# Long-term outcomes of the WEGENT trial on remission-maintenance for granulomatosis with polyangiitis or microscopic polyangiitis

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**Running head:** LONG-TERM WEGENT TRIAL OUTCOMES FOR AAV MAINTENANCE THERAPY

# Long-Term Outcomes of the WEGENT Trial on Remission-Maintenance for Granulomatosis with Polyangiitis or Microscopic Polyangiitis

Xavier Puéchal,[1] Christian Pagnoux,[1,2] Élodie Perrodeau,[3] Mohamed Hamidou,[4] Jean-Jacques Boffa,[5] Xavier Kyndt,[6] François Lifermann,[7] Thomas Papo,[8] Dominique Merrien,[9] Amar Smail,[10] Philippe Delaval,[11] Catherine Hanrotel-Saliou,[12] Bernard Imbert,[13] Chahéra Khouatra,[14] Marc Lambert,[15] Charles Leské,[16] Kim H. Ly,[17] Edouard Pertuiset,[18] Pascal Roblot,[19] Marc Ruivard,[20] Jean-François Subra,[21] Jean-François Viallard,[22] Benjamin Terrier,[1] Pascal Cohen,[1] Luc Mouthon,[1] Claire Le Jeunne,[1] Philippe Ravaud,[3] and Loïc Guillevin[1] for the French Vasculitis Study Group*

[1]Xavier Puéchal, MD, PhD, Christian Pagnoux, MD, MSc, MPH, Benjamin Terrier, MD, PhD, Pascal Cohen, MD, Luc Mouthon, MD, PhD, Claire Le Jeunne, MD, Loïc Guillevin, MD: Université Paris Descartes, Hôpital Cochin, Assistance Publique–Hôpitaux de Paris, Paris, France; [2]Christian Pagnoux, MD, MSc, MPH, current address: Mount Sinai Hospital, Toronto, Canada; [3]Élodie Perrodeau, MSc, Philippe Ravaud, MD, PhD: Hôpital Hôtel-Dieu, Paris, France; [4]Mohamed Hamidou, MD, PhD: Hôpital Hôtel-Dieu, Nantes, France; [5]Jean-Jacques Boffa, MD, PhD: Hôpital Tenon, Paris, France; [6]Xavier Kyndt, MD: Centre Hospitalier, Valenciennes, France; [7]François Lifermann, MD: Centre Hospitalier, Dax, France; [8]Thomas Papo, MD, PhD: Hôpital Bichat–Claude-Bernard, Paris, France; [9]Dominique Merrien, MD: Centre Hospitalier, Compiègne, France; [10]Amar Smail, MD: Hôpital Nord, Amiens, France; [11]Philippe Delaval, MD: Hôpital Sud, Rennes, France; [12]Catherine Hanrotel-

Saliou, MD: Hôpital de la Cavale Blanche, Brest, France; [13]Bernard Imbert, MD: CHU, Grenoble, France; [14]Chahéra Khouatra, MD: Hôpital Louis-Pradel, Lyon, France; [15]Marc Lambert, MD, PhD: Centre Hospitalier Régional Universitaire, Lille, France; [16]Charles Leské, MD: Centre Hospitalier, Cholet, France; [17]Kim H. Ly, MD, PhD: Hôpital Dupuytren, Limoges, France; [18]Edouard Pertuiset, MD: Hôpital René-Dubos, Pontoise, France; [19]Pascal Roblot, MD, PhD: Centre Hospitalier Universitaire, Poitiers, France; [20]Marc Ruivard, MD, PhD: Hôpital d'Estaing, Clermont-Ferrand, France; [21]Jean-François Subra, MD, PhD: Centre Hospitalier Universitaire, Angers, France; and [22]Jean-François Viallard, MD, PhD: Hôpital Haut Lévêque, Pessac, France.

*Other investigators are listed in the Appendix.

Address correspondence to: Dr Xavier Puéchal, National Referral Center for Rare Systemic Autoimmune Diseases, Necrotizing Vasculitides and Systemic Sclerosis, Department of Internal Medicine, Hôpital Cochin, 27, rue du Faubourg Saint-Jacques, 75679 Paris Cedex 14, France. Tel: +33 (0)1 58 41 32 41; Fax: +33 (0)1 58 41 29 68; E-mail: xavier.puechal@cch.aphp.fr

The main investigators, Drs Puéchal, Pagnoux, Mouthon, Cohen and Guillevin, are employees of the Assistance Publique–Hôpitaux de Paris. Other authors are employees of public and/or university hospitals.

XP has declared speaking fees (Roche, Pfizer, GL Events, <$10,000) and congress inscription/travel/accommodations (Novartis, Roche, LFB, GSK, <$5,000); CP has declared consultancies, speaking fees or honoraria (Hoffman-La Roche, BMS, GSK, <$10,000); MH has declared speaking fees (Roche <$10,000); JJB has declared speaking fees (Roche,

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## ABSTRACT

***Objective.*** The WEGENT trial and other short-term studies suggested that azathioprine or methotrexate could effectively maintain granulomatosis with polyangiitis (GPA) or microscopic polyangiitis (MPA) remission. Whether differences in relapse or adverse event rates would appear after discontinuation of those 2 maintenance regimens and longer follow-up remains unknown.

***Methods.*** Long-term outcomes for the patients enrolled in the WEGENT trial were analyzed according to their randomization group. Parameters at trial entry were evaluated as potential prognostic factors for death, relapse or damage in multivariate models.

***Results.*** Data were returned for 88.8% of the 126 original participants. Median [95% confidence interval] followup was 11.9 [11.3–12.5] years. For the azathioprine and methotrexate arms, respectively, the 10-year overall survival rates were 75.1% [64.8–86.9] and 79.9% [70.3–90.8] ($P$ = 0.56), and relapse-free survival rates 26.3% [17.3–40.1] and 33.5% [23.5–47.7] ($P$ = 0.29). No between-arm differences were observed for relapse, adverse events, damage, survival rates without severe side effects and survival rates without relapse and severe side effects. Considering only the 97 GPA patients, no between-arm survival differences were observed. Relapse-free survival was shorter for GPA than MPA patients but the multivariate analysis retained anti-PR3–ANCA-positivity, and not GPA, as being independently associated with relapse.

***Conclusion.*** This long-term analysis confirms that azathioprine and methotrexate are comparable options for maintaining GPA or MPA remission. Despite good overall survival, relapses, adverse events and damage remain matters of concern and further studies are needed to reduce them.

The introduction of cyclophosphamide (CYC) and glucocorticoids in the 1950s dramatically improved prognoses of antineutrophil cytoplasm antibody (ANCA)-associated vasculitides (AAVs) (1). For granulomatosis with polyangiitis (Wegener's) (GPA), 74–80% of patients now survive 5 years (2–4), compared with ~70% 1-year mortality for untreated patients (5). Similarly, for microscopic polyangiitis (MPA), the 5-year survival rate reaches 65–95%, depending on the prognostic factors considered (6–8). However, those advances were achieved at the cost of treatment-related toxicity (9).

