

Elsevier Editorial System(tm) for American
Journal of Ophthalmology
Manuscript Draft

Manuscript Number: AJO-16-1566R3

Title: Experience of Anti-VEGF Treatment and Clinical Levels of
Depression and Anxiety in Patients with Wet Age-Related Macular
Degeneration

Article Type: Original Article

Keywords: Wet Age-Related Macular Degeneration; Anti-VEGF; Depression;
Anxiety; Experience.

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Abstract

Purpose: To investigate detailed patient experiences specific to receiving vascular endothelial growth factor inhibitors (anti-VEGF) for wet Age-Related Macular Degeneration (wAMD), and to acquire a snapshot of the frequency of clinically significant levels of depression, anxiety and post-traumatic stress among patients and levels of burden in patients' carers.

Design: Observational cross-sectional mixed-methods study

Methods: 300 patients with wAMD receiving anti-VEGF treatment and 100 patient carers were recruited. Qualitative data on patients' experience of treatment were collected using a structured survey. Standardised validated questionnaires were used to quantify clinically significant levels of anxiety, depression, post-traumatic stress, as well as cognitive function and carers' burden.

Results: Qualitative data showed that 56% of patients (n =132) reported anxiety related to anti-VEGF treatment. The main sources of anxiety were fear of going blind due to intravitreal injections, and concerns about treatment effectiveness rather than around pain. From validated questionnaires, 17% of patients (n=52) showed clinical levels of anxiety, and 12% (n=36) showed clinical levels of depression. Depression levels, but not anxiety, were significantly higher in patients who received up to 3 injections compared to patients who received from 4 to 12 injections (ANOVA $P=.027$) and compared to patients who received more than 12 injections (ANOVA $P=.001$).

Conclusions: Anti-VEGF treatment is often experienced with some anxiety related to treatment regardless of the number of injections received. Clinical levels of depression seem to be more frequent in patients at early stages of anti-VEGF treatment. Strategies to improve patient experience of treatment and minimise morbidity are suggested.

Key Words: Wet Age-Related Macular Degeneration; Anti-VEGF; Depression; Anxiety; Experience.

Title: Experience of Anti-VEGF Treatment and Clinical Levels of Depression and Anxiety in Patients with Wet Age-Related Macular Degeneration

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Short Title: Patient Experience of Anti-VEGF treatment for Wet AMD

Introduction

Age-related macular degeneration (AMD) is one of the leading causes of vision loss and blindness in people aged 50 years and older, particularly in the developed world (1,2). Currently, wet AMD (wAMD) is the only form of AMD that is treatable, usually involving the use of vascular endothelial growth factor inhibitors (anti-VEGF) such as bevacizumab, ranibizumab, or aflibercept (3,4). Anti-VEGF treatments are regarded as a generational breakthrough in the treatment of macular diseases such as wAMD (5). Recent studies have shown that anti-VEGF treatment can significantly reduce patients' risk of severe visual impairment as it has great potential for halting disease progression (3-5). However, this treatment is administered by invasive intravitreal injections, often at the conclusion of lengthy, frequent and repeated visits after transport to a suitably equipped hospital. The specific act of these intraocular anti-VEGF injections can be experienced by patients as a stressful event, with anticipatory anxiety and expectations of pain and discomfort (6-8). Evidence on this topic is still limited due the lack of studies exploring the complexity and diversity of patient experiences of anti-VEGF treatment for wAMD (9). A recent review of the literature (9) only found 3 studies exploring in-depth patients' experiences of receiving anti-VEGF treatments using qualitative designs (8,10,11). The remaining studies addressing the experience of receiving anti-VEGF treatment were mainly focused on medical aspects such as the anaesthetic's effectiveness to prevent pain when receiving an intravitreal injection (12-17). The studies suggest that anticipatory anxiety associated with anti-VEGF treatment tends to be circumscribed to the first injections, i.e. at early stages of treatment (17,18). The aspects of anti-VEGF treatment in which patients have reported more discomfort and anxiety are (6-8,10,18): needle entry; application of drops; insertion of speculum; waiting for injection; experiences of pain, fear of losing sight, fear for the unknown and side effects. One qualitative study (11) also stressed the potential importance of other variables for the way patients experience anti-VEGF treatment and cope with anxiety and the fear for the "unknown". These variables are: communication between healthcare professionals and patients, especially about treatment procedures; and the way service is delivered, with a special attention for anticipatory anxiety induced by waiting times before the injection. In another qualitative study on patient experience of anti-VEGF treatment (8), cautious optimism regarding treatment success and disease stabilization was found as a frequent and valid response to treatment from wet AMD patients. There is, overall, a need for more research exploring the complexity of patient experience of anti-VEGF treatment to clarify reasons underlying patients' anxieties when receiving regular intravitreal injections (9). The relationship between AMD and depression and anxiety has been well documented in literature (19-24). Research shows a wide prevalence range from 15.7% to 44% for depressive symptoms and 9.6% to 30.1% for anxiety symptoms among AMD patients (19). Previous studies have suggested that vision-related disability (caused by visual impairment) (25-28), visual acuity (29,30), and social support (31,32) can play an important role in the link between visual impairment and depression. Other studies have highlighted the link between ageing and depression (33) which might also play a role in the relationship between AMD and depression. However, most studies on depression associated with AMD were conducted prior to the implementation of anti-VEGF treatments or were conducted on general AMD patients (dry and wet) (22,34). This might be explained by the fact of anti-VEGF treatment is relatively recent and previous research on AMD and depression was conducted before the dissemination of anti-VEGF as the first line treatment for wAMD (34). Considering the positive effects of anti-VEGF to prevent further vision loss in wAMD patients, the question has been raised as to whether patients receiving anti-VEGF treatment might present a different prevalence of depression and anxiety (34,35). Existing studies in this field are still limited in generating evidence and often with low numbers (9,34). A recent

1 review on this topic (9) found four studies where the prevalence of depression was examined
2 in patients receiving anti-VEGF treatments (22-24,36). Findings were preliminary but
3 suggested that the wAMD patient group receiving anti-VEGF treatment still present higher
4 rates of depression and anxiety in comparison with general population. Finally, previous
5 research has also shown that despite depression and anxiety being common among adults
6 with vision loss, they tend to not be tackled by health services and therefore remain untreated
7 (36-39).

