

SCHEDULING STATUS S4

1. NAME OF THE MEDICINE

NUBEQA® 300 mg film-coated tablets

2. QUALITATIVE AND QUANTITATIVE COMPOSITION

Each film-coated tablet contains 300 mg of darolutamide.

Excipient with known effect

Each film-coated tablet contains 186 mg of lactose monohydrate (see section 4.4).

For the full list of excipients, see section 6.1.

3. PHARMACEUTICAL FORM

Film-coated tablets

White to off-white, oval tablets with a length of 16 mm and a width of 8 mm, marked with “300” on one side, and “BAYER” on the other side.

4. CLINICAL PARTICULARS

4.1 Therapeutic indications

NUBEQA is indicated for the treatment of adult men with non-metastatic castration resistant prostate cancer (nmCRPC) who are at high risk of developing metastatic disease (see section 5.1).

4.2 Posology and method of administration

Treatment should be initiated and supervised by a specialist experienced in treatment of prostate cancer.

Posology

The recommended dose is 600 mg darolutamide (two tablets of 300 mg) taken twice daily, equivalent to a total daily dose of 1200 mg (see section 5.2).

Medical castration with a luteinising hormone-releasing hormone (LHRH) analogue should be continued during treatment of patients not surgically castrated.

Missed dose

If a dose is missed, the dose should be taken as soon as the patient remembers prior to the next scheduled dose. The patient should not take two doses together to make up for a missed dose.

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Dose modification

If a patient experiences a \geq Grade 3 toxicity or an intolerable adverse reaction (see section 4.8), dosing should be withheld or reduced to 300 mg twice daily until symptoms improve. Treatment may then be resumed at a dose of 600 mg twice daily.

Dose reduction below 300 mg twice daily is not recommended, because efficacy has not been established.

Special populations

Elderly

No dose adjustment is necessary in elderly patients (see section 5.2).

Renal impairment

No dose adjustment is necessary for patients with mild or moderate renal impairment.

For patients with severe renal impairment (eGFR 15-29 mL/min/1,73 m²) not receiving haemodialysis, the recommended starting dose is 300 mg twice daily (see sections 4.4 and 5.2).

Hepatic impairment

No dose adjustment is necessary for patients with mild hepatic impairment.

The available data on darolutamide pharmacokinetics in moderate hepatic impairment is limited.

Darolutamide has not been studied in patients with severe hepatic impairment.

For patients with moderate hepatic impairment (Child-Pugh B), the recommended starting dose is 300 mg twice daily (see sections 4.4 and 5.2).

Paediatric population

There is no relevant use of darolutamide in the paediatric population for the indication of treatment of nmCRPC.

Method of administration

NUBEQA is for oral use.

The tablets should be taken whole with food (see section 5.2).

4.3 Contraindications

- Hypersensitivity to the active substance or to any of the excipients listed in section 6.1.
- Women who are or may become pregnant (see section 4.6).

4.4 Special warnings and precautions for use

Renal impairment

The available data in patients with severe renal impairment (eGFR 15-29 ml/min/1,73 m²) are limited. As exposure might be increased those patients should be closely monitored for adverse reactions (see sections 4.2 and 5.2).

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Hepatic impairment

The available data in patients with moderate hepatic impairment are limited, and darolutamide has not been studied in patients with severe hepatic impairment.

As exposure might be increased those patients should be closely monitored for adverse reactions (see sections 4.2 and 5.2).

Recent cardiovascular disease

Patients with clinically significant cardiovascular disease in the past 6 months including stroke, myocardial infarction, severe/unstable angina pectoris, coronary/peripheral artery bypass graft, and symptomatic congestive heart failure were excluded from the clinical studies. Therefore, the safety of darolutamide in these patients has not been established.

If NUBEQA is prescribed, patients with clinically significant cardiovascular disease should be treated for these conditions according to established guidelines.

Concomitant use with other medicines

Use of strong CYP3A4 and P-gp inducers during treatment with darolutamide may decrease the plasma concentration of darolutamide and is not recommended, unless there is no therapeutic alternative. Selection of an alternate concomitant medicines with less potential to induce CYP3A4 or P-gp should be considered (see section 4.5).

Patients should be monitored for adverse reactions of BCRP, OATP1B1 and OATP1B3 substrates as co-administration with darolutamide may increase the plasma concentrations of these substrates. Co-administration with rosuvastatin should be avoided unless there is no therapeutic alternative (see section 4.5).

Androgen deprivation therapy may prolong the QT interval

In patients with a history of risk factors for QT prolongation and in patients receiving concomitant medicines that might prolong the QT interval (see section 4.5), medical practitioners should assess the benefit-risk ratio including the potential for Torsade de pointes prior to initiating NUBEQA.