The development of a 2-staged approach, using CYC (10), and later rituximab (11,12), for induction, and a less toxic remission-maintenance regimen to limit cumulative CYC exposure, was a major step forward in GPA and MPA treatment. Maintenance usually combines low-dose glucocorticoids and azathioprine (AZA) or methotrexate (MTX) (10–18). The prospective, multicenter, randomized, open-label, WEGENT trial, conducted by the French Vasculitis Study Group, evaluated the safety and efficacy of AZA versus MTX, combined with prednisone, as maintenance therapy for severe GPA or MPA, after complete remission had been achieved with glucocorticoids and pulse intravenous CYC (18). Trial results demonstrated that MTX was as safe and effective as AZA at maintaining GPA or MPA remission during 29 months of followup. Thus, either agent has emerged as standard care for AAV-remission maintenance (19).

However, it remains unknown whether differences in relapse or adverse event rates would appear after discontinuation of those 2 maintenance regimens and longer followup. The aim of this followup study was to evaluate the long-term outcomes of WEGENT trial participants to determine whether initial AZA or MTX maintenance might be associated with fewer relapses, less toxicity and better long-term survival. Clinical and laboratory parameters at trial entry were also tested as potential prognostic factors in multivariate models for survival, relapse-free survival, relapse or damage.

## PATIENTS AND METHODS

**Study eligibility criteria.** The WEGENT trial was conducted from November 1998 through February 2005 in France and Belgium (18). Briefly, it included patients with newly diagnosed GPA or MPA according to the Chapel Hill nomenclature (20,21). In addition, patients had to have severe GPA, defined as renal disease, involvement of ≥2 organs or systems, or involvement of 1 organ or system and constitutional symptoms; or severe MPA with ≥1 poor-prognosis items of the Five-Factor Score (FFS) (serum creatinine >140 $\mu$mol/liter, proteinuria >1 g/day, specific cardiomyopathy, gastrointestinal tract and/or central nervous system involvement) (22).

**Treatment protocol.** All patients received daily intravenous (IV) methylprednisolone for 3 days, followed by oral prednisone (1 mg/kg/day) for 3 weeks, then progressively tapered according to a predefined schedule to obtain complete cessation after 27 months. CYC pulses were administered until remission, followed by 3 additional consolidation pulses. Patients who entered remission were randomized after the 3$^{rd}$ consolidation to receive oral maintenance with 12 months of AZA (2 mg/kg/day) or MTX (progressively increased to 25 mg/week). The study primary analysis was conducted when the last enrolled patient completed maintenance therapy, yielding a median followup of 29 months for the entire population. After the end of the study, treatment, including for potential relapses, was left to the treating physician's discretion.

**Evaluations.** The original protocol scheduled long-term analysis at 10 years of followup. Long-term outcomes were ascertained for the 126 enrolled patients. A questionnaire, sent to participating physicians, requested information on survival, relapse, cancer, infection, cardiovascular morbidity, damage, immunosuppressant use and death. Patients' medical charts were also examined to complete discordant or incomplete information. Replies were collected from October 2013 until September 2014. Demographic, clinical and laboratory parameters at inclusion were analyzed in multivariate models as potential prognostic factors for survival, relapse or damage.

This followup study was performed in accordance with the 1964 Declaration of Helsinki

and subsequent amendments. The Île-de-France III Ethics Committee approved the study in accordance with national legislation.

**Study endpoints.** The primary endpoint was defined as the 10-year overall survival. Other judgment criteria were: relapse, major relapse, any adverse event, severe adverse event, infection, damage assessed with the Vasculitis Damage Index (VDI) (23), relapse-free survival and event-free survival, i.e., the probability of surviving without suffering a relapse or severe adverse event.

Vasculitis activity was assessed with the Birmingham Vasculitis Activity Score (BVAS) version 3 (24). The following definitions were applied: remission: the absence of signs of "new/worsening" disease activity, with BVAS = 0 (25); relapse: the reoccurrence or new appearance of disease activity attributable to active vasculitis (26); a major relapse: the reoccurrence or new onset of potentially organ- or life-threatening disease activity that cannot be treated with increased glucocorticoids alone and requires further therapeutic escalation (26). Adverse events were graded 1–4, according to World Health Organization toxicity criteria, with grades 3 and 4 considered severe (27). A serious infection was defined as life-threatening, requiring IV antibiotics or hospitalization.

**Statistical analyses**. All trial participants' data were analyzed according to the assigned randomization group. Followup began at WEGENT trial inclusion and continued until the last medical update, death or 10 years post-inclusion, whichever occurred first. Events were defined as death, relapses (major or not) and serious adverse events. Frequencies of adverse events, serious adverse events, infections, cancers, relapses and major relapses were compared with robust Poisson regression analyses. Numbers of relapses, major relapses and damaged organs were compared using negative binomial regressions. Those analyses were adjusted to followup time, added as an offset term in the respective models. Overall survival, relapse-free survival and event-free survival were analyzed with the Kaplan–Meier method and compared using log-rank tests.

Demographic, clinical and laboratory parameters at inclusion were analyzed in multivariate

models as potential prognostic factors for survival, relapse-free survival, relapse or damage. Multivariate analyses used Cox models to estimate hazard ratios (HRs) and their confidence intervals (CIs). A multistate model was used to account for multiple relapses per patient and distinguish between the 2 competing events: death and relapse (28). A competing-risk model was used because a disease-severity variable associated with death can also be associated with relapse, meaning that patients with a risk factor for relapse might be censored early due to death in traditional time-to-event analyses, thereby obscuring the association of those risk factors with relapses. Forty-five imputations run for risk-factor evaluation were analyzed in 2 steps: variables with $P$ <0.20 in a univariate analysis were selected for possible inclusion in the multivariate model, and stepwise selection based on Akaike's information criterion considered all the selected factors in the stacked dataset (29). All analyses were truncated at 10 years of followup and computed with R statistical software v3.0.1 (30).

## RESULTS

Among the 126 patients (median age 61 years) randomized in the original study (Figure 1), 97 (77%) patients had GPA and 29 (23%) MPA. Anti-proteinase-3 (PR3) ANCA were found in 76 (60%) patients, while anti-myeloperoxidase (MPO) ANCA were detected in 39 (31%). Ten-year data were available for 112/126 (88.8%) patients and were missing for 14 after a median followup of 7.0 (interquartile range (IQR) 5.1–9.1) years. Median followup was 11.9 [95% CI 11.4–12.4] years. Clinical outcomes according to treatment group are summarized in Table 1.

