (ADT). The impact of age ($\leq$70y vs. > 70y) was investigated. Oncological outcome focused on biochemical relapse-free survival (bRFS), cause-specific (CSS) and overall survival (OS). Late genito-urinary (GU) and gastro-intestinal (GI) toxicities were investigated.

Results: From 07/08 to 01/22, 518 pts received a HDB boost, and 380 were analyzed ($\leq$70y:177pts [46.6%] vs. > 70y:203pts [53.4%]). Regarding NCCN classification, 98 pts ($\leq$70y: 53pts; >70y: 45pts; p = 0.107) and 282 pts ($\leq$70y: 124pts; >70y: 158pts; p = NS) were IR and HR pts respectively. Median EBRT dose was 46 Gy [37.5–46] in 23 fractions [14–25]. HDB boost delivered a single fraction of 14/15 Gy (79%). ADT was used in 302 pts ($\leq$70y: 130pts; >70y: 172pts; p = 0.01). With MFU of 72.6 months [67–83] for the whole cohort, 5-y bRFS, 5-y CSS and 5-y OS were 88% [85–92], 99% [97–100] and 94% [92–97] respectively; there was no statistical difference between the two age groups except for 5-y CSS (p = 0.05). Late GU and GI toxicity rates were 32.4% (G $\geq$ 3 7.3%) and 10.1% (no G3) respectively.

Conclusions: For IR and HR prostate cancers, HDB boost leads to high rates of disease control with few late G $\geq$ 3 GU/GI toxicities. For elderly pts, HDB boost remains warranted mainly in HR pts, while competing comorbidity factors influence OS.

Introduction

Prostate cancer (PC) is the second most common cancer in the world, and the most frequent after the age of 70. According to estimates, its incidence in the next twenty years will double in men over 70, with 1.44 million new cases (compared to 709,000 today) [1,2]. The management of localized PC in older adults is already a challenge for clinicians and will be a major public health issue in the future.

The current recommended standard of care for localized intermediate (IR) to high-risk (HR) PC is prostatectomy or a combination of androgen deprivation therapy (ADT) plus definitive radiotherapy, which may be external beam radiotherapy (EBRT) with or without brachytherapy (BT) boost allowing dose escalation [3]. In the 3 randomized clinical trials (RCT) which compared PC irradiation with or without BT boost, the latter demonstrated a significant biochemical relapse-free survival (bRFS) benefit, with no overall survival (OS) impact [4–7]. In the ASCENDE-RT trial, brachytherapy boost significantly decreased urinary function [7]. However, these RCT included patients up to 80 years old, without specific sub-group analysis related to age which was only reported as a predictive factor of OS [7]. Elderly patients remain under-represented or under-evaluated in RCTs, making elderly PC management complex and controversial due to lack of robust and consensual data. Furthermore, the National Comprehensive Cancer Network (NCCN) guidelines are less applied to HR subjects over 75 y, which can lead to a risk of inappropriate or even under-treatment [8–15]. However, chronological age is not the only factor to consider in the management of older adults, whose PC is often associated with poorer histological criteria combined with competing comorbidities [16].

Elderly PC irradiation has recently been investigated, showing both oncological outcomes and toxicity profiles comparable to younger populations [17–21]. The impact of EBRT plus BT boost was also investigated in IR and HR elderly PC populations. Although this treatment improved bRFS, cause-specific survival (CSS) and OS, results must be viewed with caution owing to the lack of data regarding patient comorbidities and treatment-related toxicities [21–24].

We therefore conducted a study comparing EBRT with high-dose-rate (HDR) BT boost and ADT in men under, and over, 70 y with IR to HR-PC.

Material and methods

An observational, retrospective, single institution study was performed in the Antoine Lacassagne Cancer Center in Nice (France) for patients with IR to HR-PC receiving HDR-BT boost. Before data collection, the consent of all patients was obtained. In accordance with current legislation, data collection was registered at the National Health Data Hub under the number F20201008194116.