8 The primary purpose of this study is to investigate the patient experience of receiving anti-
9 VEGF treatment for wAMD, with a particular focus on patient sources of anxiety related to
10 anti-VEGF treatment. The secondary aim of this study is to achieve a snapshot of the
11 frequency of clinical levels of anxiety, depression, and post-traumatic stress (PTS), among
12 patients attending for treatment of wet AMD, and to explore levels of burden among patient
13 carers. To the best of our knowledge there is no literature supporting the existence of any link
14 between AMD or anti-VEGF and PTS, but we included the assessment of PTS as exploratory
15 of any serious unmet mental health needs that could influence patients' experience of
16 treatment. Additionally, we want to explore clinical levels of depression and anxiety between
17 patients with different number of injections received and between patients with different
18 visual acuity. Mental health problems in our patient group could be related to their AMD, the
19 injection treatments, ageing, personal history, burden of travel or other internal and external
20 factors and we do not attempt to prove any specific link between anti-VEGF and
21 psychological symptoms. Instead we aimed to explore any existent mental health needs in our
22 patient group, exploring clinical levels of depression and anxiety across different patient sub-
23 groups to derive a general picture of patients' mental health and whether these needs are
24 being met by health services. With regard to patient carers, we also wanted to achieve a
25 snapshot of the burden experienced by carers of a patient who regularly receives anti-VEGF
26 treatment. Our study aims were built upon two premises: the fact our patient group is
27 receiving regular invasive treatment that has been described as potential stressful; and the fact
28 of AMD patients are generally considered at risk of having comorbid mental health problems
29 that tend to not be addressed by health services. Our ultimate hope is that information from
30 this study can be used to help managing the psychological as well as ophthalmic needs of our
31 patients in AMD clinics.

32 Literature on depression and anxiety among wAMD patients receiving anti-VEGF treatment
33 is still very limited and scarce, which necessitates a more exploratory scope for our study.
34 However, we hypothesise that patient anxiety related to anti-VEGF is more frequent among
35 patients at early stages of treatment, i.e., in patients who have received up to 3 injections than
36 in patients who are receiving treatment for longer, in light of what was suggested in previous
37 studies (17,18). Additionally, we hypothesise that clinical levels of depression and anxiety
38 are significantly more frequent in patients who are at early stages of treatment (who have
39 received up to 3 injections) than in patients receiving treatment for longer, i.e., the higher the
40 number of anti-VEGF injections received, the less frequent anxiety and depression are seen.
41 Finally we also hypothesise that the frequency of clinical levels of depression and anxiety are
42 negatively correlated with visual acuity, as previous studies suggested that depression is
43 associated with poorer visual acuity in patients with vision disorders (29,30).

44 **Methods**

45 **Ethics**

46 North West Research Ethics Committee (NHS, UK) approved study procedures (reference
47 15/NW/0288). The study adheres to the tenets of the declaration of Helsinki. We offered all
48 participants a participant information sheet, and obtained informed consent prior to
49 recruitment.
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1 **Study Design**

2 We carried out an observational cross-sectional mixed-methods study. The qualitative strand
3 used a structured survey to explore patient experience of receiving anti-VEGF treatment and
4 sources of anxiety associated with this treatment. The quantitative strand of this study used
5 standardised psychological instruments to investigate depression and anxiety, and post-
6 traumatic stress in our sample of patients and levels of burden among patients' carers. This
7 mixed-methods design allows us to combine the measurement of psychological health in
8 patients undergoing treatment for wAMD (depression, anxiety and post-traumatic stress) with
9 in-depth data (qualitative strand) that explores experience of treatment and sources of anxiety
10 associated with treatment.
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13 **Participants**

14 We invited consecutive patients with formal diagnoses of wAMD attending the macular
15 treatment centre at Manchester Royal Eye Hospital to take part in the study. Patients and
16 carers were recruited from May 2015 to November 2015. Inclusion criteria for patients were:
17 to have a confirmed diagnosis of wAMD, to have received at least one anti-VEGF injection
18 prior to the interview for this study, and to be followed-up in the macular treatment centre of
19 the corresponding hospital. We included in our study patients who were receiving and who
20 were not receiving psychological and psychiatric treatment. We excluded patients whose first
21 anti-VEGF injection was on the day of interview and patients who were not able to
22 communicate effectively. For carers the inclusion criteria was only to be carer of a patient
23 currently receiving anti-VEGF treatment for wAMD. In our study, all researchers were
24 blinded to carer-patient relationship, i.e., we interviewed carers without knowing who was the
25 corresponding patient of each carer, in order to allow carers to be as open and honest as
26 possible.
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32 **Procedures**

33 Participants were approached by an experienced clinical psychologist (HS) on the same day
34 they were scheduled to have the medical appointment and receive treatment. All patients
35 were invited to participate in an individual interview before receiving the injection, in a
36 private room where all study instruments were administered. Participants were issued with a
37 patient information sheet, and given the opportunity to ask questions about their participation.
38 They provided written informed consent if they agreed to participate. Questionnaires and
39 forms were read to patients who were unable to read as a result of their vision loss or having
40 received topical eye medication. Carers of patients were approached by another researcher
41 (NM) on the same day, following the same procedures.
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46 **Measures for Qualitative Strand**