**Overall survival.** Fifteen AZA-group and 12 MTX-arm patients died during followup, with, respectively, 1 and 2 deaths during the original trial's followup. The primary endpoint, defined as the 10-year overall survival rate, did not differ significantly for the AZA (75.1%) and MTX arms (79.9%) (Figure 2A and B). Causes of AZA-group deaths, censored at 10 years, included 6 cancers, 3 cardiac causes, 1 alveolar hemorrhage, 1 end-stage renal disease (ESRD), 1

pulmonary embolism, 1 trauma and 2 unknown causes. MTX-arm deaths were attributed to 1 cancer, 4 cardiac causes, 4 infections, 1 ESRD, 1 pulmonary embolism and 1 Alzheimer's disease.

Multivariate analysis retained advancing age as the only factor significantly associated with increased risk of death (HR 1.09 [95% CI 1.05–1.14]; $P$ <0.001), with each additional year increasing the probability of death by 9% (Figure 2C). Lung involvement (affecting 75% of our patients at baseline), neurologic, cardiovascular or digestive involvement, impaired kidney function, AAV (GPA versus MPA) (Figure 2D), ANCA status (PR3 versus MPO or no ANCA) and BVAS-assessed disease activity at inclusion had no statistically significant impact on survival.

**Relapses.** During followup, ≥1 relapses occurred in ~60% of AZA-group and 54% of MTX-arm patients before the 10-year censoring date, with respective first relapses in 31/38 (81.6%) and 30/34 (88.2%) only after terminating maintenance. No between-arm differences were found for the total numbers of relapses and major relapses per patient, and the relapse or major relapse rates. The risk of relapse adjusted to followup duration until the first event was comparable for both arms. Ten-year relapse-free survival rates for the AZA and MTX arms did not differ significantly (Figure 3A).

ANCA status (anti-PR3 versus anti-MPO or no ANCA) was a more powerful predictor of relapse-free survival and relapse than disease subtype (GPA versus MPA) (Figure 3B). Moreover, AAV was not significantly associated with either relapse parameter in multivariate analyses. Neither CYC duration nor cumulative dose was associated with relapse-free survival. In the multistate model accounting for all relapses, baseline anti-PR3–ANCA-positivity was the strongest factor significantly associated with relapses (Table 2). High initial serum creatinine decreased the probability of relapse, with each additional 10 $\mu$mol of creatinine/liter lowering the relapse risk by 1%. The glucocorticoid dose at the end of maintenance therapy or thereafter increased that risk. In this multivariate model, AAV, its BVAS-assessed activity at baseline and

the CYC pulse number or cumulative dose (g) for remission-induction before randomization did not affect the relapse rate.

**Adverse events.** During the 10-year censured followup, no long-term between-arm differences were observed for severe adverse events, serious infections or cancer.

Thirty-three (26%) patients developed serious infections requiring hospitalization, with the infection leading to the deaths of 4 (3%) of them. The 10-year AZA-group and MTX-arm severe side-effect–free and event-free survival rates were comparable.

During long-term followup, the following cancers were observed: in the AZA arm: 6 adenocarcinomas, including 3 colorectal, 1 stomach, 1 breast and 1 ovarian cancer; 1 bladder cancer (after a cumulative total CYC dose of 8 g); 1 squamous cell carcinoma of the lung; 1 cerebral glioblastoma; 1 cutaneous melanoma and 1 cutaneous basal cell cancer; in the MTX arm: 5 adenocarcinomas, including 2 colorectal, 2 ovarian and 1 uterine cancer; 1 small-cell lung carcinoma; 1 hepatocellular carcinoma without viral hepatitis infection; 1 cutaneous squamous cell carcinoma and 1 cutaneous basal cell carcinoma.

**Duration of immunosuppression.** All patients received their assigned AZA or MTX maintenance according to the trial protocol for comparable times and glucocorticoid durations of intake were also similar for the 2 arms. Table 3 summarizes the post-trial treatments patients received during long-term followup. Neither the numbers of treated patients nor the estimated mean cumulative cyclophosphamide or rituximab doses for AAV relapse differed significantly between arms.

At the last update for AZA and MTX arms, respectively, data on glucocorticoids and other immunosuppressants were missing for 8 and 6 patients; 29 patients in each group were still taking prednisone (median respective doses: 7.0 and 5.0 mg/day); 20 and 18 patients were still taking other immunosuppressants, mainly MTX (12 patients), rituximab (11 patients) and AZA (8 patients); and, finally, 28 and 27 patients were no longer taking any immunosuppressant.

**Renal function.** No significant between-arm difference was observed for renal function or

ESRD, with 7 (11.1%) AZA-group and 8 (12.7%) MTX-arm patients developing ESRD. Although all these 15 patients had initial renal involvement, 3 of them had creatinine <100 $\mu$mol/liter at inclusion. Those 15 patients had 24 relapses, 16 of which included renal involvement. In addition, 4 patients required transient dialysis at AAV onset or at relapse; with median follow-up of 11 years, their mean ± SD creatinine value and glomerular filtration rate (GFR) at last follow-up was 159 ± 27 $\mu$mol/liter and 34 ± 6 ml/min, respectively.

Among the 93 (47 AZA and 46 MTX, respectively) patients without ESRD and whose renal parameters were available at last update, mean serum creatinine levels (111.4 [range 55–273] and 105.9 [range 49–276] $\mu$mol/liter) and mean GFR (59.5 and 61.3 ml/min) did not differ significantly.

**Damage.** At the last update, accrued damage was severe in both arms but mean VDI scores were similar for the 2 study arms. Multivariate analysis adjusted to followup duration retained age, baseline anti-PR3–ANCA-positivity versus anti-MPO–ANCA or none, initial creatinine level and glucocorticoid dose at the end of the maintenance as being significantly associated with VDI-assessed damage (Table 2).

**Survival analysis of GPA patients alone and versus MPA patients.** Considering only the 97 GPA patients, the AZA and MTX arms did not differ significantly for overall survival, relapse-free survival, survival without major relapse, survival without severe side effects or event-free survival.

For GPA versus MPA, respectively, the 10-year overall survival rates (75.1% [95% CI 66.8–84.5] and 85.2% [95% CI 72.8–99.8]) did not differ significantly (HR 1.84 [95% CI 0.64–5.33) (Figure 2D). Ten-year relapse-free survival was shorter for GPA than MPA patients (23.3% [95% CI 16.2–33.7] versus 51.7% [95% CI 36.4–73.5], respectively; HR 2.20 [95% CI 1.24–3.91]; $P$ = 0.007) but multivariate analysis did not retain GPA as being independently associated with relapse.

## DISCUSSION

The WEGENT trial was undertaken to compare the safety and efficacy of MTX versus AZA as GPA or MPA remission-maintenance therapy. Both drugs appeared to be equivalent alternatives to maintain remission at 29 months and our long-term analysis results further confirm our original findings (18). Whereas overall survival was good, relapses, adverse events and damage were common.