Patients

Patients with histologically proven localized PC, who received EBRT combined with HDR-BT boost, were eligible. Exclusion criteria were lymph node involvement, metastatic disease and other non-controlled neoplasia. Patients with IR or HR-PC with a follow-up of at least 18 months were selected. Patients underwent a clinical rectal examination, prostate-specific antigen (PSA) blood test, pelvic magnetic resonance imaging (MRI) and/or computed tomography scan (CT) and bone scan at the time of diagnosis. Tumors were classified according to NCCN guidelines and the International Society of Urological Pathology (ISUP) grading [3,25].

Treatment modalities

External beam radiotherapy (EBRT)

The planning CT-scan was performed in the treatment position with 2.5 mm slices. The target volume (CTV) was defined using the planning CT-scan and covered the prostate gland up to the first third of the seminal vesicles with or without pelvic lymph node irradiation (obturator, bilateral internal/external iliac vessels up to L5/S1 or 1.5 cm above their bifurcation). A 10 mm margin (PTV) reduced to 5 mm at the rectal level was applied to the predefined CTV. The EBRT delivered dose was 46 Gy (ICRU point) in 23 fractions of 2 Gy, based on three-dimensional conformational (3DRT) radiotherapy or intensity modulated radiotherapy (IMRT), using 6 or 10 MV X-photons. Organs at risk (OARs) included rectum, bladder, and bowel. Delineation and dose constraints for OARs were based on the RECORAD 2.0 recommendations [26].

High-dose-rate brachytherapy boost (HDR-BT boost)

The brachytherapy technique has already been described [27]. Briefly, HDR-BT boost was performed during the month before or after EBRT. Under general or spinal anesthesia, a triple lumen urinary catheter was inserted into the bladder. Transperineal needles were then implanted under endorectal ultrasound guidance using a dedicated perineal template sutured to the skin. After leaving the recovery room, patients underwent a post-implant CT-scan for treatment planning purposes. The CTV included the entire prostate and OARs (rectum, urethra and bowel) were delineated. Dose-volume adaptation was performed manually by graphical optimization (OncentraBrachy, Nucletron, an Elekta company, Elekta AB, Stockholm, Sweden; Sagiplan™ Eckert&Ziegler BEBIG, Berlin, Germany). Three different irradiation regimens were used: 3 fractions (total dose- TD: 18 Gy), 2 fractions (TD: 18 Gy) and 1 fraction (TD: 14 then 15 Gy). Prostate dose constraints were V100 > 95%, V150 < 35%, and V200 < 15%, D90 > 105%, and D100 > 80%. Because of dose escalation between multi- and mono-fractioned schemes, dose constraints used for OARs relied on the BT regimen groups. For 2 or 3 fraction BT regimens, Vu125 and Vr100 should be<1%, while for 1 fraction BT protocols, Vu115 and Vr90 should be<1%. The different BT regimens improved comparable efficacy and tolerance [28,27]. After the last session, the needles were removed and the urinary catheter kept until hematuria resolved. The catheter was then removed and the patient was discharged after micturition resumed.

Androgen deprivation therapy (ADT)

According to the NCCN recommendations [3], short (6 months) ADT was prescribed to unfavorable IR patients while HR patients received prolonged ADT for 18 to 30 months depending on patient tolerance and background (especially cardiovascular or cognitive impairment comorbidities). ADT comprised a LHRH agonist (Leuprorelin, Triptorelin or Degarelix) combined with a non-steroid anti-androgen for the first month to prevent flare-up (Bicalutamide 50 mg daily).

Follow-up and evaluation

Oncological outcome was analyzed based on biochemical, local, regional (pelvic lymph-node), and metastatic recurrence. Biochemical relapse was defined according to the Phoenix definition: nadir + 2 ng/mL. However, in the event of PSA increase > nadir + 2, pts underwent prostate MRI and PET-scan in order to detect local and/or distant disease progression followed by prostate biopsies if local relapse was suspected. Local recurrence was defined as a relapse occurring in the prostate gland. Regional node relapse was defined as lymph-node failure confirmed by imaging encompassing the pelvic to *para*-aortic area. Metastatic recurrence was defined as distant failure confirmed by CT-scan, bone-scan or choline/PSMA PET-CT.