Information about excipients

NUBEQA contains lactose. Patients with rare hereditary problems of galactose intolerance, total lactase deficiency or glucose-galactose malabsorption should not take this medicine.

4.5 Interaction with other medicines and other forms of interaction

Effects of other medicines on darolutamide

CYP3A4 and P-gp inducers

Darolutamide is a substrate of CYP3A4 and P-glycoprotein (P-gp).

Use of strong and moderate CYP3A4 inducers and P-gp inducers (e.g. carbamazepine, phenobarbitone, St. John's Wort, phenytoin, and rifampicin) during treatment with darolutamide is not recommended, unless

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there is no therapeutic alternative. Selection of an alternate concomitant medicine, with no or weak potential to induce CYP3A4 or P-gp should be considered.

Repeated administration of rifampicin (600 mg), a strong CYP3A4 and a P-gp inducer, with a single dose of darolutamide (600 mg) together with food, resulted in a decrease of 72 % in mean exposure (AUC_{0-72}) and a decrease of 52 % in C_{max} of darolutamide.

CYP3A4, P-gp and BCRP inhibitors

Darolutamide is a substrate of CYP3A4, P-gp and breast cancer resistance protein (BCRP). No clinically relevant interaction is expected in case of CYP3A4, P-gp or BCRP inhibitor administration. Darolutamide may be given concomitantly with CYP3A4, P-gp or BCRP inhibitors. Concomitant use of darolutamide with a combined P-gp and strong CYP3A4 inhibitor increases darolutamide exposure which may increase the risk of darolutamide adverse reactions. It is recommended to monitor patients more frequently for darolutamide adverse reactions and modify darolutamide dose as needed.

Administration of itraconazole (200 mg twice daily on day 1 and once daily on the following 7 days), a strong CYP3A4, P-gp and BCRP inhibitor, with a single dose of darolutamide (600 mg on day 5 together with food) resulted in a 1,7-fold increase in mean exposure (AUC_{0-72}) and a 1,4-fold increase of C_{max} of darolutamide.

UGT1A9 inhibitors

Darolutamide is a substrate of UGT1A9. No clinically relevant interaction is expected in case of UGT1A9 inhibitor administration. Darolutamide may be given concomitantly with UGT1A9 inhibitors. A population pharmacokinetic analysis showed that co-administration of UGT1A9 inhibitors with darolutamide resulted in a 1,2-fold increase in exposure (AUC_{0-72}) of darolutamide.

Effects of darolutamide on other medicines

BCRP, OATP1B1 and OATP1B3 substrates

Darolutamide is an inhibitor of breast cancer resistance protein (BCRP) and Organic Anion Transporting Polypeptides (OATP) 1B1 and 1B3.

Co-administration of rosuvastatin should be avoided unless there is no therapeutic alternative. Selection of an alternative concomitant medicines with less potential to inhibit BCRP, OATP1B1 and OATP1B3 should be considered.

Administration of darolutamide (600 mg twice daily for 5 days) prior to co-administration of a single dose of rosuvastatin (5 mg) together with food resulted in approximately 5-fold increase in mean exposure (AUC) and C_{max} of rosuvastatin.

Co-administration of darolutamide with other BCRP substrates should be avoided where possible. Co-administration of darolutamide may increase the plasma concentrations of other concomitant BCRP, OATP1B1 and OATP1B3 substrates (e.g. methotrexate, sulfasalazine, fluvastatin, atorvastatin, pitavastatin). Therefore, it is recommended to monitor patients for adverse reactions of BCRP, OATP1B1 and OATP1B3 substrates. In addition, the related recommendation in the product information of these substrates should be followed when co-administered with darolutamide.

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P-gp substrates

No clinically relevant interaction is expected in case of P-gp substrate administration.

Darolutamide may be given concomitantly with P-gp substrates (e.g. digoxin, verapamil or nifedipine).

Co-administration of darolutamide together with the sensitive P-gp substrate dabigatran etexilate did not reveal any increase in exposure (AUC and C_{max}) of dabigatran.

CYP3A4 substrates

Darolutamide is a mild inducer of CYP3A4.

No clinically relevant interaction is expected in case of CYP substrate administration.

Darolutamide may be given concomitantly with CYP substrates (e.g. warfarin, L-thyroxine, omeprazole).

Administration of darolutamide (600 mg twice daily for 9 days) prior to co-administration of a single dose of the sensitive CYP3A4 substrate midazolam (1 mg) together with food, decreased the mean exposure (AUC) and C_{max} of midazolam by 29 % and 32 %, respectively.

Darolutamide did not inhibit the metabolism of selected CYP substrates *in vitro* at clinically relevant concentrations.

