PATRIOT: A phase I study to assess the tolerability, safety and biological effects of a specific ataxia telangiectasia and Rad3-related (ATR) inhibitor (AZD6738) as a single agent and in combination with palliative radiation therapy in patients with solid tumours

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ABSTRACT

PATRIOT is a phase I study of the ATR inhibitor, AZD6738, as monotherapy, and in combination with palliative radiotherapy. Here, we describe the protocol for this study, which opened in 2014 and is currently recruiting and comprises dose escalation of both drug and radiotherapy, and expansion cohorts.

Background

Radiotherapy is used in the treatment of approximately 40% of cancer patients [1]. It is used as a primary treatment in combination with chemotherapy in locally advanced cancers of the head and neck, lung, oesophagus, rectum, anus and as part of multimodality treatment in numerous other cancers. Standard-of-care chemoradiation has been shown to be superior to radiation alone in most cancers where it is used for primary treatment, at the expense of increased normal tissue toxicity. In spite of this, tumour control rates, and consequent survival, remain inadequate in a number of clinical settings.

Many strategies have been investigated over recent decades to attempt to improve outcomes with radiotherapy, including altered fractionation, dose-escalation with the use of advanced radiotherapy techniques, hypoxia modification and combination with targeted therapies and immunotherapy [2]. These have met with limited degrees of success.

Targeting the G2 cell cycle checkpoint is an attractive option for selective sensitisation of tumour cells to radiation [3]. There are multiple lines of preclinical data demonstrating that inhibiting this checkpoint through kinase inhibition of ATR and CHK1 will sensitise to radiation therapy, by increasing mitotic cell death and reducing DNA repair [4–9]. There are currently three ATR inhibitors in early clinical development, including AZD6738, an orally bioavailable inhibitor of the ATR kinase [10]. ATR is critical in the cellular response to DNA replication stress, the levels of which are elevated in many cancers as a result of oncogene activation, endogenous and exogenous DNA damage [11], and targeting this may be a novel therapeutic strategy.

Traditionally, combination of novel agents with radiation therapy has not taken place until monotherapy studies at phase I or later have completed, with some evidence of monotherapy effect. This study is notable for introducing radiation combination studies early in the clinical development of AZD6738.
Here, we describe the clinical trial protocol of the PATRIOT study, which combines AZD6738 monotherapy dose-escalation and dose-expansion components with a combination phase I component with palliative radiotherapy.

Methods and study design

PATRIOT is co-sponsored by the Royal Marsden and The Institute of Cancer Research. The study is jointly funded by Cancer Research UK, AstraZeneca and the Experimental Cancer Medicines Network as part of the Combinations Alliance collaborative agreement. The study has been approved by the National Research Ethics Committee (14/LO/0465). It is registered on the clinicaltrials.gov (NCT02223923) and EudraCT (2013-003994-84) databases.

It is a multi-centre, open-label, non-randomised phase I study of AZD6738 in advanced solid tumours with three parts: monotherapy dose-escalation (part A), monotherapy dose-expansion at maximum tolerated dose (MTD) (part B), and dose-escalation in combination with palliative radiotherapy (part C). This design was chosen in order to gain information about monotherapy toxicity prior to combination with radiation, to investigate dosing schedules which would be amenable to combination with radiation, and improve monotherapy tolerability, and to gain further information about markers of response to AZD6738.

Parts A and C of the study are 3+3 dose-escalation designs (Figs. 1, 2). Part A has single-patient cohorts at lower dose levels, changing to 3+3 at the first G2 toxicity. Part C initially escalates drug dose, followed by escalation of radiation dose. It allows dose escalation of AZD6738 with 20 Gy in 10 fractions of radiotherapy, starting at least 2 dose-levels below the currently tolerated dose of AZD6738. At the MTD, or a dose lower than MTD as determined by the safety review committee, the radiation dose will be escalated to 30 Gy in 15 fractions, with 10 fractions sensitised, further cohorts will sensitisie 15 fractions and expansion cohorts will add maintenance AZD6738 until disease progression (Fig. 2).