Toxicity analysis focused on genitourinary (GU) and gastrointestinal (GI) side effects using CTCAE, version 4.0 criteria (National Cancer Institute Common Toxicity Criteria). Toxicity assessment was performed weekly during the EBRT course, 1 month after HDR-BT boost, then every 6 months for the first 5 years of follow-up, then annually. The cut-off

between acute and late toxicities was fixed at 6 months after the end of HDR-BT. Late toxicities were evaluated using their highest grade at any given consultation starting 6 months after treatment and the grade at last follow-up.

Statistical analysis

The primary endpoint was biochemical relapse-free survival (bRFS). Secondary endpoints were local- (lRFS), regional lymph node- (rRFS) and metastatic relapse-free survival (mRFS), disease-free (DFS), cancer-specific (CSS) and overall survival (OS). Late GU and GI toxicities were also investigated. Qualitative data were summarized using absolute and relative frequencies and quantitative data using median and range. Patients were censored at their last follow-up. BRFS, lRFS, mRFS, DFS, CSS and OS were estimated using the Kaplan-Meier method and compared using a log-rank test and Cox multivariate analysis when required. BRFS was defined between the date of diagnosis (biopsy) and date of the first biochemical event. LRFS, rRFS, mRFS were defined between the date of diagnosis and date of the first local, regional lymph-node and distant event respectively. DFS was defined between the date of diagnosis and

date of the first event (biochemical, local, regional or distant recurrence as well as all causes of death). CSS was defined between the date of diagnosis and date of death due to PC. OS was defined as the period between diagnosis and date of death (all causes of death).

Statistical analysis was performed using R.3.6.1 Software for Windows. All tests were two-sided, and p-values < 0.05 were considered as significant results.

Results

Patient characteristics

Between 02/2008 to 01/2022, 518 pts treated with HDR-BT were eligible, of whom 380 IR or HR-PC pts with a minimal follow-up of 18 months were included in this study: 177 pts ≤ 70 y (46.6%) and 203 pts > 70 y (53.4%) with a median age of 64 y [47–70] and 75 y [70–85.3] respectively. Patient and treatment characteristics are reported in Table 1. Except for ADT, the two age groups were comparable. Ninety-eight pts (25.8%; ≤ 70 y (29.9%) vs. > 70 y (22.2%); p = 0.107) and 282 pts (74.2%; ≤ 70 y (70.1%) vs. > 70 y (77.8%); p = 0.107) were IR and

Table 1
Patient and treatment features.

	Whole cohort		≤ 70 y		> 70 y		p value
	data	%/[min–max]	data	%/[min–max]	data	%/[min–max]	
# pts	380		177	46.6	203	53.4	
Median age (years)	70.6	[47 – 85]	64.4	[47 – 70]	74.3	[70 – 85.3]	
MFU (months)	73.6	[67 – 83]	60	[60 – 60]	60	[54 – 60]	
NCCN classification							0.107
Intermediate-risk	98	25.8	53	29.9	45	22.2	
High-risk	282	74.2	124	70.1	158	77.8	
T (TNM)							0.936
T1	40	10.5	20	11.3	20	9.9	
T2	138	36.3	62	35.0	76	37.4	
T3	196	51.6	92	52.0	104	51.2	
T4	4	1.1	2	1.1	2	1.0	
TX	2	0.5	1	0.6	1	0.5	
Median iPSA (ng/ml)	9.5	[1 – 369]	9	[6.6 – 369]	10	[1 – 16.1]	0.154
ISUP							0.132
1	71	18.7	38	21.5	33	16.3	
2	101	26.6	56	31.6	45	22.2	
3	61	16.1	25	14.1	36	17.6	
4	73	19.2	28	15.8	45	22.2	
5	71	18.7	29	16.4	42	20.7	
X	3	0.8	1	0.6	2	1.0	
EBRT							
3DRT	144	38.1	70	39.5	74	3.4	0.256
IMRT	234	61.9	107	60.4	127	63.2	0.301
Pelvic LN irradiation	329	86.6	146	82.5	183	90.1	0.042
Median duration (d)	35.4	[14 – 62]	35	[18 – 56]	35.7	[14 – 62]	0.112
Median dose (Gy)	46	[37.5 – 46]	46	[37.5 – 46]	46	[37.5 – 46]	0.85
Median # fraction	23	[14 – 25]	23	[14 – 25]	23	[15 – 23]	0.253
BT							
Time interval EBRT/BT (d)	14.1	[0 – 43]	13	[0 – 39]	13	[0 – 43]	0.951
1 fraction (14/15 Gy)	300	79	133	75.1	167	82.3	0.116
2/3 fractions (18 Gy)	80	21	44	24.9	36	17.7	0.201
Median CTV (cc)	39	[11 – 140]	38	[11 – 120]	41	[15 – 140]	0.286
Median D90 (%)	110	[78 – 140]	110	[78 – 120]	110	[95 – 140]	0.718
Median V100 (%)	98	[79 – 100]	98	[79 – 100]	98	[87 – 100]	0.05
Median DNR	0.28	[0.13 – 0.38]	0.29	[0.17 – 0.34]	0.27	[0.13 – 0.38]	0.07
D2cc urethra (%)	95	[81 – 110]	91	[90 – 110]	97	[81 – 110]	0.002
D2cc rectum (%)	66	[60 – 93]	67	[60 – 93]	66	[64 – 92]	0.09
ADT	302	79.4	130	73.4	172	84.7	0.01
Median duration (months)	18	[3 – 41]	18	[6 – 26.9]	18	[8.9 – 23]	0.495
Median duration IR (months)	6	[5 – 33]	6	[5.8 – 33]	6	[5 – 17]	0.552
Median duration HR (months)	19	[3 – 41]	23	[5.3 – 41]	18	[3 –41]	0.262