47 For the qualitative strand of this study, we were keen to acquire a broad range of information
48 specific to AMD. A structured survey was developed from input provided by a patient and
49 public involvement (PPI) group, previous literature on the topic, and considering our prior
50 experience of dealing with AMD patients. The PPI event consisted of an informative meeting
51 with wAMD patients, researchers and healthcare professionals who worked with these
52 patients on a daily basis. The PPI group helped to identify key issues of patients' perceptions
53 and concerns about anti-VEGF treatment and the way it has been delivered, which shaped the
54 development of the survey. The PPI meeting lasted 2 hours and was audio-recorded and
55 transcribed to identify the main and key concerns raised by participants about the treatment
56 for wet AMD and the way the treatment is being delivered by our service. Although our
57 survey was built upon the main topics raised by PPI participants, we have also included
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1 questions addressing topics that have been highlighted in previous literature on patient
2 experience of anti-VEGF treatment (9), such as sources of anxiety related to anti-VEGF
3 treatment, and experiences of pain when receiving an injection. The final version of our
4 survey comprised of 17 closed-ended questions addressing patients' demographics, clinical
5 data and experience and perception of anti-VEGF treatment, and one open-ended question
6 addressing patient concerns and anxieties on the anti-VEGF treatment (for more details on
7 the survey please see appendix A). Topics covered by the survey included anxieties and
8 concerns about anti-VEGF treatment, treatment preferences and options, doctor/patient
9 relationship, pain experienced when receiving treatment and perception of carer's burden.

11 **Measures for Quantitative Strand**

12 We defined patients' visual acuity (VA) as the best-corrected VA of the eye with better
13 vision. Best-corrected VA was converted into the logarithm of the minimum angle of
14 resolution during analysis. We divided patients into 3 groups, based on the World Health
15 Organization (WHO) classification of visual impairment (40): no visual impairment or mild
16 visual impairment ($VA \geq 6/18$), moderate impairment ($6/60 < VA < 6/18$) and severe
17 impairment ($VA < 6/60$).

18 Depression and anxiety were assessed by the Hospital Anxiety and Depression Scale (HADS)
19 (41). HADS is a 14-item self-report scale, comprising two subscales evaluating levels of
20 anxiety (HADS-Anxiety) and levels of depression (HADS-Depression). The HADS has been
21 used extensively in the hospital setting as a standardised psychological screening tool for
22 emotional disorders (41). Each subscale includes 7 items, generating possible scores of 0 to
23 21 for anxiety (Cronbach's $\alpha = 0.89$) and depression (Cronbach's $\alpha = 0.91$). A score of 8 and
24 above is widely used to indicate the presence of clinical levels of anxiety or depression that
25 may warrant further psychological investigation (41,42).

26 Post-traumatic stress (PTS) symptoms related to receiving an intravitreal injection was
27 assessed by the Impact of Events Scale-Revised (IES-R) (43). IES-R is a validated measure
28 of self-reported posttraumatic stress symptoms experienced in the past seven days in relation
29 to a specific stressor (40). IES-R consists of 22 items, each ranging from 0 ("Not at all") to 4
30 ("Extremely"), with the total score ranging from 0 to 88. Three symptom clusters associated
31 with post-traumatic stress are assessed with the IES-R, including intrusion, avoidance and
32 hyperarousal. Intrusion relates to intrusive thoughts, nightmares and imagery associated with
33 the traumatic event (8 items; Cronbach's $\alpha = 0.90$), avoidance relates to avoidance of any
34 feelings or situations (8 items; Cronbach's $\alpha = 0.95$) and hyper-arousal is an inability to
35 concentrate, anger, irritability and hypervigilance (6 items; Cronbach's $\alpha = 0.96$). Higher
36 scores indicate more symptoms of posttraumatic stress, with scores above 24 indicating the
37 potential need for clinical assessment and care (43).

38 The Mini-Mental State Examination (MMSE) (44) was used to assess patients' cognitive
39 status. MMSE consists of two sections: the first section requires oral responses regarding
40 temporal and spatial orientation, memory and attention; the second section requires the
41 subject to name simple objects, follow verbal written commands, write a sentence
42 spontaneously, and copy two intersecting pentagons, in order to assess language and visuo-
43 spatial functions. MMSE final score ranges from 0 to 30 (the maximum score). MMSE
44 scores from 25 to 30 suggest a questionably significant degree of cognitive impairment.
45 Scores from 21 to 24 indicate mild cognitive impairment. Scores from 10 to 20 suggest
46 moderate cognitive impairment, and scores below 10 suggest severe cognitive impairment.
47 We adjusted some vision-related tasks to make them suitable for patients with vision
48 impairment: for the task "writing a sentence" we helped the patient to find the paper and
49 writing space; for the task "reading a sentence" we provided larger letters printed in bold; and
50 for "identifying a pen and a watch" we adjusted the distance of those objects to the patients'

1 eyes. We only excluded the last MMSE task which consists of asking the patient to copy a
2 pair of intersecting pentagons, as this task involves more complex visuospatial planning and
3 executive skills. We anticipated that some patients would perform inaccurately in this task
4 due to reduced visual acuity which would compromise the reliability of results. Final scores
5 were adjusted from 0 (minimum) to 29 (maximum) because one point refers to the last test
6 task involving the copy of a pair of pentagons. Cut-off scores were also adjusted, i.e., we
7 used the original test cut-off scores minus 1 point. The internal consistency of the MMSE
8 obtained Cronbach's alphas of 0.82 in elderly patients admitted to a medical service and 0.84
9 in elderly nursing home residents (44,45).

10 The Burden Assessment Scale (BAS) (46) was used to assess burden in patients' carers. BAS
11 is a 19-item measure that evaluates burden in an objective way, that is, the amendment of
12 caring for someone with limitations imposed on the level of activities and resources of the
13 caregiver. BAS employs a 4-point scale (1–4), with higher scores indicating greater levels of
14 caregiving burden. Cronbach's alphas for the subscales and total scale were as follows: a =
15 0.82 for limitation in activity, a = 0.64 for feelings of worry and guilt, a = 0.71 for social
16 burden, and a = 0.81 for total scale.