Part C of the study will run 2 parallel tracks, stratifying by site of irradiation into disease above and below the diaphragm, in order to provide more meaningful information on specific toxicities. These two tracks will be treated independently, and may result in different recommended doses to proceed for each site of irradiation.

Total number of patients for parts A and C will depend upon the toxicities encountered. Part B will treat a maximum of 50 patients.

Selected inclusion and exclusion criteria

Inclusion criteria

1. Histologically or cytologically documented solid tumour without further standard therapy options.
2. Part B only: documented disease progression prior to study entry, tumour site amenable to fresh biopsy.
3. Part C only: disease causing or likely to cause symptoms within a short period of time such that palliative radiotherapy is indicated or justified.
4. Evidence of measurable or evaluable disease by RECIST 1.1.
5. ECOG performance status 0–1 (part A); 0–2 (parts B and C).
6. Life expectancy of at least 3 months.
7. Adequate and stable haematological, hepatic and renal function.
8. Not pregnant, using adequate contraception.
9. Willing and able to comply with scheduled visits, tissue sampling, treatment plan, and laboratory tests.
10. Able to swallow, absorb and retain oral medication.

**Exclusion criteria**

1. Part C only: prior radiotherapy to the treatment site.
2. Concomitant anti-cancer therapy or investigational medical products (long-term hormonal therapy permitted in part C).
3. Receiving, or having received, concomitant medications, herbal supplements and/or foods that significantly modulate CYP3A4.
4. Pregnant or breast-feeding women.
5. Clinically significant cardiac disease.
6. Known HIV positive or active hepatitis B or C infection.
7. Uncontrolled active infection.
8. Symptomatic and progressive or steroid-requiring brain metastases or leptomeningeal disease involvement.
9. Uncontrolled active infection.
10. Relative hypotension or clinically relevant orthostatic hypotension.
11. Haematuria: +++ on microscopy or dipstick.

**Objectives and endpoints**

The primary objective of the study is to determine the feasibility and safety of administration of AZD6738 as a single-agent and in combination with different schedules of radiotherapy. Toxicity will be recorded using CTCAE 4.03 criteria, and definitions of dose-limiting toxicity are given in Table 1.

The secondary objectives are to guide dose and schedule selection for subsequent later-phase studies of AZD6738 as a single-agent or with palliative or radical radiotherapy, to perform pharmacokinetic analysis of plasma drug levels after single and multiple doses, and to assess preliminary anti-tumour activity (by RECIST response) of AZD6738 as a single-agent and in combination with palliative radiotherapy.

Exploratory objectives of the study are to conduct pharmacodynamic studies on tumour and normal tissue, and explore the value of putative predictive biomarkers for response to AZD6378.

**Study treatments**

Patients will take AZD6738 tablets by mouth, twice daily. Proposed dose escalation schema is shown in Table 2. Part A of the study has continuous dosing in 28-day cycles, part B allows intermittent schedules. Tumour response assessments will take place every 2 cycles (8 weeks). During part C, participants will start taking AZD6738 three to seven days before radiotherapy starts, then continuously through radiation, finishing two days after the final sensitised fraction. Response assessments will take place at 4 and 8 weeks after the end of radiotherapy.

**Duration of study**

During the monotherapy parts of the study, participants will continue taking AZD6738 until disease progression, unacceptable toxicity or withdrawal of consent. During radiotherapy, participants will take a defined duration of AZD6738 around the course of radiotherapy, unless in expansion cohorts, where they will continue maintenance AZD6738 until disease progression. Participants will be followed up until acute toxicity resolves to baseline or ≤grade 1. Participants in part C will be followed up for late toxicity at three-monthly intervals for one year. Where physical attendance is not possible, telephone contact will be made with referring oncologist or general practitioner to establish whether there is significant late toxicity. Overall survival will not be assessed.

**Data analysis**

Data analysis will be descriptive, with analysis taking place at every dose-level to inform dose-escalation decisions. Toxicity will be graded according to CTCAE v4.03 and dose-limiting toxicities are defined in Table 1. Late toxicity after three months from
The authors declare no conflict of interest.

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