Survival of our severe GPA patients is consistent with previous studies, but 10-year survival data for MPA patients were lacking. The prolonged followup of WEGENT-trial patients yielded 10-year overall survival rates of 75.1% for GPA and 85.2% for MPA patients, comparable to the 80% reported for the 158 GPA patients enrolled in the NIH cohort study but after mean followup of only 8 years (9); 75% for the 56 GPA patients included in another study (2); and 88% for a cohort of 155 consecutive GPA patients (followup 6.6 years), 24 with localized disease (31), and 86% of 148 GPA patients (followup 4 years), 18 with localized disease, participating in a single-center cohort study (32). Reported 5-year survival of MPA patients ranged between 45% and 76% in 5 studies that included 217 MPA patients (33). The higher MPA survival rate observed herein, despite the inclusion of only patients with severe disease (FFS $\geq$1), fully supports the usefulness of therapy adapted to the prognostic FFS and further validates it for severe MPA.

In our long-term study, overall survival was comparable for GPA and MPA patients, in accordance with another large, long-term study (34). Differences noted in earlier investigations (35,36) may have reflected either the reporting of crude mortality, without adjusting for MPA patients' older age, underpowered multivariate analyses and/or inadequate case-mix (34).

According to our multivariate analysis, advancing age was the sole factor significantly associated with death, as identified in previous GPA studies (2,3,31). The only other study that identified prognostic baseline factors for survival in a cohort of GPA patients receiving homogeneous care found age, kidney and lung involvement to be associated with poorer survival

(31). For MPA, age, renal and severe gastrointestinal involvement were reported to be the main significant indicators of diminished survival (6,37). All those are items included in the revised FFS, which is also applicable to GPA and MPA (38).

Although the induction-maintenance approach to treat GPA and MPA undoubtedly represents an important therapeutic advance, the frequent relapses (half to two-thirds of our participants at 10 years) still pose a challenge for their long-term management. Indeed, 10-year relapse-free survival was only 26.3% and 33.5% for the AZA and MTX recipients, respectively. These low rates are consistent with other long-term studies on GPA (24% at 5 years) (39) and MPA (45.4% and 43.4% at 7 years) (7,8). Anti-PR3–ANCA-positivity has repeatedly been shown to be associated with a higher relapse risk for AAV cohorts (40–43) or other randomized–controlled trials (44–46), in agreement with our findings. Although GPA patients reportedly relapsed more frequently than those with MPA (10), it must be emphasized that our multivariate analysis retained baseline anti-PR3–ANCA-positivity, but not GPA, as being independently and significantly prognostic of recurrent relapses and, thus, negatively affected relapse-free survival. Thus, the more frequent cumulative GPA relapses might be linked to the more frequent presence of those antibodies in these patients. This notion supports those found in a study including patients with renal disease (42). Our results also retained high serum creatinine levels as being independently associated with significantly fewer relapses. That finding corroborates observations based on 2 large AAV cohorts: relapses of 535 European and 439 Chinese patients were inversely associated with the serum creatinine concentration (43,47). Patients with impaired renal function, who are less prone to relapse but have an increased risk of death due to treatment side effects (48), might be better treated with milder immunosuppression. This hypothesis should be investigated prospectively.

The WEGENT protocol required stopping glucocorticoids after a 2-year total duration. That glucocorticoid dose and duration were associated with heightened risk of relapse in our study might be explained by physicians being more likely to continue glucocorticoids or delay their

dose-tapering, when vasculitis remains in remission but atypical signs or symptoms appear or acute-phase reactants increase, possibly due to an intercurrent affection, or perhaps immediately preceding relapse. Meta-analysis results showed that trials in which glucocorticoids were not scheduled for withdrawal (usually continuing prednisone at 5–7.5 mg/day) or were routinely prescribed for >18 months (mostly European studies) had markedly lower relapse rates than those in which they were discontinued earlier by month 6–12 (including most U.S. studies) (49). On the other hand, our findings demonstrated that glucocorticoid dose at the end of the maintenance was associated with higher accrued damage, consistent with previous observations (2). Thus, optimal glucocorticoid duration needs to be examined in randomized–controlled trials analyzing both relapse rate and accrued damage.

In the WEGENT trial, the study drug had to be discontinued after 12 months of maintenance therapy and >80% of our patients' first relapses in each arm occurred only after treatment withdrawal, as previously reported (9,50). Patients initially anti-PR3–ANCA-positive are at higher risk of relapse and may require longer maintenance therapy to limit this risk. Results of a retrospective study showed, among newly diagnosed GPA patients, that longer maintenance therapy was associated with fewer relapses, even after adjusting for prednisone use (50). Because of limited power, a prospective controlled trial was unable to confirm significantly different relapse-free survival among patients persistently positive for cytoplasm-labeling ANCA at remission randomized to receive either standard or extended maintenance therapy (51). The results of the randomized REMAIN trial, comparing 18–24 months versus 4 years of treatment, should help better define optimal maintenance-therapy duration for different AAVs (52).

Further investigation is needed to optimize maintenance regimens. In our group's recently published randomized–controlled MAINRITSAN trial, the reinfusion of fixed-interval low-dose rituximab (0.5 g every 6 months until month 18) better prevented GPA or MPA relapses than 22 months of azathioprine and represents a significant advance, particularly for anti-PR3–ANCA-positive patients who are more prone to relapse (53).

Severe adverse events remain frequent during the long-term followup of these patients, with a quarter of them developing serious infections. The same percentage was observed in the German cohort (31), as opposed to 46% of the NIH cohort (9). Infection led to the deaths of 3% of our patients, again similar to those reported for the German (31) and NIH cohorts (9).

Our study has several notable strengths. To our knowledge, it has the longest followup among studies investigating survival of patients with MPA or GPA, followed for a median of >11 years post-inclusion in a randomized–controlled trial for newly diagnosed AAV. In addition, data was available for ~90% of the original trial participants. We used competing-risk analysis that may more easily identify some factors associated with relapse and death. Moreover, multiple imputations improved the resulting estimates and decreased bias due to missing data. Furthermore, these patients were recruited from 70 French Vasculitis Network centers and are therefore likely to be representative of the entire vasculitis-patient spectrum. Hence, our findings should be generalizable.

Some limitations also need to be acknowledged. This original trial was not designed to assess the impact of the 2 regimens on long-term relapse or survival. After the year-long maintenance therapy, immunosuppressant use was left to the treating physician. One cannot exclude that a difference between the 2 drugs, in terms of efficacy and/or safety, could be observed at a later date if they were taken for a longer duration. Our study may have been underpowered to detect a higher risk of death associated with initial cardiovascular involvement or severe renal impairment because too few affected patients were included. This long-term followup study was retrospective, with all the inherent potential biases associated with retrospective data collection. However, questionnaire-response rates were high and patients' medical charts were also reviewed to complete discordant or incomplete information, leading to the availability of long-term data for ~90% of the participants. So, despite being retrospective, we think that significant ascertainment bias is unlikely.