20 **Data Analysis**

21 Results are presented mainly with descriptive statistics using SPSS software. We had no prior
22 sample to perform power calculations. As part of pilot analyses, Chi-square test was used to
23 investigate whether or not anxiety related to treatment is more frequent in patients who have
24 received up to 3 injections than in patients who have received more injections, i.e., patients
25 receiving treatment for longer. The basic assumptions for this statistical test were satisfied in
26 that there were distinct categories and all expected frequencies were greater than 5. We
27 created three sub-groups of patients who received up to 3 injections, i.e. patients who are at
28 early stages of treatment (Group 1, n=21); patients who received 4 to 12 injections, i.e.,
29 patients who are not at early stages of treatment but are more experienced with treatment and
30 are not yet regarded as chronically treated (Group 2, n= 119); and patients who have received
31 more than 12 injections and therefore are more likely to be chronically treated with anti-
32 VEGF (Group 3, n=160). The choice of sub-groups was based upon patient and public
33 involvement meetings and upon timeframes cited in previous literature indicating patient
34 anxiety associated with earlier stages of treatment (17,18). Univariate ANOVA was used to
35 investigate differences in HADS scores for depression and anxiety between all sub-groups of
36 patients (G1, G2 and G3). Chi-square test was used to investigate differences in the frequency
37 of patients with HADS scores indicating clinical levels of depression between all sub-groups
38 of patients (G1, G2 and G3). Chi-square post-hoc analysis was performed using adjusted
39 residuals (47) to investigate which sub-groups of patients present significant differences in
40 number of cases of clinical levels of depression. The samples were from a number of
41 independent groups and the variables were normally distributed with similar variance in each
42 group. Pearson correlation was used to investigate associations between HADS scores and
43 visual acuity (LogMAR), and between HADS scores and number of injections received.
44 Data from the survey was analysed in terms of frequency of responses for each closed-ended
45 question. The final open-ended question of the survey was analysed for the frequency of each
46 source/type of anxiety related to anti-VEGF treatment that patients reported.

54 **Results**

55 *Patient Characteristics*

56 We invited 345 patients and 100 carers to participate in our study. Of 345 patients 41 refused
57 to participate and 4 were not eligible because they were not able to communicate effectively
58 with the interviewer. A total of 300 wAMD patients and 100 carers gave their consent and
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1 agreed to participate in this study. Patients' demographic and clinical data are presented in
2 Table 1. Our sample of patients had a higher percentage of women (59.7%), and patients who
3 were receiving treatment for more than 1 year (72%). The great majority of patients (85%)
4 had good visual acuity or mild visual impairment. More than 95% of our patients were not
5 receiving any psychological or psychiatric support at the time of the interview.
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7 *Please insert Table 1 here*
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10 ***Qualitative Strand – Broad Experience of Receiving Anti-VEGF Treatment from Survey***

11 Patients' experience of receiving anti-VEGF treatment is presented in table 2 and table 3.
12 Generally patients reported a positive feedback on doctor/patient relationship and the quality
13 of care received. Most patients were satisfied with the support received from the hospital and
14 also satisfied with the information received about the condition and treatment. Most patients
15 also preferred to rely on the doctors to make treatment decisions. With regard to patients'
16 treatment concerns and anxiety, we found that 132 patients (56%) reported some type of
17 anxiety related to anti-VEGF treatment. Further analysis showed that the patients' main
18 concerns and sources of anxiety related to anti-VEGF treatment were: fear of going blind due
19 to intravitreal injections / fear of the needle causing damage in the eye (n=118; 39.3%); hope
20 the treatment works properly / fear of getting worse because the treatment didn't work
21 (n=111; 37%); waiting in the patient waiting room / anticipatory anxiety (n=104; 34.6%); and
22 fear of the unknown in relation to treatment outcomes and disease progression (n=91; 30%).
23 In contrast, anxiety around injection pain (n=10; 3.3%) were relatively infrequently raised.
24 127 patients (42.3%) did report experiences of pain when receiving an intravitreal injection,
25 but the level of pain was relatively minor with mean score of 2.4 (± 3.17) on a scale from 0 to
26 10 with 67% of patients experiencing a level of pain equal or below to 3 (scale 0 to 10).
27 Among those patients who reported pain when receiving an injection, 42 patients (33%)
28 experienced pain only during the initial treatment injection(s), 55 patients (43.3%)
29 experienced pain half way through their treatment, and 30 patients (23.6%) experienced pain
30 only during the last few injections received. More than half of patients (53.7%) reported to
31 have expected more pain than they really experienced when receiving an intravitreal
32 injection.
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39 *Please insert Table 2 and Table 3 here*
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41 ***Anxiety related to Anti-VEGF treatment and Number of Injections Received***

42 Frequency of anxiety related to treatment in each patient sub-group for the number of
43 injections received is presented in Table 4. Chi-Square showed no significant differences
44 ($P > .05$) in the frequency of anxiety related to anti-VEGF treatment between patients who
45 have received different number of injections, i.e., between all patient sub-groups (G1, G2 and
46 G3).
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49 *Please insert Table 4 here*
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52 ***Quantitative Strand – Clinical Levels of Depression, Anxiety, Post-traumatic stress and*** 53 ***Carers Burden***

54 Results from the standardized measures on depression, anxiety, post-traumatic stress,
55 cognitive function and burden are presented in Table 1. HADS-Anxiety scores indicated that
56 17% (n=52) of all wAMD patients had clinical levels of anxiety, 10.6% (n=5) of which were
57 receiving psychological or psychiatric treatment at the time of interview. HADS-Depression
58 scores indicated that 12% (n=36) of all wAMD patients had clinical levels of depression, 9%
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(n=3) of which were receiving psychological or psychiatric treatment for depression. Therefore 89% (n=47) of patients who showed anxiety, and 91% (n=33) of patients who showed depression were not receiving appropriate psychological and psychiatric treatment for their condition. 1 % (n=3) of patients showed symptoms of post-traumatic stress disorder according to the IES-R. Most patients (90.3%; n=271) did not exhibit impaired cognition according to MMSE. All patients were able to perform the administrated MMSE vision-related tasks successfully. Finally, according to BAS scores, 73% (n=73) of carers reported little or no burden, 19% (n=19) reported mild to moderate burden, and 8% (n=8) reported moderate to severe burden. No carers reported severe burden.