#pts: number of patients; MFU: median follow-up; NCCN: National Comprehensive Cancer Network; T: tumor; iPSA: initial prostate specific antigen; ISUP: International Society of Urological Pathology; EBRT: external beam radiation therapy; 3DRT: three-dimensional radiation therapy; IMRT: intensity modulated radiation therapy; LN: lymph-node; # fraction: number of fractions; BT: brachytherapy; CTV: clinical target volume; D90: dose delivered to 90% of the CTV, V100: percentage of the clinical target volume receiving 100% of the prescribed dose; DNR: dose non-homogeneity ratio D2cc: dose delivered to 2 cc of the organ at risk; ADT: androgen deprivation therapy; IR: intermediate risk; HR: high risk.

HR respectively. EBRT was mainly performed through IMRT (61.9%) on a pelvic field (86.6%) delivering a median dose of 46 Gy [37.5–46] in 15 to 23 fractions. HDR-BT boost was mostly delivered in a single fraction of 14/15 Gy (79%), with median V100 and median D90 of 98 % [79–100] and 110% [78–140] respectively (Table 1 & e-Table Supplementary data). ADT was used in 302 pts (79.4%; ≤ 70 y (73.4%) vs. > 70 y (84.7%); p = 0.01) for a median time of 18 months [3 –41] (IR: 6 months [5 –33]; HR: 19 months [3 –41]).

Oncological outcomes

With a median follow-up (MFU) of 73.6 months [67.4 – 83.4] for the whole cohort, 5-year oncological outcomes were: 5-y bRFS: 88% [CI95%: 85–92], 5-y lRFS: 97% [CI95%: 95–99], 5-y rRFS: 99% [CI95%: 98 – 100] and 5-y mRFS: 96% [CI95%: 94–98]. Five-y DFS, 5-y CSS and 5-y OS were 85% [CI95%: 81–89], 99% [CI95%: 97–100] and 94% [CI95%: 92–97] respectively (e-Fig. 1 Supplementary data). With a comparable MFU, no statistical oncological outcome difference was reported in the two age-groups, except for 5-y CSS, with a better result in the oldest group (≤70 y: 97% [CI95%: 94–100] vs. > 70 y: 100%; p = 0.05) (Fig. 1, Table 2). In a subgroup analysis comparing elderly (70 y < pts ≤ 80 y [182 pts]) vs. super-elderly (>80 y pts [21 pts]), 5-y bRFS (p = 0.3), 5-y lRFS (p = 0.3) and 5-y CSS (p = NA) were not statistically different between the two age-groups; however, a significant difference was observed for 5-y OS (p = 0.003) (e-Fig. 2 Supplementary data).