In conclusion, this long-term analysis confirms that MTX and AZA are comparable

options for maintaining GPA or MPA remission. Despite good overall survival, relapses, adverse events and damage continue to be persistent concerns in AAV patients. Longer maintenance treatment, at least for anti-PR3–ANCA-positive patients should be evaluated prospectively, as well as newer strategies to decrease relapse and damage rates.

## AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content and all authors approved the final version to be published. Dr. Puéchal had full access to all of the data in the study, and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Study conception and design.** Puéchal, Pagnoux, Ravaud, Guillevin.

**Acquisition of data.** Puéchal, Pagnoux, Perrodeau, Hamidou, Boffa, Kyndt, Liferman, Papo, Merrien, Smail, Delaval, Hanrotel-Saliou, Imbert, Khouatra**,** Lambert, Leské, Ly, Pertuiset, Roblot, Ruivard, Subra, Viallard, Terrier, Cohen, Mouthon, Le Jeunne, Ravaud, Guillevin.

**Analysis and interpretation of data.** Puéchal, Pagnoux, Perrodeau, Ravaud, Guillevin.

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**APPENDIX**

In addition to the authors, the following FVSG investigators and members (listed alphabetically by city) participated in the study (all in France unless specified otherwise): Centre Hospitalier (CH), Agen: P Rispal; CH, Alençon: N Baidi, O Chrétien; CH Universitaire (CHU), Hôpital Nord, Amiens: R Cevallos, J-P Ducroix; Amou: J-G Darmaillacq; CHU, Angers: F Dubas†, M-N Maghakian, C Moreau; CH, Argentan: C Dubos-Arvis; Cliniques du Sud Luxembourg, Arlon, Belgium: R Frognier; CH, Avignon: P Gobert, J Pollini; Beaune: D Pingat; CH, Beaune: L Janin-Manificat; CH, Blois: B Lafon; Hôpital Jean-Verdier, Bondy: A Kettaneh; CHU Pellegrin, Bordeaux: M Moiton, JM Ragnaud; CH, Bourg-en-Bresse: C Boudray, B Raphanel, J-P Renand; CH Pierre-Oudot, Bourgoin-Jallieu: M Roux; Bouzy: G Bonnaire; Branne: A Guiso; CHU, Brest: JM André, R Perrichot; Broglie: J Louvet; CHU Clémenceau, Caen: N Artigues, B Bienvenu, B Hurault de Ligny, C Le Hello, P Letellier, T Lobbedez, Y Ollivier, M Pujo, J-P Ryckelynck; CH René-Dubos, Cergy-Pontoise: J-J Montseny; Champs-sur-Marne: P Collet; CH, Charleville Mézières: B Ayach, J-J Dion, H Mouawad; CH, Chartres: R Damade, L Dupouët; Château Thébaud: K Asgaraly; Chaumont: B Depernet; Hôpital Louis-Pasteur, Cherbourg: T Colin; Hôpital Antoine-Béclère, Clamart: V Ioos; CHU Hôtel-Dieu, Clermont-Ferrand: V Rieu; Hôpital Beaujon, Clichy: N Belmatoug, L Foulon, G Jebrak; CH, Compiègne: L du Coedic; CH Laennec, Creil: C Bachmeyer; CHU Henri-Mondor, Créteil: A Dumoulin, B Godeau, M Khellaf, M Michel, M Pastural, A Schaeffer; Dammartin-en-Goële: M Geffroy; CHU, Dijon: P Bielefeld; CH, Dreux: D Fichet; CH, Eaubonne: J-L Saraux; Groupe Hospitalier Mutualiste, Grenoble: S Vinzio; Jard-sur-Mer: P Ehrlacher; CHU, Kremlin–Bicêtre: A Azria, X Mariette; CH, La Roche-sur-Yon: M Tiab; CH, Laval: D Delansorne; CH, Le Mans: N Boullanger, F Closs-Prophette, A Goldstein; Le Mans: L Bouscaud; CH Robert-Boulin, Libourne: V Meunier; CHU Claude-Huriez, Lille: E Hachulla, P-Y Hatron, D Launay; CHU Dupuytren, Limoges: C Hottelart, E Liozon, O Longuet, V Loustaud-Ratti, P Soria, E Vidal; CH Robert Bisson, Lisieux: L Geffray, P Henri, I Landru; CH Bretagne-Sud, Lorient: J-M Guillemot, J Le Noach; Hôpital Louis-Pradel,

Lyon: J-F Cordier, V Cottin, B Gentil; Hôpital Edouard-Herriot, Lyon: S Demolombe-Rague, M-H Girard-Madoux, J Ninet, L Pinède; Magnac Laval: J-P Meynieux; CHU La Timone, Marseille: J Serratrice, B Xeridat; CHU Nord, Marseille: D Bagnères; Hôpital de la Conception, Marseille: J Roudier; Montauban: B Denis; Montherme: N Boillet; CH, Montluçon: A Geraads, R Teyssandier; Hôpital Saint-Eloi, Montpellier: F Degraeve, A Le Quellec, S Rivière; CH, Morlaix: C Rogé; Mugron: J-P Fauchay; CHU, Nancy: D Wahl; CHU Hôtel-Dieu, Nantes: C Agard; Nantes: T Généreau, D Meker; CHU, Nice: S Bensakel; CHU Caremeau, Nîmes: F Vecina; Hôpital Bichat–Claude-Bernard, Paris: M Aubier, G Foulon, G Jebrak, P Lelièvre, O Lidove, F Mignon, O Meyer†, M Piperaud, G Queffeulou, F Vrtovsnik; Hôpital Cochin, Paris: A Aouba, J-P Arène, A Bérezné, V Le Guern; Groupe Hospitalier Pitié–Salpêtrière, Paris: Z Amoura, O Benveniste, D Dimitri, D Lê Thi Huong; Hôpital Saint-Louis, Paris: A Bergeron, A Bourgarit, D Farge, A Mahr, F Martinez, D Séréni; Hôpital Hôtel-Dieu, Paris: E Aslangul; Hôpital Tenon, Paris: C Arnal, J Cadranel, E Daugas, G Pelle, J Rossert, M Wislez; Institut Mutualiste Montsouris, Paris: M Gayraud; CH Intercommunal de Poissy–Saint-Germain, Poissy: A Bruet, Y Hillion; Hôpital Jean-Bernard, Poitiers: M Paccalin; CHU Robert-Debré, Reims: J Léone, J-L Pennaforte; Hôpital Bois Guillaume, Rouen: S Barbier, B Legallicier; Hôpital Charles-Nicolle, Rouen: S Dominique; CH, Saint-Brieuc: C Charasse, D Coëtmeur, E Duhamel; Saint-Brieuc: J-P Goulias; CH, Saint-Cloud: F Bournerias; Stotzheim: P Gautherie; CHU Hautepierre, Strasbourg: J-L Schlienger; Tourlaville: A Vidal; CHU Bretonneau, Tours: E Diot, P Diot; CH, Valenciennes: P Vanhille; Hôpital Saint-Nicolas, Verdun: P Bindi; Villefranche-sur-Saone: G Cervantes.