Medicines that prolong the QT interval

Since androgen deprivation treatment may prolong the QT interval, the co-administration with medicines known to prolong the QT interval or medicines able to induce Torsade de pointes should be carefully evaluated. These include medicines such as class IA (e.g., quinidine, disopyramide) or class III (e.g., amiodarone, sotalol, dofetilide, ibutilide) antidysrhythmic medicines, methadone, moxifloxacin, and antipsychotics (e.g. haloperidol).

4.6 Fertility, pregnancy and lactation

NUBEQA is not indicated in women of childbearing potential. It is not to be used in women who are, or may be, pregnant or breast-feeding (see sections 4.1 and 4.3).

Women of childbearing potential / contraception in males and females

It is not known whether darolutamide or its metabolites are present in semen. If the patient is engaged in sexual activity with a woman of childbearing potential, a highly effective contraceptive method (<1 % failure rate per year) should be used during and for 1 week after completion of treatment with NUBEQA to prevent pregnancy.

Pregnancy

Based on its mechanism of action, darolutamide may cause foetal harm. No non-clinical reproductive toxicity studies have been conducted (see section 5.3).

It is not known whether darolutamide or its metabolites are present in semen. If the patient is engaged in sexual activity with a pregnant woman, a condom should be used during and for 1 week after completion

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of treatment with NUBEQA. Exposure of the foetus to an androgen receptor inhibitor through seminal transfer to the pregnant woman has to be avoided, as this could affect development of the foetus.

Breast-feeding

It is unknown whether darolutamide or its metabolites are excreted in human milk. No studies in animals have been conducted to evaluate the excretion of darolutamide or its metabolites into milk (see section 5.3). A risk to the breast-fed child cannot be excluded.

Fertility

There are no human data on the effect of darolutamide on fertility. Based on animal studies, NUBEQA may impair fertility in males of reproductive potential (see section 5.3).

4.7 Effects on ability to drive and use machines

NUBEQA has no or negligible influence on the ability to drive and use machines.

4.8 Undesirable effects

Summary of the safety profile

The most frequently observed adverse reaction is fatigue/asthenic conditions (15,8 %).

Tabulated list of adverse reactions

The adverse reactions observed are listed in Table 1 below. They are classified according to System Organ Class (MedDRA).

Adverse reactions are grouped according to their frequencies. Frequency groups are defined by the following convention: very common ($\geq 1/10$); common ($\geq 1/100$ to $< 1/10$); uncommon ($\geq 1/1\ 000$ to $< 1/100$); rare ($\geq 1/10\ 000$ to $< 1/1\ 000$); very rare ($< 1/10\ 000$).

Within each frequency group, adverse reactions are presented in order of decreasing seriousness.

Table 1: Adverse reactions reported in the ARAMIS study

System organ class (MedDRA)	Very common	Common
Cardiac disorders		Ischaemic heart disease ^b Heart failure ^c
Skin and subcutaneous tissue disorders		Rash
Musculoskeletal and connective tissue disorders		Pain in extremity Musculoskeletal pain Fractures
General disorders and administration site conditions	Fatigue/asthenic conditions ^a	
Investigations ^d	Neutrophil count decreased Bilirubin increased AST increased	

^a Includes fatigue and asthenia, lethargy and malaise.

^b Includes arteriosclerosis coronary artery, coronary artery disease, coronary artery occlusion, coronary artery stenosis, acute coronary syndrome, acute myocardial infarction, angina pectoris, angina unstable, myocardial infarction, myocardial ischaemia.

^c Includes cardiac failure, cardiac failure acute, cardiac failure chronic, cardiac failure congestive, cardiogenic shock.

^d Common Terminology Criteria for Adverse Events (CTCAE) version 4.03.

Description of selected adverse reactions

Fatigue

Fatigue/asthenic conditions were reported in 15,8 % of patients treated with darolutamide and in 11,4 % of patients treated with placebo. Events with worst grade of 3 were reported in 0,6 % of patients treated with darolutamide and in 1,1 % of patients treated with placebo. Fatigue (not including asthenia, lethargy or malaise) occurred in the majority of patients (12,1 % of patients treated with darolutamide and 8,7 % of patients treated with placebo).

Fractures

Fractures occurred in 4,2 % of patients treated with darolutamide and in 3,6 % of patients treated with placebo.

Ischaemic heart disease and heart failure

Ischaemic heart disease occurred in 3,2 % of patients treated with darolutamide and in 2,5 % of patients treated with placebo. Grade 5 events occurred in 0,3 % of patients treated with darolutamide and 0,2 % of patients treated with placebo. Heart failure occurred in 1,9 % of patients treated with darolutamide and in 0,9 % of patients treated with placebo.