Please insert Table 5 here

Depression and Anxiety Investigated for Number of Anti-VEGF Injections Received and Visual Acuity

Table 5 displays HADS scores in different sub-groups of patients regarding the number of anti-VEGF injections received. HADS-Depression scores were significantly higher in patients who had received up to 3 injections (Group 1) in comparison with patients who had received from 4 to 12 injections (Group 2) (ANOVA $P=.027$), and in comparison with patients who had received more than 12 injections (Group 3) (ANOVA $P=.001$). No significant differences were found in HADS-Anxiety scores between the three sub-groups of patients for the number of injections received (ANOVA $P=.22$).

Table 6 displays the frequency of patients with a HADS-Depression score indicating clinical levels of depression in the three sub-groups of patients (HADS-Depression \geq 8). Chi-square test showed significant differences between groups ($P=.003$). Chi-square post-hoc analysis indicated that the number of patients with clinical levels of depression were significantly higher in Group 1 (patients who had received up to 3 injections) ($P=.002$), considering the adjusted Bonferroni corrected P -value of .008.

HADS-Depression scores were significantly but weakly correlated with number of anti-VEGF injections received ($R=-.126$; $P=.03$). HADS-Anxiety scores were not significantly correlated with number of injections ($P=.325$). Both HADS-Anxiety ($P=.536$) and HADS-Depression scores ($P=.635$) were not significantly correlated with VA (LogMAR).

Please insert Table 6 here

Discussion

The qualitative findings of the study demonstrated that patients generally reported to have a good understanding of anti-VEGF treatment, and a good relationship with healthcare professionals. Additionally, they acknowledged the need for receiving treatment and its potential benefits for their eye health. However, despite presenting positive feedback on anti-VEGF treatment, more than half of the patients reported anxiety associated with receiving anti-VEGF treatment. In addition, our findings suggest that the frequency of anxiety related to treatment is similar between patients who are at early stages of treatment, i.e., patients who had received up to 3 injections, and patients who are receiving treatment for longer. This finding rejects our hypothesis that patients anxiety related to treatment is higher in patients who have received up to 3 injections and suggests that the anxiety related to anti-VEGF might persist throughout the treatment, which is not consistent with some previous literature (17,18). A possible explanation for this finding is the fact of patients' three most frequent sources of anxiety related to treatment in our study were related to fear of going blind due to injections, concerns about vision getting worse from treatment failure and waiting in the waiting room. These sources of anxiety are known to be frequent in this patient group

1 (8,10,11) and are triggered by treatment preconceptions, and anticipatory anxiety induced by
2 regular waiting times in the waiting area before receiving treatment (11). Further cohort
3 studies will better clarify patient anxiety related to anti-VEGF treatment, in terms of variance
4 throughout the treatment and identifying potential anxiety triggers.

5 Previous literature has suggested that the main sources of patient discomfort and anxiety are
6 related to the injection procedure and the fear of a needle causing damage in the eye
7 (6,8,10,11). Our survey acknowledges this but suggests greater patient fears of going blind
8 either as the final route of wAMD and / or as a consequence of an unexpected adverse event
9 occurred during the injection, which is very unlikely to occur. These fears occurred despite
10 patients having received routine information from the medical staff about the potential
11 benefits of anti-VEGF treatment and the safety of treatment procedures. The findings from
12 the survey suggest patients may benefit from additional and very specific information before
13 they start the treatment with regard to the success rates of anti-VEGF treatment in halting
14 disease progression, the disease process and how treatment can reduce the risk of becoming
15 blind in the future. Additionally, it would be useful for patients to be informed that the needle
16 in the eye will not be applied in the central area of the ocular globe, i.e., the patient will not
17 see the needle coming into the eye. Finally patients need to be better informed about low
18 likelihood of serious problems following the treatment, and that most adverse effects can be
19 easily manageable after the treatment. Further patient resources and/or communication skills
20 training for health professionals would help to better inform patients.

21 The quantitative finding of the study illustrated a considerable frequency of patients with
22 clinical levels of depression and anxiety, and low percentage of patients with symptoms of
23 post-traumatic stress. According to epidemiologic studies on depression and anxiety (48,49),
24 the frequency of clinical levels of anxiety and depression we found in our patient group is
25 higher than general population, and within the range of what has been found in studies on
26 general AMD patients (dry and wet AMD) (19). However, it is also noticeable that the
27 frequency of patients with clinical levels of anxiety that we found in our validated
28 questionnaires (17%) is clearly lower than the frequency of patients reporting anxiety related
29 to treatment in our survey (56%). This difference is explained by the concept that patient
30 anxiety related to treatment does not necessarily have clinical value or entail clinical levels of
31 anxiety, i.e., a patient can have concerns and anxiety about the treatment but not being
32 clinically anxious.

33 Another important issue was that most of our patients were not receiving any psychiatric or
34 psychological treatment at the time of interview. These findings draw attention to the need of
35 tackling mental health needs among adults with vision loss, especially in health services
36 dedicated to provide care for ophthalmologic diseases. Previous research has highlighted the
37 tendency for these needs to remain unaddressed (36-39), which might have a negative impact
38 on patient healthy life-style, and eventually compromise medical treatment outcomes.

39 The study results partially reject our previous hypothesis that the frequency of clinical levels
40 of depression and anxiety is higher at early stages of anti-VEGF treatment. We only
41 confirmed the hypothesis that the frequency of clinical levels of depression is higher in
42 patients who were at early stages of treatment (had received up to 3 intravitreal injections),
43 compared to patients who had received more than 3 injections, i.e., patients who were at later
44 stages of treatment. This hypothesis is also supported by the correlation we found between
45 the number of injections received and HADS-Depression scores. However, this finding
46 should be confirmed in further studies conducted on a larger sample size, as our group 1
47 sample was small and the correlation coefficient we found was significant but weak. Previous
48 literature on this topic is very limited and inconclusive about the frequency of depression in
49 patients at different anti-VEGF treatment stages (9,22,28,34). One possible hypothesis to
50 explain why depression is higher in patients at early stages of treatment is the fact of AMD is

1 often seen as a threatening condition that entails further blindness (50). Patients recently
2 diagnosed with wAMD can therefore have that expectation of going blind. Previous
3 qualitative and mixed-methods studies on adults with serious vision disorders suggested that
4 the fear of further vision loss and blindness can be an important source of emotional distress
5 (32,51,52), which can ultimately lead to depression (32). In light of this, patients at early
6 stages of anti-VEGF treatment might be at higher risk of having depression due to their fear
7 of going blind because of wAMD. However, as anti-VEGF treatment proceeds, patients can
8 become more optimistic about treatment success and disease stabilization (8).