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**Table 1.** Clinical outcomes during long-term followup of WEGENT trial participants according to their initial randomization arm

| Parameter | Azathioprine (n = 63) | Methotrexate (n = 63) | HR or aRR or aIRR [95% CI] | *P* |
|---|---|---|---|---|
| Months of therapy during trial, mean ± SD | | | | |
| Maintenance | 12.5 ± 7.3 | 11.5 ± 5.1 | | 0.36 |
| Glucocorticoids | 27.0 ± 6.4 | 26.7 ± 7.8 | – | 0.86 |
| Years of followup, median [95% CI] | 11.9 [11.3–12.5] | 12.0 [11.2–12.5] | – | 0.81 |
| Patients lost-to-followup* | | | | |
| No. | 8 | 6 | – | 0.57 |
| Years of followup, median [range] | 7.7 [4.9–9.8] | 5.0 [2.7–9.7] | – | 0.28 |
| Deaths*, no. (%) | 15 (23.8) | 12 (19.0) | 0.80† [0.37–1.71] | 0.56 |
| Patients with* | | | | |
| ≥1 relapses, no. (%; cases/100 person-years) | 38 (60.3; 12.5) | 34 (54.0; 9.8) | 0.78‡ [0.13–4.85] | 0.35 |
| ≥1 severe adverse events, no. (%; cases/100 person-years) | 33 (52.4; 7.9) | 35 (55.6; 8.3) | 1.05‡ [0.70–1.58] | 0.84 |
| ≥1 serious infections, no. (%; cases/100 person-years) | 16 (25.8; 3.4) | 22 (34.9; 4.8) | 1.40‡ [0.20–9.80] | 0.32 |
| ≥1 malignancies, no. (%; cases/100 person-years) | 11 (17.7; 2.2) | 10 (15.9; 1.9) | 0.90‡ [0.56–1.47] | 0.81 |
| Patients with end-stage renal disease*, no. (%) | 7 (11.0) | 8 (12.7) | – | 0.78 |
| Relapse* | | | | |
| No. | 80 | 67 | – | – |
| Mean no. (± SD) per patient | 1.3 ± 1.4 | 1.0 ± 1.3 | 0.83§ [0.55–1.25] | 0.38 |
| Major, no. | 58 | 51 | – | – |

| | | | | |
|---|---|---|---|---|
| Major, mean no. (± SD) per patient | 0.9 ± 1.2 | 0.8 ± 0.9 | 0.81§ [0.53–1.26] | 0.35 |
| First only after stopping study maintenance drug, no. (%) | 31/38 (81.6) | 30/34 (88.2) | 1.08 [0.89–1.31] | 0.43 |
| Relapse-free survival, median [95% CI], years | 3.8 [2.4–5.5] | 4.8 [3.7–8.4] | | 0.29 |
| Major relapse-free survival, median [95% CI], years | 5.0 [2.9–9.6] | 6.3 [4.8–9.6] | | 0.46 |
| Survival at 10-year followup* | | | | |
| Overall (%) [95% CI] | 75.1 [64.8–86.9] | 79.9 [70.3–90.8] | 0.80† [0.37–1.71] | 0.56 |
| Relapse-free (%) [95% CI] | 26.3 [17.3–40.1] | 33.5 [23.5–47.7] | 0.80† [0.52–1.21] | 0.29 |
| Severe side effect-free (%) [95% CI] | 43.6 [32.8–58.0] | 42.1 [31.4–56.4] | 1.02† [0.64–1.62] | 0.94 |
| Relapse- and severe side effect-free (%) [95% CI] | 21.9 [13.7–35.1] | 21.2 [13.1–34.4] | 0.96† [0.65–1.43] | 0.84 |
| VDI per patient, mean ± SD | 3.2 ± 2.5 | 3.1 ± 2.0 | 1.00§ [0.74–1.36] | 1.00 |

*Data censored at 10 years. HR = hazard ratio; aRR = adjusted relative risk on length of followup until the first event; aIRR = incidence risk ratio adjusted to length of followup.

**Table 2.** Multivariate analyses of factors associated with relapses or damage*

| Factor | Hazard ratio [95% CI] | *P* |
|---|---|---|
| Associated with relapses | | |
| Anti-PR3ANCA (versus anti-MPOANCA or no ANCA) | 1.99 [1.29–3.08] | 0.002 |
| Baseline serum creatinine† | 0.99 [0.98–1.00] | <0.05 |
| Glucocorticoid dose at the end of maintenance‡ | 1.05 [1.01–1.09] | 0.01 |
| Glucocorticoid duration§ | 1.03 [1.00–1.05] | 0.02 |
| Associated with VDI-assessed damage | | |
| Age↑ (years) | 1.05 [1.02–1.09] | 0.002 |
| Anti-PR3–ANCA (versus anti-MPO–ANCA or no ANCA) | 2.53 [1.11–5.76] | <0.03 |
| Baseline serum creatinine£ | 1.03 [1.00–1.05] | <0.02 |
| Glucocorticoid dose at the end of maintenance¥ | 1.12 [1.01–1.24] | 0.03 |

*Data censored at 10 years.

†Each additional 10 µmol/liter of creatinine at inclusion decreased the relapse risk by 1%.

‡Each additional mg of prednisone at the end of maintenance increased the relapse risk by 12%.

§Each additional 6 months of prednisone after stopping maintenance increased the relapse risk by 3%.

↑Each additional year increased VDI by 5%.

£Each additional 10 $\mu$mol/liter of creatinine at inclusion increased the VDI by 3%.

¥Each additional mg of prednisone when AZA/MTX was discontinued increased VDI by 12%.

**Table 3.** Post-trial treatments prescribed during long-term followup

| Therapy | AZA n = 63 | MTX n = 63 | *P* |
|---|---|---|---|
| Cyclophosphamide | | | |
| Patients, no. | 26 | 24 | 0.77 |
| IV induction therapies, no. | 27 | 23 | 0.51 |
| Oral induction therapies, no. | 10 | 9 | 0.83 |
| Oral cyclophosphamide after IV induction, no. | 6 | 5 | 0.77 |
| Cumulative dose, mean ± SD (g) | 1.2 ± 2.7 | 1.0 ± 2.1 | 0.40 |
| Rituximab | | | |
| Patients, no. | 10 | 8 | 0.64 |
| Induction therapies, no. | 10 | 8 | 0.64 |
| Remission-maintenance therapies, no. | 6 | 6 | 0.98 |
| Cumulative dose, mean ± SD (g) | 11.9 ± 15.9 | 9.1 ± 11.3 | 0.67 |
| GC ≥30 mg/day, no. patients | 47 | 46 | 0.96 |
| IVIg, no. patients | 9 | 2 | 0.03 |
| Plasma exchange, no. patients | 1 | 0 | 1 |
| Infliximab, no. patients | 1 | 2 | 0.62 |

AZA = azathioprine; MTX = methotrexate; IV = intravenous; GC = glucocorticoids; IVIg = intravenous immunoglobulins.