Neutrophil count decreased

Neutrophil count decreased was reported as a laboratory abnormality in 19,6 % of patients treated with darolutamide and in 9,4 % of patients treated with placebo. The median time to nadir was 256 days. The laboratory tests abnormalities manifested predominantly as grade 1 or 2 intensity. Neutrophil count decreased of grade 3 and 4 was reported in 3,5 % and 0,5 % of patients, respectively. Only one patient permanently discontinued darolutamide due to neutropenia. Neutropenia was either transient or reversible (88 % of patients) and were not associated with any clinically relevant signs or symptoms.

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Bilirubin increased

Bilirubin increased was reported as a laboratory abnormality in 16,4 % of patients treated with darolutamide and in 6,9 % of patients treated with placebo. The episodes were predominantly of grade 1 or 2 intensity, not associated with any clinically relevant signs or symptoms, and reversible after darolutamide was discontinued. Bilirubin increased of grade 3 was reported in 0,1 % of patients treated with darolutamide and in 0 % of patients treated with placebo. In the darolutamide arm, the mean time to first onset of increased bilirubin was 153 days, and the mean duration of the first episode was 182 days. No patients were discontinued from treatment due to increase in bilirubin.

AST increased

AST increased was reported as a laboratory abnormality in 22,5 % of patients treated with darolutamide and in 13,6 % of patients treated with placebo. The episodes were predominantly of grade 1 or 2 intensity, not associated with any clinically relevant signs or symptoms, and reversible after darolutamide was discontinued. AST increased of grade 3 was reported in 0,5 % of patients treated with darolutamide and in 0,2 % of patients treated with placebo. In the darolutamide arm, the mean time to first onset of increased AST was 258 days, and the mean duration of the first episode was 118 days. No patients were discontinued from treatment due to increase in AST.

Reporting of suspected adverse reactions

Reporting suspected adverse reactions after authorisation of the medicine is important. It allows continued monitoring of the benefit/risk balance of the medicine. Health care providers are asked to report any suspected adverse reactions to SAHPRA via the “**6.04 Adverse Drug Reactions Reporting Form**”, found online under SAHPRA’s publications: <https://www.sahpra.org.za/Publications/Index/8>.

4.9 Overdose

The highest dose of darolutamide studied clinically was 900 mg twice daily, equivalent to a total daily dose of 1800 mg. No dose limiting toxicities were observed with this dose.

Considering the saturable absorption (see section 5.2) and the absence of evidence for acute toxicity, an intake of a higher than recommended dose of darolutamide is not expected to lead to toxicity. In the event of intake of a higher than recommended dose, treatment with darolutamide can be continued with the next dose as scheduled.

There is no specific antidote for darolutamide and symptoms of overdose are not established.

5. PHARMACOLOGICAL PROPERTIES

5.1 Pharmacodynamic properties

Pharmacotherapeutic group: Endocrine therapy, anti-androgens; ATC code: L02BB06

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Mechanism of action

Darolutamide is an androgen receptor (AR) inhibitor with a flexible polar-substituted pyrazole structure that binds with high affinity directly to the receptor ligand binding domain.

Darolutamide competitively inhibits androgen binding, AR nuclear translocation, and AR mediated transcription. A major metabolite, keto-darolutamide, exhibited similar *in vitro* activity to darolutamide. Darolutamide treatment decreases prostate tumour cell proliferation leading to potent antitumour activity.

Pharmacodynamic effects

No prolongation of the mean QTcF interval (i.e., greater than 10 ms) was observed after oral administration of 600 mg darolutamide twice daily compared to placebo.

Clinical efficacy and safety

The efficacy and safety of darolutamide was assessed in a randomised, double-blind, placebo-controlled multicentre phase III study (ARAMIS) in patients with non-metastatic (as assessed by conventional imaging CT, bone scan, MRI) castration resistant prostate cancer with a prostate-specific antigen doubling time (PSADT) of ≤ 10 months.

Patients were included in the trial if they had 3 rising prostate-specific antigen (PSA) levels after the nadir taken at least 1 week apart during androgen deprivation therapy, PSA ≥ 2 ng/mL at screening and castrate level of serum testosterone $< 1,7$ nmol/L.

Patients with a medical history of seizure were allowed to enter the study. There were 12 patients (0,21 %) enrolled on the darolutamide arm with a history of seizure.

Patients with uncontrolled hypertension or recent (in the past 6 months) stroke, myocardial infarction, severe/unstable angina pectoris, coronary/peripheral artery bypass graft, congestive heart failure New York Heart Association (NYHA) Class III or IV were excluded from the study.