9 Patients in this study were on anti-VEGF therapy and the great majority of them had good
10 visual acuity and did not have visual impairment according to the WHO's criteria (40).
11 We still found that a percentage of wAMD patients are clinically depressed and anxious
12 within the same prevalence range found in previous studies conducted with adults with visual
13 impairment (53-55). Additionally, we rejected our hypothesis that depression and anxiety are
14 negatively correlated with visual acuity, which is not consistent with some previous literature
15 suggesting that patients with lower visual acuity are more likely to suffer from depression
16 than patients with better visual acuity (29,30). However this is possibly explained by the fact
17 of the great majority of our patients did not have visual impairment and therefore they were
18 not likely to suffer from vision-related disability which may trigger depression (25-28).

19 Social support has been described as playing an important role in patient experience of illness
20 and depression (31,32). Most of patient carers did not report experience of burden while
21 being carers of someone with wAMD. This finding is consistent with the fact that most of our
22 patients didn't perceive themselves as a source of burden for carers which might suggest that
23 the majority of our patients had no issues with social support.

24 Our study highlights common sources of anxiety related to the process of treatment for wet
25 macular degeneration and an awareness of these would be useful for any clinician to improve
26 the patient experience with wAMD. It is suggested that some patient anxiety such as the fear
27 of going blind due to injections, fear for the unknown and fear of getting worse, might be
28 attenuated with effective communication from healthcare professionals and some counselling
29 if needed. To ask patients about their preconceptions and expectations of treatment and
30 prepare them for initiating anti-VEGF treatment, explaining how injections are administered
31 and how unlikely it is to go blind because of injections, might help patients to cope with
32 treatment. Physicians should also be aware of the prevalence of undiagnosed anxiety and
33 depression in their AMD patients and be alert to the opportunity to manage this. Inclusion of
34 standardized tools to screen wAMD patients for symptoms of anxiety and depression in the
35 clinical routine of a macular treatment unit could help to better identify such patients. This
36 should be applied irrespective of how long patients have been having injections.

37 In the current study, some limitations need to be acknowledged. This is a cross-sectional
38 study and therefore it is more limited in providing insights into dynamic changes in clinical
39 levels of depression and anxiety over time which would be valuable to understand these
40 symptoms in our sample. In our study there was potential for selective bias in data collection
41 because we were not able to identify patients who discontinued treatment after initial
42 injection and patients with very good response (no recurrence after the first loading phase of
43 3 injections) or very poor response to treatment (vision drop below 6/60 despite treatment),
44 because these patients' follow-up is usually carried out outside the hospital. One of the
45 researchers who collected data for this study (HS) also contributed to the study design and
46 data analysis which may have entailed some bias to the results of study. Furthermore some of
47 the researchers involved in the study have had prior clinical experience with wAMD patients,
48 and therefore may hold preconceptions about patients' coping behaviours with treatment,
49 which may also contribute as a source of bias. In our study the researcher were blinded to the
50 patient-carer relationship, and did not link carers to the corresponding patients to ensure they
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1 would provide a more authentic input of their experiences and perceptions of being a carer.
2 However, a limitation of this was that we were not able to know about the potential
3 importance of patients' social support for their experience of treatment and for the occurrence
4 of clinical levels of depression. Finally, the authors were not able to have data on the clinical
5 characteristics of the 41 patients who refused to participate and therefore didn't provide
6 informed consent, and the 4 patients who were excluded because they were unable to
7 communicate effectively with the interviewer.

8 In conclusion, this study represents one of the largest and most detailed examinations of
9 patients undergoing anti-VEGF therapy to date. We found that although anti-VEGF
10 treatments themselves are generally well-accepted, particular causes of anxiety exist which
11 could potentially be reduced by improved education and minor alterations in practice. Our
12 additional study using validated objective questionnaires demonstrated that in our examined
13 population, a substantial percentage of patients with wAMD receiving anti-VEGF treatment
14 had undiagnosed clinical levels of anxiety and depression, despite the good visual acuity and
15 the promising outcomes offered by anti-VEGF treatment in preventing further visual
16 impairment. Doctors should be vigilant to this finding that might impair patients' quality of
17 life and consider measures to detect and address this. Further longitudinal studies and
18 controlled trials are needed to provide a more in-depth understanding about depression and
19 anxiety in wAMD patients and to aid development of new intervention tools, at both the
20 patient and clinical level, aiming to reduce these symptoms and to improve the well-being of
21 patients receiving anti-VEGF treatment.
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27 **Abbreviations and Acronyms:**

28 **wAMD:** Wet Age-Related Macular Degeneration; **Anti-VEGF:** Vascular endothelial growth
29 factor inhibitors; **HADS:** Hospital Anxiety and Depression Scale; **IES-R:** Impact of Events
30 Scale Revised; **MME:** Mini-Mental State Examination; **VA:** Visual Acuity; **BAS:** Burden
31 Assessment Scale
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35 **Financial Disclosure(s):**

36 This work was supported by a grant received from Bayer – reference: R117779.

37 Hugo Senra received an educational grant from Bayer.

38 Konstantinos Balaskas is receiving Travel/educational grants from Novartis, Bayer, and
39 Alimera.

40 Neda Mahmoodi has no conflicts of interest.

41 Tariq Aslam is receiving travel and educational grants from Bayer, Novartis, Bausch and
42 Lomb, Alimera, Oraya, and Thea.
43
44
45

