Efficacy and Safety of Esketamine Nasal Spray as Monotherapy in Adults with Treatment-Resistant Depression: A Randomized, Double-Blind, Placebo-Controlled Study

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Introduction

- Treatment-resistant depression (TRD) is a chronic condition and is associated with higher rates of relapse, increased mortality, and a greater risk for suicide compared to non-treatment-resistant depression.[1]
- Esketamine (ESK) nasal spray is approved in 75 countries for use in conjunction with an oral antidepressant for TRD but its efficacy as a monotherapy for patients with TRD has not been studied.[2,3]
- Given the suboptimal efficacy of standard of care (SoC) oral antidepressants and their associated side effects in treating many patients with TRD, whether ESK is effective as a monotherapy is an important question that could inform clinical practice.
- This was the first controlled study to assess efficacy and safety of ESK nasal spray as a monotherapy for TRD.

Objectives

- To assess efficacy and safety of 2 fixed doses (56 mg and 84 mg) of ESK nasal spray monotherapy compared with placebo (PBO) in reducing depressive symptoms in adults with TRD.

Methods

Study Participants

Inclusion criteria

- To Adult participants ≥18 years of age
- Recurrent or single (duration ≥2 years) episode of MDD (per DSM-5 criteria), without psychotic features*
- Medically stable
- Nonresponse# (≤25% improvement) to ≥2 oral antidepressants used during the current depressive episode
- IDS-C_{30} total score of ≥34

Exclusion criteria

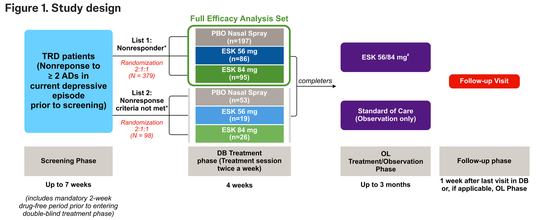
- The participant has used ketamine/ESK (lifetime)
- Previous non-responsiveness to ECT in the current MDD episode (at least 7 treatments with unilateral/bilateral ECT)
- Participant underwent vagal nerve or deep brain stimulation in current depression episode
- Participant with anatomical or medical condition that may impede delivery or absorption of nasal spray study drug
- Homicidal/suicidal ideation/intent within 6 months, or suicidal behavior within the past year pre-screening
- Moderate/severe substance or alcohol use disorder (DSM-5 criteria), except nicotine or caffeine, within 6 months pre-screening

*Based upon clinical assessment and confirmed by the Mini International Neuropsychiatric Interview.
#Nonresponse to oral antidepressants was assessed using MGH-ATRQ.
DSM-5, Diagnostic and Statistical Manual of Mental Disorders (5th edition); ECT, electroconvulsive therapy; ESK, esketamine; IDS-C_{30}, Inventory of Depressive Symptomatology-Clinician rated, 30-item; MDD, major depressive disorder; MGH-ATRQ, Massachusetts General Hospital-Antidepressant Treatment Response Questionnaire.

Study Design

- Phase 4, randomized, double-blind (DB), PBO-controlled, multicenter study (NCT04599855) conducted in the United States. **Figure 1** depicts the study design.

Figure 1. Study design



*Non-response criteria (blinded to study sites): MADRS, total score of ≥ 28 at screening week 1, week 2 and day 1 (pre-randomization) and ≤ 25% improvement in the MADRS total score from screening week 1 to day 1 (pre-randomization). The non-responder criteria were designed to ensure the full efficacy analysis set included only those participants who met the severity criteria throughout screening without notable improvement in depressive symptoms.
#With or without standard of care.
AD, antidepressant; DB, double-blind; ESK, esketamine; MADRS, Montgomery-Asberg Depression Rating Scale; OL, open-label; PBO, placebo; TRD, treatment-resistant depression.