Patients with prior treatment with second generation AR inhibitors such as enzalutamide, apalutamide and darolutamide, or CYP17 enzyme inhibitors such as abiraterone acetate as well as patients receiving systemic corticosteroid with dose greater than the equivalent 10 mg of prednisone/day within 28 days before randomisation were excluded from the study.

In total, 1509 patients were randomized 2:1 to receive either 600 mg darolutamide orally twice daily (n=955) or matching placebo (n=554).

All patients received a gonadotropin-releasing hormone (GnRH) analogue concurrently or had a bilateral orchiectomy. Patients with presence of pelvic lymph nodes < 2 cm in short axis below the aortic bifurcation were allowed to enter the study. Absence or presence of metastasis was assessed by independent central radiological review. Included in these analyses were 89 patients that were retrospectively identified with metastasis at baseline. Randomization was stratified by PSADT (≤ 6 months or > 6 months) and use of osteoclast-targeted therapy at study entry (yes or no).

The following patient demographics and disease characteristics were balanced between treatment arms. The median age was 74 years (range 48-95) and 9 % of patients were 85 years of age or older. The racial distribution was 79 % White, 13 % Asian, and 3 % Black. A majority of patients had a Gleason score of 7 or higher at diagnosis (73 %). The median PSADT was 4,5 months. Nine percent (9 %) of patients had prior orchiectomy, 25 % of patients had prior prostatectomy and 50 % of patients had at least one prior radiotherapy. Seventy-six percent (76 %) of patients received more than one prior anti-hormonal treatment. Patients had an Eastern Cooperative Oncology Group Performance Status (ECOG PS) score of 0 (69 %) or 1 (31 %) at study entry.

Treatment with darolutamide continued until radiographic disease progression as assessed by conventional imaging (CT, bone scan, MRI) by blinded central review, unacceptable toxicity or withdrawal.

The primary efficacy endpoint was metastasis free survival (MFS). Secondary endpoints were overall survival (OS), time to pain progression, time to initiation of first cytotoxic chemotherapy for prostate cancer, and time to first symptomatic skeletal events (defined as occurrence of any of the following: external beam radiotherapy to relieve skeletal symptoms, new symptomatic pathologic bone fracture, spinal cord compression, or tumour-related orthopaedic surgical intervention).

Treatment with darolutamide resulted in an improvement in MFS compared to placebo (see Table 2 and Figure 1).

MFS results were consistent across patient subgroups regardless of PSADT, prior use of bone-targeting agents or loco-regional disease. Additional subgroups with consistent MFS results included PSA at baseline, Gleason score at diagnosis, age, geographical region, ECOG PS at baseline, race, and number of prior hormonal therapies.

Treatment with darolutamide also resulted in a positive trend in overall survival (median was not reached in either arm at the time of the interim OS analysis) and a delay in time to pain progression compared to placebo (see Table 2 and Figure 2). Time to initiation of first cytotoxic chemotherapy and time to first symptomatic skeletal event were not mature at the time of primary analyses (see Table 2).

Table 2: Efficacy results from the ARAMIS study

Efficacy parameter	Number of events (%)		Median (95 % CI)		Hazard Ratio ^a (95 % Confidence Interval [CI]) p-value (two-sided)
	Darolutamide (n=955)	Placebo (n=554)	Darolutamide (n=955)	Placebo (n=554)	
Metastasis free survival	221 (23,1 %)	216 (39,0 %)	40,4 months (34,3; NR)	18,4 months (15,5; 22,3)	0,413 (0,341; 0,500) <0,000001
Overall survival	78 (8,2 %)	58 (10,5 %)	NR (44,5; NR)	NR (NR; NR)	0,706 (0,501; 0,994) 0,045210 ^b
Time to pain progression ^c	251 (26,3 %)	178 (32,1 %)	40,3 months (33,2; 41,2)	25,4 months (19,1; 29,6)	0,647 (0,533; 0,785) 0,000008 ^b
Time to initiation of first cytotoxic chemotherapy	73 (7,6 %)	79 (14,3 %)	NR (NR; NR)	38,2 months (35,6; 41,9)	0,433 (0,314; 0,595) <0,000001 ^b
Time to first symptomatic skeletal event	16 (1,7 %)	18 (3,2 %)	NR (NR; NR)	NR (NR; NR)	0,428 (0,218; 0,842) 0,011262 ^b

^a Hazard ratio < 1 favours darolutamide

^b The p-value for OS did not reach the pre-defined threshold for statistical significance at the time of the interim OS analysis. Therefore (as per hierarchical methodology) a formal testing for significance of the remaining three secondary endpoints was not conducted.

^c Patient reported outcome as evaluated by Brief Pain Inventory-Short Form questionnaire

NR: Not reached.