## FIGURE LEGENDS

**Figure 1.** Design of the WEGENT trial and of its long-term followup study. Followup was from trial inclusion to the last medical update or death. Patients were censored 10 years after inclusion. AZA = azathioprine; MTX = methotrexate.

**Figure 2.** Overall survival (A) censored at 10 years with confidence interval (---) and according to (B) randomization arm, (C) age or (D) vasculitis of the 126 enrolled patients in the WEGENT trial. AZA = azathioprine; MTX = methotrexate; MPA = microscopic polyangiitis; GPA = granulomatosis with polyangiitis (Wegener's). The vertical line indicates the discontinuation of azathioprine or methotrexate maintenance therapy after 1 year.

**Figure 3.** Relapse-free survival censored at 10 years according to (A) randomization arm and (B) ANCA status of the 126 enrolled patients in the WEGENT trial. AZA = azathioprine; MTX = methotrexate; ANCA status = anti-PR3 versus anti-MPO or none. The vertical line indicates the discontinuation of azathioprine or methotrexate maintenance therapy after 1 year.

**Figure 1.**

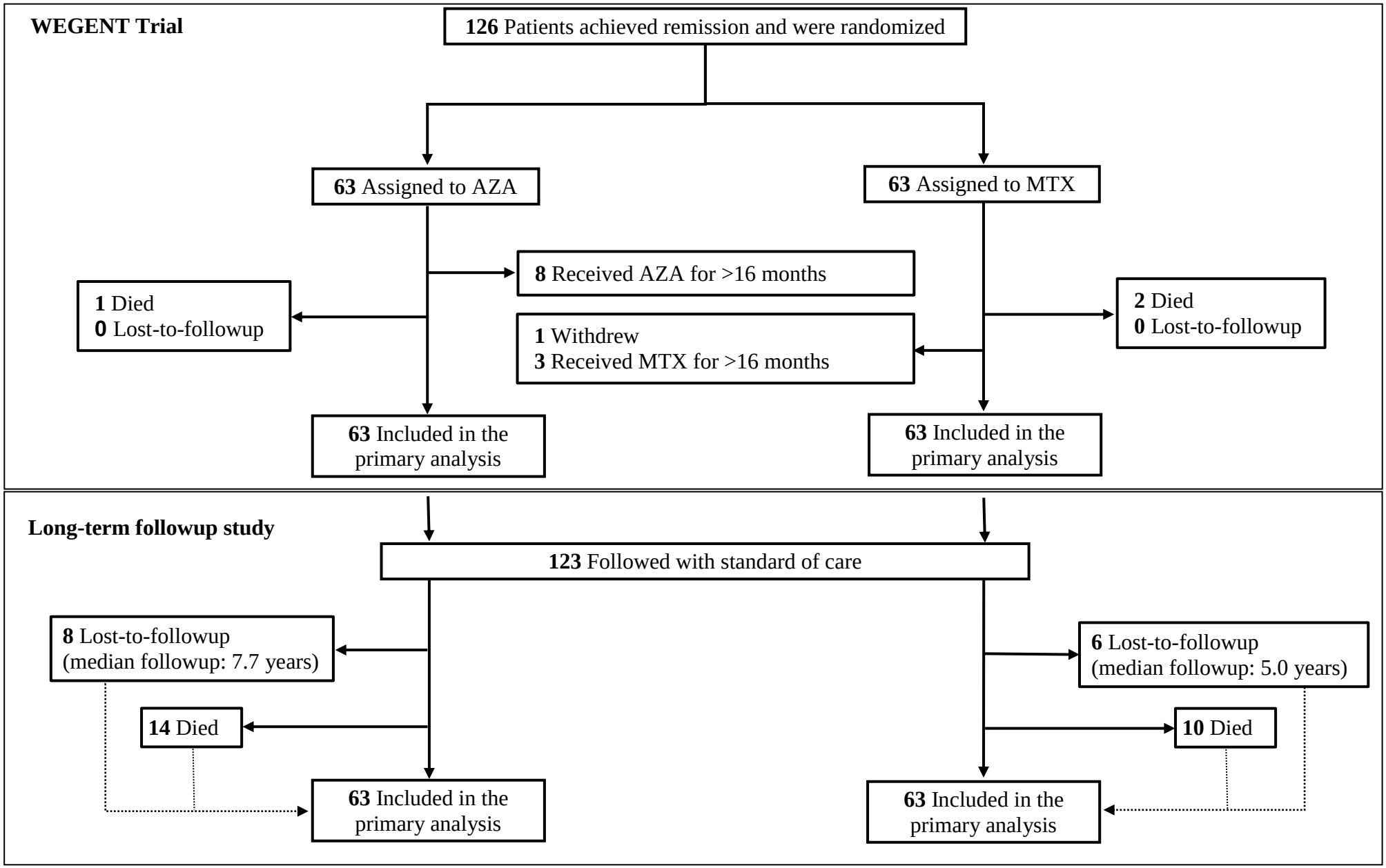

WEGENT Trial
126 Patients achieved remission and were randomized
63 Assigned to AZA
63 Assigned to MTX
8 Received AZA for >16 months
1 Died
0 Lost-to-followup
2 Died
0 Lost-to-followup
1 Withdrew
3 Received MTX for >16 months
63 Included in the primary analysis
63 Included in the primary analysis
Long-term followup study
123 Followed with standard of care
8 Lost-to-followup (median followup: 7.7 years)
6 Lost-to-followup (median followup: 5.0 years)
14 Died
10 Died
63 Included in the primary analysis
63 Included in the primary analysis