46 **Author Contributions:**

47 Study conception and design: Tariq Aslam, Konstantinos Balaskas, Hugo Senra

48 Analysis and interpretation: Hugo Senra, Tariq Aslam, Neda Mahmoodi

49 Data collection: Hugo Senra, Neda Mahmoodi

50 Obtained funding: Tariq Aslam, Konstantinos Balaskas

51 Overall responsibility: Tariq Aslam
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Table 1 – Demographical and Clinical Data

Variable		No. (%)	Range	Mean ± SD
Age			56-95	80±7.4
Gender	Female	179 (59.7%)		
	Male	121 (40.3%)		
Years of education	<10	193 (64.3%)	4-21	10.8±2.5
	≥10	107 (35.7%)		
Relationship status	Single	22 (7.3%)		
	Married	122 (40.7%)		
	Widowed	123 (41%)		
	Cohabited	7 (2.3%)		
	Divorced	36 (8.7%)		
Visual acuity (LogMAR)	Good VA / Mild visual impairment ($\geq 6/18$)	255 (85%)	0.02-1.0	0.6±0.26
	Moderate VA ($6.60 \leq VA < 6/18$)	42 (14%)		
	Poor VA ($< 6/60$)	3 (1%)		
Type of anti-VEGF treatment	Ranibizumab	120 (40%)		
	Aflibercept	175 (58.3%)		
	Bevacizumab	5 (1.6%)		
Elapsed time since the first anti-VEGF injection (Treatment Duration)	≤ 1 Year	84 (28%)	0-96	30.9±24
	> 1 Year	216 (72%)		
Number of injections received to date			1-66	16.6±11.6
Receiving any type of psychiatric or psychological treatment	Yes	13 (4,3%)		
	No	287 (95,7%)		
Symptoms of Clinical Depression (HADS-D)	No symptoms of depression	264 (88%)		
	Symptoms of depression	36 (12%)		
Symptoms of Clinical Anxiety (HADS-A)	No symptoms of anxiety	248 (82.7%)		
	Symptoms of anxiety	52 (17.3%)		
Symptoms of PTS (IES-R)	No symptoms of PTS	297 (99%)		
	Symptoms of PTS	3 (1%)		
Cognitive Impairment	No cognitive impairment	271 (90.3%)		

(MMES)	Mild cognitive impairment	25 (8.3%)		
	Moderate to severe cognitive impairment	4 (1.3%)		
Carers' Perception of Burden (BAS)	Little or no burden (0-20)	73 (73%)	0-55	14.4±13.07
	Mild to moderate burden (21-40)	19 (19%)		
	Moderate to severe burden (41-60)	8 (8%)		
	Severe burden (61-88)	0		

Table 2 Results from Survey about Patient Experiences of Anti-VEGF treatment

Survey Topic	Sub-Topics	No.(%)	
Anxiety related to anti-VEGF Treatment	Anxiety / concerns related to treatment not reported	132 (44%)	
	Anxiety / concerns related to treatment reported	168 (56%)	
Preferences about the treatment	Hospital Visits	Prefer having fewer hospital visits	163 (54.3%)
		Don't mind about the number of hospital visits	137 (45.7%)
	Frequency of Intravitreal Injections	Prefer receiving less frequent injections	174 (58%)
		Don't mind about the frequency of injections	126 (42%)
Expectation of Pain before start the Treatment	No pain expected	128 (42.7%)	
	Pain expected	161 (53.7%)	
Experience of Pain When Receiving an Intravitreal Injection	No painful experience	162 (54%)	
	One or more painful experiences	127 (42.3%)	
Doctor/patient relationship	Understanding of Treatment Options	Good understanding of the different treatment options	192 (64%)
		Poor understanding of the different treatment options	21 (7%)
		Have only been told about one treatment option	87 (29%)
	Making Decisions on the Eye Treatment	Prefer just rely on the doctors for making decisions on the AMD treatment	197 (65.7%)
		Prefer to be more in charge for making decisions on the AMD treatment	8 (2.7%)
		Both (to rely on the doctors and to be in charge for making decisions)	38 (31.7%)
	Contradictory	Have received contradictory	22 (7.3%)

	Information about the Condition and Treatment	information about the diagnosis and treatment	
		Did not have received contradictory information about the diagnosis and treatment	277 (92.3%)
	Satisfaction with the support received from the hospital	Some disappointment	38 (12.7%)
		Not disappointed	262 (87.3%)
	Explanation about treatments and exams	Insufficient	35 (11.7%)
		Good	265 (88.3%)
Perception of carer's burden	The carer has been burdened with hospital visits		44 (14.6%)
	The carer has not been burdened with hospital visits		130 (43.3%)
	Not applicable / no carer		126 (42%)

Table 3 Results from Survey about Patient Concerns and Sources of Anxiety Related to Anti-VEGF Treatment

Concerns / Anxieties Associated with anti-VEGF Treatment	No.(% of total sample)
Fear of going blind due to injections / fear of the needle in the eye	118 (39.3%)
Hope the treatment works properly / Fear of getting worse because the treatment didn't work (treatment effectiveness)	111 (37%)
Waiting in the waiting room / Anticipatory anxiety	104 (34.7%)
Fear of the unknown in relation to treatment outcomes and disease progression	91 (30%)
Anxiety caused by being in the eye hospital for a medical appointment, exam or eye-treatment	52 (17.3%)
Fear of pain when receiving an injection	10 (3.3%)
Fear of side effects	8 (2.6%)

Table 4 – Frequency of Anxiety related to Anti-VEGF Treatment between Sub-Groups of Patients

	G1: Up to 3 injections received (N=21)	G2: From 4 to 12 injections received (N=119)	G3: More than 12 injections received (N=160)	<i>P</i> -value*
Patients who reported anxiety related to treatment (N=168)	14 (66,7%)	64 (53,8%)	90 (56,3%)	.546
Patients who did not report anxiety related to treatment (N=132)	7 (33,3%)	55 (46,2%)	70 (43,8%)	