Toxicity

Late GU toxicity was observed in 123 pts (32.4%), including 10.6% G2 and 7.3% G3 toxicities, with no grade 4. No statistical difference between the two age-groups was observed for late GU toxicity (p = 0.669) (Table 3). Late GI toxicity was observed in 39 pts (10.1%) with 12.8% G2 toxicity and no grade ≥ 3. No statistical difference between

the two age-groups was observed for late GI toxicity (p = 1) (Table 3). However, in the subgroup analysis comparing elderly vs. super-elderly, late GU toxicity was observed in 55 pts ≤ 80 y (30.4%) versus 13 pts > 80 y (61.9%), a statistical difference (p = 0.008). Late GI toxicity profile was non-significantly different between elderly and super-elderly (e-Table 2 Supplementary data).

Discussion

The combination of EBRT, BT boost and ADT is one of the standards of care for IR/HR localized PC. These recommendations are not as yet applied to elderly pts, who are often mis- or undertreated because only their age is taken into account. As a result, their treatment remains complex and controversial.

Oncological outcomes in our analysis of 380 IR to HR-PC pts with a MFU of 72.3 months 5-y results were: bRFS 87 vs. 90% (p = 0.4), CSS 97 vs. 100% (p = 0.05) and OS 95 vs. 94% (p = 0.8) for ≤ 70 y and > 70 y age groups respectively. The only significant difference was observed for 5-yCSS. However, this result should be viewed with caution in light of the insufficient number of clinical events (4 vs. 0 for ≤ 70 y and > 70 y respectively), which makes this result less relevant. Patient characteristics were comparable in the two age-groups, except for the use of ADT (≤70 y 130 pts vs. > 70 y 172 pts; p = 0.01); there was no statistical difference in ADT indication or duration. Geinitz et al. [18] analyzed the impact of age (>75 y) in pts treated with EBRT +/- ADT. The authors reported a better 4-y bRFS in the elderly group (76% vs. 61%, p = 0.042), which could possibly be explained by lower testosterone levels after ADT in elderly patients.

Our data were consistent with available retrospective studies reporting BT boost in older adults, with some heterogeneity in population, follow-up, and treatment modalities. Stromberg et al. [23] compared 3 different regimens (3DRT, EBRT + HDR-BT boost, IMRT) in 443 IR or HR-PC patients > 70 y and reported a 5-y bRFS and OS of
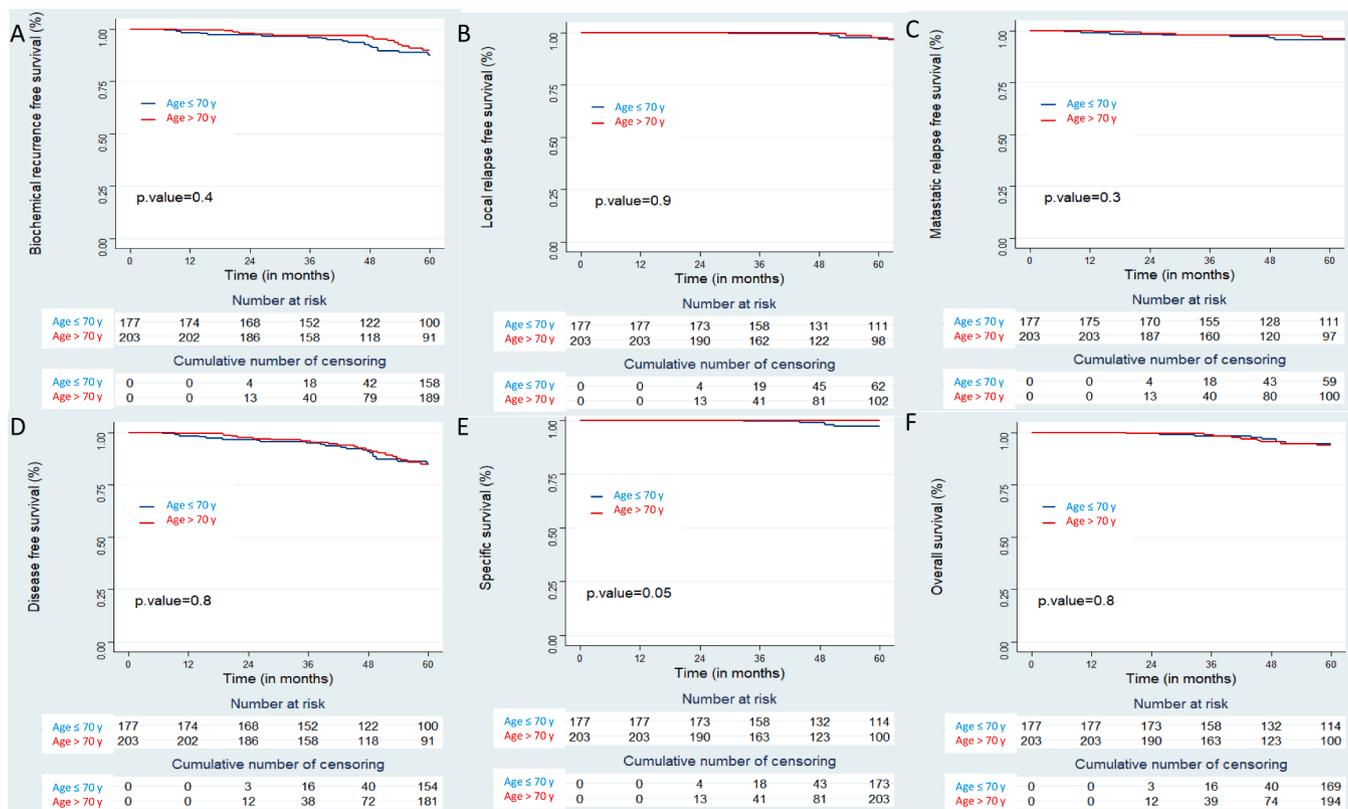
Fig. 1. Oncological outcome according to patient age: Biochemical recurrence free survival (A); Local recurrence free survival (B); Metastatic recurrence free survival (C); Disease free survival (D); Specific survival (E); Overall survival (F).

