Poster 73

Corticosteroid toxicity and related healthcare resource utilization in patients with myasthenia gravis in the USA

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INTRODUCTION

- Myasthenia gravis (MG) is an autoimmune neuromuscular disorder characterized by fatigable muscle weakness[1,2]
- Corticosteroids are frequently prescribed to patients with MG, despite the significant adverse effects associated with corticosteroids, particularly with long-term and high-dose use[3]
- In a real-world study of patients with MG in the USA, cumulative corticosteroid doses as low as 1000 mg were associated with higher steroid toxicity as demonstrated by[4]:
  - Increasing prevalence of steroid-related adverse effects
  - Increasing **cumulative worsening scores (CWS)** and **aggregate improvement scores (AIS)** on the Glucocorticoid Toxicity Index-Metabolic Domains (GTI-MD)
- The dose-dependent effect of corticosteroid-induced toxicity on healthcare resource utilization and cost have not been well studied in patients with MG

OBJECTIVE

- The objective of this study was to assess the association of corticosteroid-induced toxicity with healthcare resource utilization in a real-world cohort of adults with MG

CONCLUSIONS

- This large retrospective analysis demonstrated that patients with MG with high corticosteroid toxicity had higher healthcare resource utilization and higher associated costs than patients with MG without corticosteroid toxicity.
- Similarly, patients who received high corticosteroid doses had higher healthcare resource utilization and higher associated costs than patients who did not receive corticosteroids

METHODS

Study design and eligibility criteria

- This retrospective cohort study of data from patients with generalized MG (gMG) treated with corticosteroids used data linkage and a multipayer claims database and electronic health records (CHRONOS; Forian Inc.) from January 1, 2016, to September 30, 2024
- All eligible participants were corticosteroid naive at baseline
  - Eligible participants included in the steroid toxicity analysis additionally had at least one post-baseline CWS on the GTI-MD (Steritas) obtained at least 6 months after the initial MG claim[5]
  - The GTI-MD instrument objectively quantifies the total burden of corticosteroid toxicity and adverse effects in patients with MG[4]
  - CWS is a measure of total toxicity, whether permanent or transient, from baseline[6]
- Steroids included prednisone and methylprednisolone. Patients receiving biologics were excluded
- The study period was within 24 months of index date (date of first corticosteroid pharmacy claim); the index date for non–corticosteroid users was 18 months after MG diagnosis

Outcomes assessed

- Healthcare resource utilization outcomes and associated costs were assessed as per-patient per-year (PPPY) rates
- Incidence rate ratios were calculated for each outcome, with the lowest risk buckets for cumulative corticosteroid dose and CWS, which are 0 mg and 0–9, respectively

Statistical analysis

- Mixed effects regression models with repeated measures were used to evaluate the dose-response relationship between cumulative corticosteroid dose, cumulative corticosteroid toxicity, and healthcare resource utilization after 2 years

RESULTS

Patients

- Data from 38,034 patients were included in the corticosteroid dosage analysis, with 549 patients also having a CWS score at 24 months (**Figure 1**; **Tables 1** and **2**)