Study Evaluations

- ***Primary efficacy endpoint:*** Change in Montgomery–Åsberg Depression Rating Scale (MADRS) total score from baseline to day 28.
- ***Key secondary endpoint:*** Change in MADRS total score from baseline to day 2 (approximately 24 hours post first dose).
- ***Safety:*** Treatment-emergent adverse events (TEAEs) were monitored throughout the study.

Statistical Analyses

Assessments

- Primary and key secondary endpoints were analyzed using a mixed-effects model with repeated measures and a predefined testing hierarchy to control multiplicity. The model included treatment group, analysis center, antidepressant treatment status (on- or off-treatment) at screening entry, day, and day-by-treatment interaction as fixed terms, and the baseline MADRS total score as a covariate.
- TEAEs were summarized descriptively by treatment group.

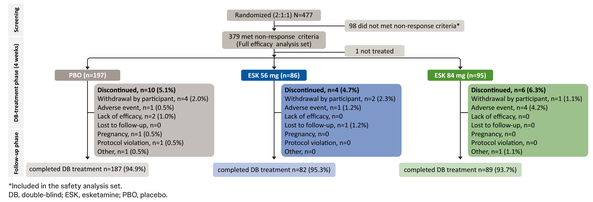
Analysis sets

- Full efficacy analysis set: All randomized participants meeting non-response criteria and who received ≥1 dose of DB study medication.
- Safety analysis set: All randomized participants who received ≥1 dose of DB study medication.

Results

- Total 477 participants were randomized
  - 379 (79.5%) met the non-response criteria: 378 received study medication (ESK: 56 mg: 86; 84 mg: 95; PBO: 197) = full efficacy analysis set.
  - 98 (20.5%) participants did not meet non-response criteria: received study medication and were included in the safety analysis set.
  - Full Efficacy Analysis Set: 358/378 (94.7%) completed the DB treatment (**Figure 2**).

Figure 2. Participant disposition - DB phase (full efficacy analysis set)



*Included in the safety analysis set.
DB, double-blind; ESK, esketamine; PBO, placebo.

- Demographic and baseline characteristics were comparable between the treatment groups (**Table 1**).
  - Most participants were women (231 [61.1%]), mean (SD) age was 45.4 (14.06) years, with 9.8% ≥65 years of age.
  - At baseline, mean IDS-C_{30} score was 45.8; mean MADRS total score was 37.3.

Table 1. Demographics and baseline characteristics (full efficacy analysis set)

	PBO N=197	ESK 56 mg N=86	ESK 84 mg N=95	Total N=378
Age, mean (SD), years	45.2 (13.77)	46.5 (14.18)	44.8 (14.65)	45.4 (14.06)
Women, n (%)	119 (60.4)	51 (59.3)	61 (64.2)	231 (61.1)
Race, n (%)				
White	171 (86.8)	76 (88.4)	81 (85.3)	328 (86.8)
Black or African American	13 (6.6)	4 (4.7)	8 (8.4)	25 (6.6)
Asian	5 (2.5)	2 (2.3)	4 (4.2)	11 (2.9)
Other, multiple, unknown, or not reported	8 (4.1)	4 (4.7)	2 (2.1)	14 (3.7)
AD status at screening / entry, n (%)				
On-treatment	124 (62.9)	59 (68.6)	65 (68.4)	248 (65.6)
Off-treatment	73 (37.1)	27 (31.4)	30 (31.6)	130 (34.4)
Age when diagnosed with MDD, mean (SD), years	25.9 (11.43)	24.5 (10.54)	25.8 (10.73)	25.5 (11.04)
Duration of current depressive episode, mean (SD), weeks	289.0 (325.75)	419.8 (488.38)	406.4 (449.61)	348.3 (403.98)
Number of episodes since diagnosis, n (%)				
1	36 (18.3)	16 (18.6)	25 (26.3)	77 (20.4)
2	34 (17.3)	16 (18.6)	15 (15.8)	65 (17.2)
≥3	127 (64.5)	54 (62.8)	55 (57.9)	236 (62.4)
Baseline MADRS total score, mean (SD)	37.5 (4.90)	37.5 (5.23)	36.6 (4.48)	37.3 (4.88)
Baseline CGI-S score, mean (SD)	4.9 (0.61)	5.0 (0.60)	4.9 (0.65)	4.9 (0.62)
Baseline PHQ-9 total score, mean (SD)	19.8 (4.07)	20.7 (3.43)	19.9 (3.79)	20.0 (3.87)
IDS-C_{30} total score, mean (SD)	46.2 (7.21)	45.8 (7.00)	44.7 (6.90)	45.8 (7.10)
History of suicidal ideation in past 6/12 months, n (%)	105 (53.3)	38 (44.2)	52 (54.7)	195 (51.6)
Number of prior ADs with non-response, n (%)				
2	117 (59.4)	49 (57.0)	58 (61.1)	224 (59.3)
≥3	80 (40.6)	37 (43.0)	37 (38.9)	154 (40.7)