G: Sub-Group of Patients; *Chi-Square test

Table 5 – HADS scores in Sub-Groups of Patients

	G1: Up to 3 injections received (N=21)	G2: From 4 to 12 injections received (N=119)	G3: More than 12 injections received (N=160)	<i>P</i> -value* between G1-G2	<i>P</i> -value* between G1-G3	<i>P</i> -value* between G2-G3
HADS-Anxiety (±SD)	5.1±3.9	3.8±4.1	3.56±3.51	.34	.19	.83
HADS-Depression (±SD)	5.8±4.5	3.7±3.8	2.9±2.9	.027**	.001**	.11

G: Sub-Group of Patients; VA: Visual Acuity; VI: Visual Impairment

* Univariate ANOVA; ** $P < 0.05$

Table 6 – Frequency of Clinical Levels of Depression between Sub-Groups of Patients

	G1: Up to 3 injections received (N=21)	G2: From 4 to 12 injections received (N=119)	G3: More than 12 injections received (N=160)	P Value*
Patients with Clinical Levels of Depression (HADS-D \geq 8)	7 (33,3%) <i>P</i> =.001**	16 (13,4%) <i>P</i> =.54**	13 (8,1%) <i>P</i> =.03**	.003

* Chi-Square Test before Post-Hoc analysis; ** Chi-Square Post-Hoc Analysis (Adjusted Bonferroni Corrected *P*-value=.008)

Manuscript Title: Experience of Anti-VEGF Treatment and Clinical Levels of Depression and Anxiety in Patients with Wet Age-Related Macular Degeneration

Table of Contents

This mixed-methods study highlights that although anti-VEGF treatments were generally well-accepted by patients with wet AMD, most of them reported particular types of anxiety related to treatment, especially the fear of going blind due to injections. A substantial percentage of wet AMD patients receiving treatment had undiagnosed and untreated clinical anxiety and depression, despite the good visual acuity and the promising outcomes of anti-VEGF treatment. Strategies to improve practice and address patient needs were suggested.

**UNIVERSITY OF MANCHESTER
MANCHESTER ROYAL EYE HOSPITAL
SURVEY FOR POPPIES STUDY**

1. DEMOGRAPHIC AND CLINICAL DATA

Date: ____ / ____ / 2015

Patient's Reference: _____

Gender: F / M

Birth Date: ____ / ____ / _____

Marital Status: _____

Years of Education: _____

Date of AMD Diagnosis: ____ / ____ / _____

Type of Medical Treatment for AMD: _____

AMD Treatment Regimen: Ranibizumab monthly PRN/Ranibizumab treated and extended,
/ First year Aflibercept fixed regimen/ Second year Aflibercept monthly PRN/ Second year Aflibercept
bimonthly PRN / Aflibercept first or second year after Ranibizumab

Date of First Injection for AMD: ____ / ____ / _____

Number of Injections Received to Date _____

Visual Acuity at the Date of this Interview: _____

Pre-Morbid Medical Conditions: _____

Co-morbid Medical Conditions (Present): _____

Premorbid Depression? Yes ____ ; No ____ ; Type of treatment _____

Premorbid Other Psychiatric Conditions? Yes ____ ; No ____ ; If so, specify _____

Comorbid Other Psychiatric Conditions? Yes ____ ; No ____ ; If so, specify _____

Are you receiving psychological / psychotherapeutic treatment? Yes ____ ; No ____

2. QUESTIONS ABOUT THE TREATMENT

1. Do you have any particular anxieties as you wait to be seen in the waiting area?

Not at all ____ ; Yes sometimes ____ ; Yes Frequently ____

2. Do you find the uncertainty of whether you need an injection or not difficult to cope with?

Not at all ____ ; Yes sometimes ____ ; Yes Frequently ____

3. Would you prefer to have slightly fewer hospital visits?

No ____ ; Yes ____ ; No Preference ____

4. If possible, would you be happy with having fewer injections than you currently have?

No ____ ; Yes ____ ; No Preference ____

5. Do you feel you have adequate understanding of the different treatment options available for your eye problem to decide which one would be more appropriate for you?
Yes ____ ; No ____; I was only told about one treatment option _____
6. Do you get anxious when you are asked to make decisions on the treatment for your eyes?
Never ____ ; Sometimes ____ ; Frequently ____; I was never asked to make decisions on the treatment for my condition _____
7. Do you prefer relying more on your doctors for making the decisions for your care or do you prefer being fully in charge of your own care?
I prefer relying more on my doctors ____ ; I prefer being in charge of my own care ____; Both ____
8. Have you experienced receiving contradictory information from the healthcare professionals about the exams or treatments you had to do / or have done?
Never ____ ; Sometimes ____ ; Frequently _____
9. Are you disappointed with the support you have received from the hospital to get information after the treatment, booking new appointments or exams?
Not disappointed _____ ; Disappointed _____ ; A Little Disappointed _____
10. Have you found insufficient explanation about your condition and treatments
Never ____ ; Sometimes ____ ; Frequently _____
11. Have you ever experienced losing control when managing your attendance to medical appointments, treatment sessions, exams, etc.?
Never ____ ; Sometimes ____ ; Frequently _____
12. Have you ever feared for your vision and becoming blind when receiving the treatment?
Never ____ ; Sometimes ____ ; Frequently _____
13. To what extent do you think your carer(s) or accompanying person has been burdened with your hospital visits?
Never _____ ; Sometimes _____ ; Frequently _____; Not Applicable ____
14. Have you experienced some financial problems related to travel to the hospital for a treatment session or a medical appointment?
Never ____ ; Sometimes ____ ; Frequently _____
15. Have you ever experienced pain when receiving injections?
Yes ____ ; No ____; If so please rate - from no pain (0) to the maximum level of pain (10) _____
16. When did you experience more pain?
In the first injection ____ ; In the first injections ____ ; Middle of treatment ____ ; Last one (s) ____
17. Before you start the treatment did you expect more pain when receiving injections than you really experienced?
Yes ____; No ____
18. What is/are your greatest concern(s) / source(s) of anxiety with regard to your treatment?
Please identify _____