Table 2
Oncological outcome.

	Whole cohort		≤ 70 y		> 70 y		p value
	data	%/CI95%	data	%/CI95%	data	%/CI95%	
# pts	380		177	46.6	203	53.3	
Oncological outcome							
Biochemical relapse	43	11.3	24	55.8	19	44.2	0.26
Local relapse	Nov-43	25.6	6	54.5	5	45.5	0.76
Pelvic LN relapse	Jun-43	14.0	4	66.6	2	33.4	0.42
Distant M relapse	19/43	44.2	12	63.1	7	36.9	0.16
Unknown	Jul-43	16.3	–	–	–	–	–
5-y bRFS	88	[85 – 92]	87	[82 – 93]	90	[85 – 95]	0.4
5-y lRFS	97	[95 – 99]	97	[94 – 100]	98	[95 – 100]	0.9
5-y rRFS	99	[98 – 100]	99	[97 – 100]	99	[98 – 100]	0.5
5-y mRFS	96	[94 – 98]	96	[93 – 99]	96	[93 – 99]	0.3
5-y DFS	85	[81 – 89]	84	[79 – 91]	85	[79 – 91]	0.8
5-y CSS	99	[97 – 100]	97	[94 – 100]	100	[100 – 100]	0.05
5-y OS	94	[92 – 97]	95	[91 – 98]	94	[90 – 98]	0.8

pts: number of patients; LN: lymph-node; M: metastatic; bRFS: biochemical relapse free survival; lRFS: local relapse free survival; rRFS: regional lymph-node relapse free survival; mRFS: metastatic relapse free survival; DFS: disease-free survival; CSS: cancer specific survival; OS: overall survival.

Table 3
Toxicity.

	Whole cohort		≤ 70 y		> 70 y		p value
	# pts	%	# pts	%	# pts	%	
# pts	380		177	46.6	203	53.3	
Late GU toxicities	123	32.4	55	31.1	68	33.7	0.669
G1	101/123	82.1	44/55	80.0	57/68	83.8	0.389
G2	13/123	10.6	Aug-55	14.5	May-68	7.4	
G3	9/123	7.3	Mar-55	5.5	Jun-68	8.8	
Late GI toxicities	39	10.1	19	11.7	20	9.7	1
G1	34/39	87.2	17/19	89.5	17/20	85	1
G2	May-39	12.8	19-Feb	10.5	20-Mar	15	

#pts: number pf patients; GU: genito-urinary; GI: gastro-intestinal.