AD, antidepressant; BMI, body mass index; CGI-S, Clinical Global Impression – Severity; ESK, esketamine; IDS-C_{30}, Inventory of Depressive Symptomatology-Clinician rated, 30-item; MADRS, Montgomery-Asberg Depression Rating Scale; MDD, major depressive disorder; PHQ-9, Patient Health Questionnaire 9 item; SD, standard deviation.

Efficacy

Primary endpoint

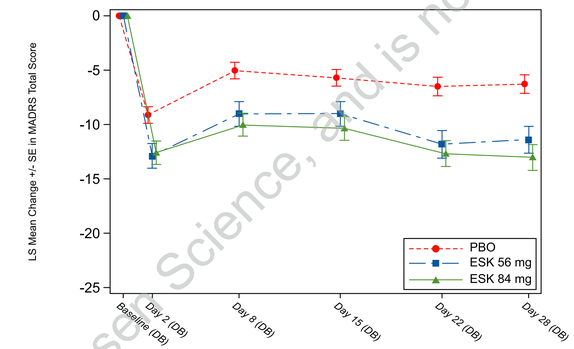
- Mean MADRS total score decreased from baseline to day 28, showing statistically significant and clinically meaningful improvement with individual doses of ESK compared to PBO (2-sided p<0.001). The least-square (LS) mean difference (standard error [SE]) between ESK and PBO was −5.1 (1.42) for 56 mg and −6.8 (1.38) for 84 mg (**Table 2, Figure 3**).

Table 2. MADRS total score: change from baseline (full efficacy analysis set)

	PBO	ESK 56 mg	ESK 84 mg
Baseline (DB)			
N	197	86	95
Mean (SD)	37.5 (4.90)	37.5 (5.23)	36.6 (4.48)
Change from baseline to day 2			
N	195	84	93
Mean (SD)	−9.7 (10.27)	−13.9 (10.15)	−13.0 (9.68)
MMRM analysis			
Diff. of LS means (SE)		**−3.8 (1.29)**	**−3.4 (1.24)**
95% CI on diff		(−6.29; −1.22)	(−5.89; −1.00)
2-sided p-value		0.004	0.006
Change from baseline to day 28			
N	185	82	89
Mean (SD)	−7.0 (10.07)	−12.7 (11.82)	−13.9 (11.89)
MMRM analysis			
Diff. of LS means (SE)		**−5.1 (1.42)**	**−6.8 (1.38)**
95% CI on diff		(−7.91; −2.33)	(−9.48; −4.07)
2-sided p-value		<0.001	<0.001

Note: MADRS total score ranges from 0 to 60; a higher score indicates a more severe condition.
Note: Negative change in score indicates improvement.
CI, confidence interval; DB, double-blind; ESK, esketamine; LS, least square; MADRS, Montgomery-Asberg Depression Rating Scale; MMRM, mixed model for repeated measures; PBO, placebo; SD, standard deviation; SE, standard error.