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Treatment with darolutamide also resulted in a longer progression free survival (PFS, median 36,8 vs 14,8 months, HR=0,380, nominal p<0,000001) and time to PSA progression (median 33,2 vs 7,3 months, HR=0,130, nominal p<0,000001). Consistency of effect was observed across all measures of survival (MFS, OS and PFS).

Figure 1: Kaplan-Meier curves of metastasis free survival

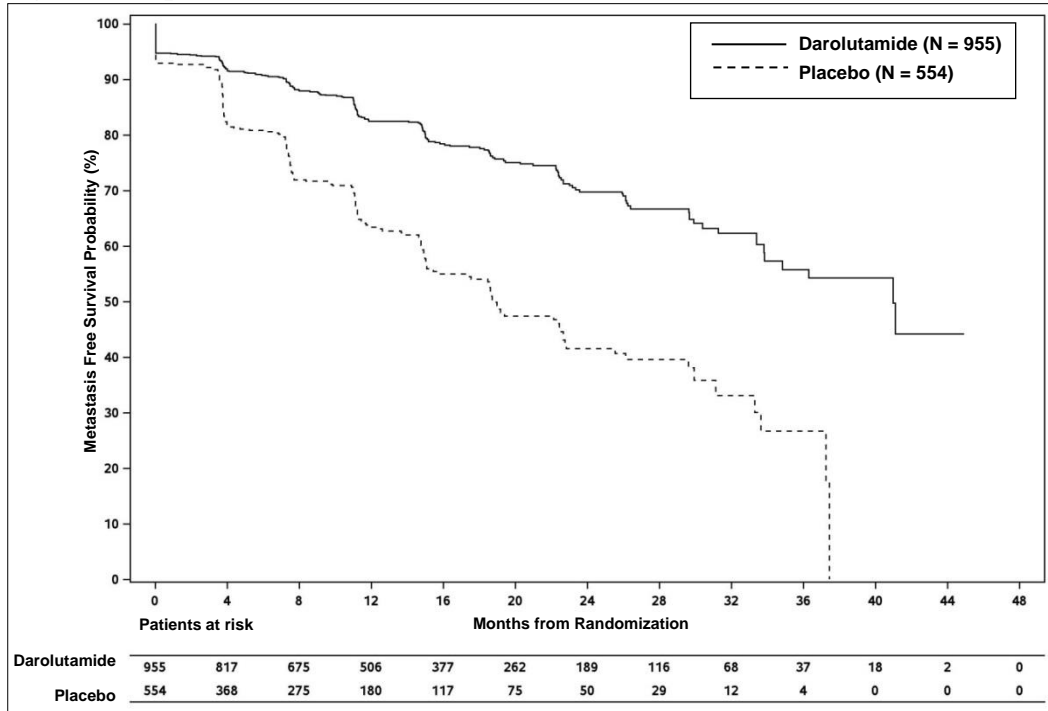
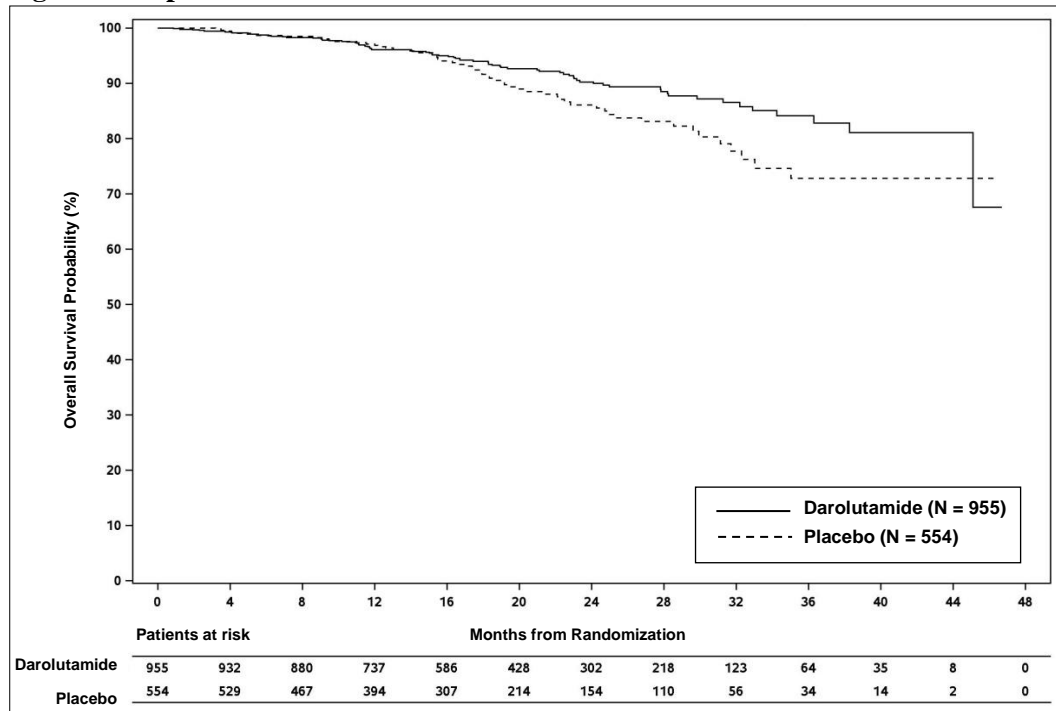