79.4% and 87.7% respectively for the BT regimen. Strouthos et al. [29] studied HDR-BT boost in 303 HR-PC pts where 63% were ≥ 70 y. With a MFU of 71.6 months, the authors reported an estimated bRFS and OS at 72 months of 85.7% and 88.3%. Yamazaki et al. [30,31] in their two studies comparing younger and elderly pts (>75 y then 80 y) with all risk PC, reported comparable outcomes in the cohorts with no impact of age. However, in a retrospective study including 2701 pts > 80 y treated with BT (77% with IR or HR-PC), Valdivieso R et al. [32] analyzed the oncological outcome at 5 and 10 years. The authors observed that, in this super-elderly population, the risk of dying of PC is 10 times less compared to all other cause death risk (2% vs. 19% for 5-y cause specific mortality and 5-y other causes mortality respectively). Consequently, the advantage of BT may disappear due to the shorter life expectancy.

Regarding toxicity analysis, our data were consistent with results reported in literature [29–31,33,34]. HDR-BT was well tolerated with 31.1% and 33.7% of late GU toxicity for ≤ 70 y and > 70 y respectively (p = 0.669) and 11.7% and 9.7% of late GI toxicity for ≤ 70 y and > 70 y respectively (p = 1). In our cohort, late G ≥ 2 GU/GI toxicity was ≤ 7%, better than results reported in literature [21], which was mainly based on references using 3DRT. We may posit that our toxicity results were improved by the use of IMRT in 62%, as already reported by Löser at al. [34]. We do not report statistical differences in terms of toxicity between the two age-groups, while several retrospective studies confirmed comparable toxicity outcomes in younger and elderly patients [30,31,33]. However, Chen et al. [35], in their large cohort of 5621 pts

> 65 y, highlighted age (comorbidities and addition of EBRT) as a factor behind post BT complications [35]. We also reported an increased late GU toxicity in pts > 80 y (p = 0.008), as described by Yamazaki et al. [31], who reported a higher incidence of GU toxicity than in other age-groups, especially with the use of BT. For > 80 y pts, the risk of BT toxicity (mainly GU) seems to increase and its oncological benefit remains open to debate.

This analysis contains a number of limitations. As in all observational studies and despite extensive corrections, our results may have been influenced by unknown residual confounding factors. It was a retrospective, monocentric analysis with data collection over a long period time (from 2008 to 2021); there may therefore be missing data or discrepancies between treatment modalities. Regarding irradiation technique, we mixed 3DRT and IMRT; also, the use of BT may lead to significant selection bias owing to patient BT feasibility status (anesthesia, comorbidity associated factors …). One of the major limitations of our study is the lack of comorbidity analysis in a heterogeneous, aged population. Comorbidity impact on life expectancy becomes ever greater with age, with competing factors of death. Cardiovascular and cognitive morbidity factors in particular can influence oncological outcomes and treatment tolerance especially with the addition of ADT [36–39]. Indeed, retrospective studies discussed the benefit of the combination EBRT + ADT for older adults with moderate/severe comorbidities or the super-aged, highlighting the importance of oncogeriatric assessment [40,41]. In a prospective study, Goineau et al. [42] analyzed quality of life (QoL) in 208 pts ≥ 75 y with localized PC treated after EBRT+/-ADT (without BT boost). The authors reported that, compared to baseline results, QoL was not significantly different in 75% of the pts. No predictive factor for QoL deterioration was observed (oncogeriatric assessment or tumor/treatment features).

Conclusion

For IR and HR prostate cancers in the elderly (>70 y), BT boost remains warranted in order to achieve optimal oncological outcome. In this population, the toxicity profile of BT boost appears acceptable. However, this treatment should be carefully discussed in super senior pts (>80 y) with competing comorbidity factors, which could significantly affect OS and the risk of side effects. The results of prospective trials to identify patients with the greatest benefit/risk balance are awaited.

Due to the increase in life expectancy, PC management in the elderly is a real challenge for patients, clinicians, health care providers and payers. Elderly patients remain candidates for optimal curative treatment (i.e. regardless of age) after oncogeriatric assessment to judiciously identify the patients who stand to benefit most.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ctro.2022.05.001.

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