Figure 3. MADRS total score: LS mean change (± SE) over time in the DB phase - MMRM observed case (full efficacy analysis set)



DB, double-blind; ESK, esketamine; LS, least squares; MADRS, Montgomery-Asberg Depression Rating Scale; MMRM, mixed model for repeated measures; PBO, placebo; SE, standard error.

Key secondary endpoint

- Significantly greater improvement was seen in the ESK 56 mg group (2-sided p=0.004) and ESK 84 mg group (2-sided p=0.006) compared to PBO. On day 2, LS mean difference (SE) between ESK, and PBO was −3.8 (1.29) for 56 mg and −3.4 (1.24) for 84 mg (**Table 2**).

Safety

- Overall, 72.4% participants in the ESK 56 mg group, 75.2% participants in the ESK 84 mg group (combined ESK: 73.9%), and (49.2%) participants in the PBO group experienced ≥1 TEAE during the DB phase; the majority of TEAEs were transient.
- The most common (>10%) TEAEs during the DB phase in combined ESK group vs PBO were nausea (24.8% vs 8.4%), dissociation (24.3% vs 2.8%), dizziness (21.7% vs 7.2%), and headache (19.0% vs 8.8%) (**Table 3**).
- Serious TEAEs were reported in 6 participants in the DB phase: ESK 56 mg: ankle fracture (n=1); ESK 84 mg: ophthalmic migraine and suicide attempt (n=1 each); PBO: self-injurious ideation, suicidal ideation, and acute myocardial infarction (n=1 each). None of these, except for acute myocardial infarction in the PBO group, were considered related to the study medication. No deaths were reported in either the DB or open-label phase.

Table 3. Most frequently reported TEAEs* in the DB treatment phase (safety analysis set)

TEAE	PBO, n (%) N=250	ESK, n (%) 56 mg N=105	ESK, n (%) 84 mg N=121	ESK, n (%) Combined N=226
Nausea	21 (8.4)	24 (22.9)	32 (26.4)	56 (24.8)
Dissociation	7 (2.8)	23 (21.9)	32 (26.4)	55 (24.3)
Dizziness	18 (7.2)	22 (21.0)	27 (22.3)	49 (21.7)
Headache	22 (8.8)	19 (18.1)	24 (19.8)	43 (19.0)
Feeling drunk	2 (0.8)	8 (7.6)	8 (6.6)	16 (7.1)
Anxiety	3 (1.2)	5 (4.8)	10 (8.3)	15 (6.6)
Fatigue	11 (4.4)	8 (7.6)	7 (5.8)	15 (6.6)
Vomiting	1 (0.4)	5 (4.8)	10 (8.3)	15 (6.6)
Insomnia	9 (3.6)	6 (5.7)	5 (4.1)	11 (4.9)
Somnolence	4 (1.6)	6 (5.7)	3 (2.5)	9 (4.0)

*Incidence ≥5% in either treatment group.
Note: TEAEs listed in decreasing order based on incidence within the combined esketamine group, and in alphabetical order for events with the same incidence.
DB, double-blind; ESK, esketamine; PBO, placebo; TEAE, treatment-emergent adverse event.

Conclusions

- The study met primary and key secondary efficacy objectives.
- In patients with TRD, Esketamine (56 mg and 84 mg) as monotherapy showed statistically significant and clinically meaningful improvement in depressive symptoms compared to placebo after 4 weeks of treatment (primary endpoint), and as early as Day 2 (approximately 24 hours post first dose: key secondary endpoint).
- The safety profile of Esketamine as monotherapy was consistent with the well-established safety profile of Esketamine from prior adjunctive treatment studies.
- These results provide important new data to inform clinicians on treatment regimens for patients with TRD receiving Esketamine.

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Disclosures

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