Figure 2: Kaplan-Meier curves of overall survival



Patients receiving darolutamide in the ARAMIS study demonstrated a significantly higher confirmed PSA response rate (defined as a $\geq 50\%$ reduction from baseline), compared with patients receiving placebo, 83,6 % vs 7,6 % (difference = 76 %, $p < 0,000001$).

5.2 Pharmacokinetic properties

General introduction

Darolutamide consists of two diastereomers [(*S,R*)-darolutamide and (*S,S*)-darolutamide] which interconvert via the main circulating metabolite called keto-darolutamide. *In vitro*, all three substances show similar pharmacological activity. Darolutamide is poorly soluble in aqueous solvents over a large pH range and generally more soluble in organic solvents.

Absorption

Following oral administration of 600 mg (2 tablets of 300 mg), peak plasma concentrations of darolutamide of 4,79 mg/L (coefficient of variation: 30,9 %) are usually reached around 4 hours after administration. The ratio of the two diastereomers, (*S,R*)-darolutamide to (*S,S*)-darolutamide, changed from a 1:1 ratio in the tablet to an approximately 1:9 ratio in plasma based on AUC_{0-12} data at steady-state. Following oral administration together with food, steady-state is reached after 2-5 days of repeated twice-daily dosing.

The absolute bioavailability compared to an intravenous injection is approximately 30 % following oral administration of a NUBEQA tablet containing 300 mg darolutamide under fasted conditions. Bioavailability of darolutamide was enhanced by 2,0- to 2,5-fold when administered with food. A similar increase of exposure was observed for the major metabolite keto-darolutamide.

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Distribution

The apparent volume of distribution of darolutamide after intravenous administration is 119 L indicating that darolutamide is widely distributed throughout the body to both intracellular and extracellular fluid spaces.

Darolutamide is moderately (92 %) bound to human plasma proteins without any difference between the two diastereomers. The major metabolite of darolutamide, keto-darolutamide, is highly (99,8 %) bound to plasma proteins.

Passage of darolutamide across the blood-brain barrier has not been studied clinically. However, brain exposures to darolutamide in terms of AUC_{0-24} are very low with 4,5 % of plasma exposure after single dose in rats and 1,9-3,9 % after repeated dose in mice. This indicates low passage of darolutamide across the intact blood-brain barrier in rats and mice and a low likelihood that darolutamide crosses the intact blood-brain barrier in humans to a clinically relevant extent.

Biotransformation

The diastereomers (*S,R*)-darolutamide and (*S,S*)-darolutamide are able to interconvert via the metabolite keto-darolutamide with a preference for (*S,S*)-darolutamide.

Following single oral administration of 300 mg¹⁴C-darolutamide given as an oral solution, keto-darolutamide is the only major metabolite with about 2-fold higher total exposure in plasma compared to darolutamide. Darolutamide and keto-darolutamide accounted together for 87,4 % of the ¹⁴C-radioactivity in plasma indicating that all other metabolites are of minor importance.

Darolutamide is metabolised primarily by oxidative metabolism mediated mainly by CYP3A4, as well as by direct glucuronidation mediated preferentially by UGT1A9 and UGT1A1. In addition, mainly the AKR1C isoforms were shown to catalyse the reduction of keto-darolutamide to the substance diastereomers.

Elimination

The effective half-life of darolutamide and keto-darolutamide in plasma of patients is approximately 20 hours. Of the two diastereomers comprising darolutamide, (*S,R*)-darolutamide has a shorter effective half-life of 9 hours compared to (*S,S*)-darolutamide with an effective half-life of 22 hours. The clearance of darolutamide following intravenous administration was 116 mL/min (CV: 39,7 %). A total of 63,4 % of substance-related material is excreted in the urine (approximately 7 % unchanged), 32,4 % is excreted in the faeces. More than 95 % of the dose was recovered within 7 days after administration.