**Figure 2.**

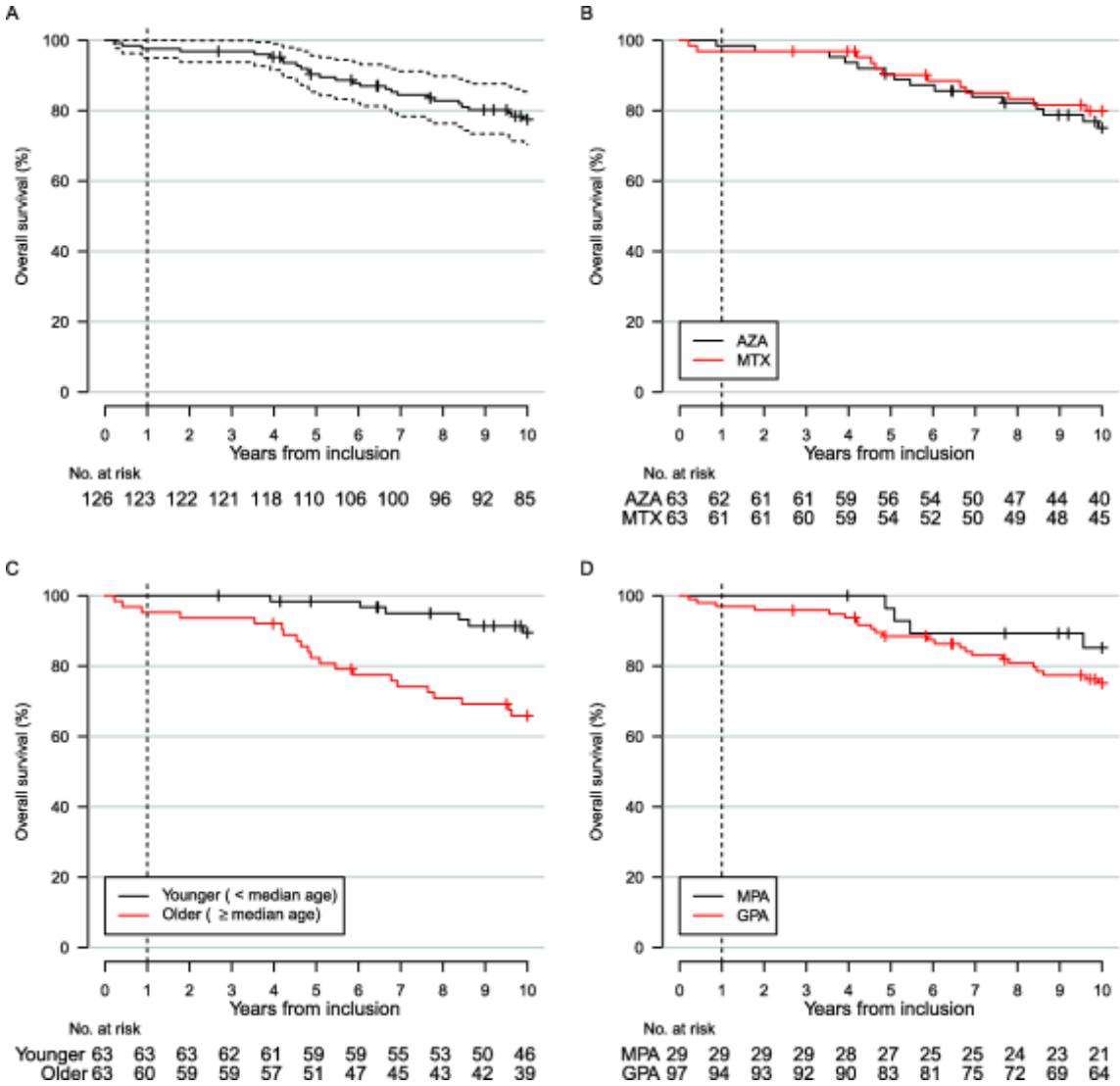
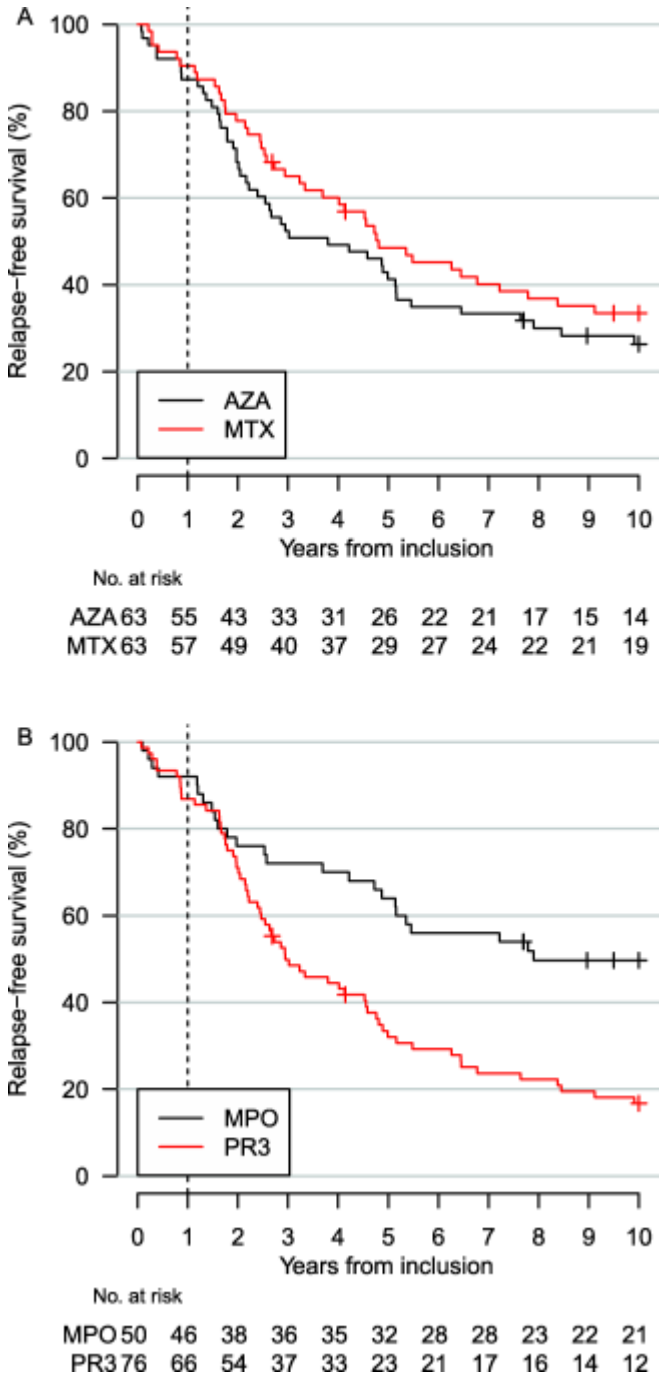

A
Overall survival (%)
Years from inclusion
No. at risk
126 123 122 121 118 110 106 100 96 92 85
B
AZA
MTX
No. at risk
AZA 63 62 61 61 59 56 54 50 47 44 40
MTX 63 61 61 60 59 54 52 50 49 48 45
C
Younger ( < median age)
Older ( ≥ median age)
No. at risk
Younger 63 63 63 62 61 59 59 55 53 50 46
Older 63 60 59 59 57 51 47 45 43 42 39
D
MPA
GPA
No. at risk
MPA 29 29 29 29 28 27 25 25 24 23 21
GPA 97 94 93 92 90 83 81 75 72 69 64

**Figure 3.**


A
Relapse−free survival (%)
100
80
60
40
20
0
AZA
MTX
0 1 2 3 4 5 6 7 8 9 10
Years from inclusion
No. at risk
AZA 63 55 43 33 31 26 22 21 17 15 14
MTX 63 57 49 40 37 29 27 24 22 21 19
B
Relapse−free survival (%)
100
80
60
40
20
0
MPO
PR3
0 1 2 3 4 5 6 7 8 9 10
Years from inclusion
No. at risk
MPO 50 46 38 36 35 32 28 28 23 22 21
PR3 76 66 54 37 33 23 21 17 16 14 12