Linearity / Non-linearity

In the dose range of 100 to 700 mg (after single dose and at steady state), the exposure to the two diastereomers and the major metabolite keto-darolutamide increases linearly in a nearly dose-related manner. Based on a saturated absorption, no further increase in exposure to darolutamide was observed at 900 mg twice daily.

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Special populations

Elderly

No clinically relevant differences in the pharmacokinetics of darolutamide were observed (65-95 years).

Renal impairment

In a clinical pharmacokinetic study, AUC and C_{max} for darolutamide were 2,5 and 1,6-fold higher in patients with severe renal impairment (estimated Glomerular Filtration Rate [eGFR] 15 to 29 mL/min/1,73 m²) compared to healthy volunteers.

A population pharmacokinetic analysis indicates a 1,1-; 1,3- and an approximately 1,5-fold higher exposure (AUC) of darolutamide in patients with mild, moderate and severe renal impairment (eGFR 15 to 89 mL/min/1,73 m²) compared to patients with normal renal function.

The pharmacokinetics of darolutamide has not been studied in patients with end-stage renal disease receiving dialysis (eGFR < 15 mL/min/1,73 m²).

Hepatic impairment

In a clinical pharmacokinetic study, C_{max} and AUC for darolutamide were 1,5 and 1,9-fold higher in patients with moderate hepatic impairment (Child-Pugh B) compared to healthy volunteers. There are no data for patients with severe hepatic impairment (Child-Pugh C).

Ethnic differences

No clinically relevant differences in the pharmacokinetics of darolutamide were observed based on ethnicity (White, Japanese, non-Japanese Asian, Black or African American). A population pharmacokinetic analysis indicated a 1,4-fold increase in exposure (AUC) in Japanese patients compared to patients from all other regions.

5.3 Preclinical safety data

Systemic toxicity

In repeated dose toxicity studies in rats and dogs, the main findings were changes in the male reproductive organs (decreases in organ weight with atrophy of the prostate and epididymides). These effects occurred at systemic exposures in the range of or below the anticipated human exposure (based on AUC comparison). Additional changes to reproductive tissues included minimal increase in vacuolation of the pituitary gland, atrophy and secretory reduction in seminal vesicles and mammary glands in rats as well as testicular hypospermia, seminiferous tubule dilatation and degeneration in dogs. Changes in the male reproductive organs in both species were consistent with the pharmacological activity of darolutamide and reversed or partially resolved after 4- to 8-week recovery periods.

Embryotoxicity / teratogenicity

Studies on developmental toxicity have not been performed.

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Product proprietary name: NUBEQA
Strength: Darolutamide 300 mg

Reproduction toxicity

Studies on reproductive toxicity have not been performed. However, male fertility is likely to be impaired based on the findings in repeat-dose toxicity studies in rats and dogs, which are consistent with the pharmacological activity of darolutamide.

Genotoxicity and carcinogenicity

Darolutamide did not induce mutations in the microbial mutagenesis (Ames) assay. At high concentrations, darolutamide did induce structural chromosome aberrations *in vitro* in cultured human lymphocytes. However, in the *in vivo* combined bone marrow micronucleus test and the Comet assay in the liver and duodenum of the rat, no genotoxicity was observed at exposures in excess of the maximum human exposure. Long-term animal studies to evaluate the carcinogenic potential of darolutamide have not been conducted.

Safety pharmacology

In vitro, darolutamide weakly inhibited the hERG potassium current and the L-type calcium channel. *In vivo*, in anaesthetised dogs, darolutamide slightly decreased the QT interval duration, but this effect was not found in conscious dogs.

6. PHARMACEUTICAL PARTICULARS

6.1 List of excipients

Tablet core

Calcium hydrogen phosphate (E 341)
Croscarmellose sodium
Lactose monohydrate
Magnesium stearate (E 470b)
Povidone (E 1201)

Film-coating

Hypromellose
Lactose monohydrate
Macrogol (E 1521)
Titanium dioxide (E 171)

6.2 Incompatibilities

Not applicable.

6.3 Shelf life

3 years

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6.4 Special precautions for storage

Store at or below 30 °C.

6.5 Nature and contents of container

PVC/Aluminium foil blisters containing 16 film-coated tablets.
Each pack contains 112 film-coated tablets.

6.6 Special precautions for disposal

Any unused medicine or waste material should be disposed of in accordance with local requirements.

7. HOLDER OF CERTIFICATE OF REGISTRATION

Bayer (Pty) Ltd
Reg. No.: 1968/011192/07
27 Wrench Road
Isando
1609

8. REGISTRATION NUMBER

55/21.12/0321

9. DATE OF FIRST AUTHORISATION/RENEWAL OF THE AUTHORISATION

Date of first authorisation: 15 March 2022

10. DATE OF REVISION OF THE TEXT

None