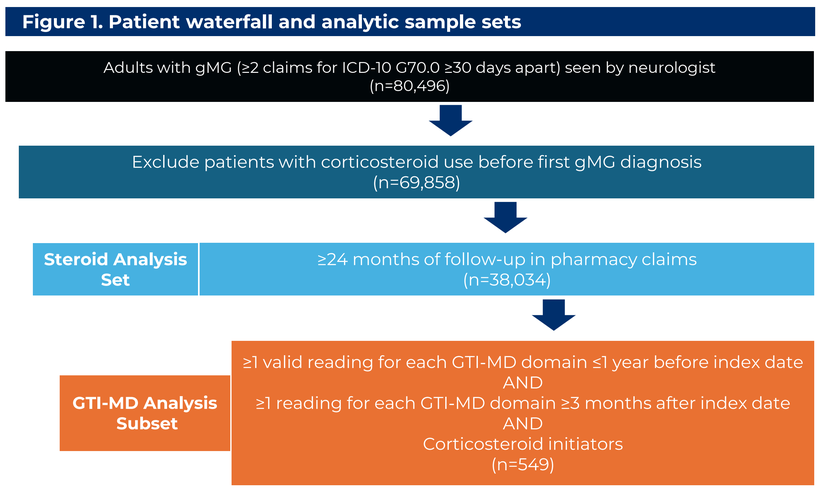
Healthcare Resource Utilization

- Compared with patients with the lowest CWS (0–9), patients with the highest CWS (≥75) had 2.07 times more emergency department (ED) visits, 3.06 times more non-gMG hospitalizations, 1.80 times more non-gMG intensive care unit (ICU) admissions, 2.95 times more outpatient hospital visits, 1.61 times more outpatient office visits, 3.85 times more pharmacy prescriptions, and 3.99 times more skilled nursing facility visits (**Table 3**)
- Compared with patients who did not receive corticosteroids, patients who received the highest doses of corticosteroids (≥20,000 mg) had 2.44 times more ED visits, 1.85 times more non-MG hospitalizations, 1.70 times more non-MG ICU admissions, 2.24 times more outpatient hospital visits, 1.52 times more outpatient office visits, 6.95 times more pharmacy prescriptions, and 1.81 times more skilled nursing facility visits (**Table 4**)
- Sepsis was the most common non-gMG reason for hospitalization among patients who received no corticosteroids and across all corticosteroid doses (**Supplemental Table 1**)

Costs Associated With Healthcare Resource Utilization

- Increasing costs of all types of inpatient and outpatient visits were associated with increasing CWS and increasing corticosteroid dose (**Figure 2**)
  - The total PPPY cost of care for patients with the highest CWS (≥75) was 5.56 times more than that for patients who had the lowest CWS (0–9; **Supplemental Table 2**)
  - The total PPPY cost of care for patients who received corticosteroid doses of ≥20,000 mg was 3.22 times more than that for patients who did not receive corticosteroids (**Supplemental Table 3**)

Figure 1. Patient waterfall and analytic sample sets



gMG, generalized myasthenia gravis; GTI-MD, Glucocorticoid Toxicity Index–Metabolic Domain; ICD-10, International Classification of Disease, 10th revision.

Table 1. Overall patients by corticosteroid dosage (n=38,034)

Dosage	Patients, n (%)
<1000 mg	7509 (19.7)
1000 to 4999 mg	5133 (13.5)
5000 to 9999 mg	2820 (7.4)
10,000 to 19,999 mg	2242 (5.9)
≥20,000 mg	898 (2.4)
No corticosteroids	**19,432 (51.1)**

CWS, cumulative worsening score.

Table 2. Patients by CWS (n=549)

CWS	Patients, n (%)
0 to 9	146 (26.6)
10 to 29	195 (35.5)
30 to 49	78 (14.2)
50 to 74	76 (13.8)
≥75	54 (9.8)

CWS, cumulative worsening score.

Table 3. HCRU by CWS

Encounters		Cumulative Worsening Score			
		10–29	30–49	50–74	≥75
		n=195	n=78	n=76	n=54
Emergency department	***IRR***	**1.22**	**1.77**	**1.23**	**2.07**
	95% CI	(0.99, 1.50)	(1.40, 2.23)	(0.95, 1.60)	(1.62, 2.65)
	P value	0.061	<0.001	0.116	<0.001
Non-gMG hospital	***IRR***	**1.55**	**1.87**	**2.31**	**3.06**
	95% CI	(0.84, 2.87)	(0.92, 3.83)	(1.16, 4.57)	(1.53, 6.14)
	P value	0.165	0.086	0.017	0.002
Non-gMG ICU	***IRR***	**1.74**	**3.74**	**2.56**	**1.80**
	95% CI	(0.45, 6.76)	(0.94, 14.97)	(0.57, 11.45)	(0.30, 10.78)
	P value	0.452	0.936	0.573	0.301
Outpatient[a] hospital	***IRR***	**1.17**	**1.20**	**1.41**	**2.95**
	95% CI	(1.06, 1.29)	(1.06, 1.36)	(1.25, 1.59)	(2.65, 3.29)
	P value	0.003	0.005	<0.001	<0.001
Outpatient[a] office	***IRR***	**1.16**	**1.05**	**1.34**	**1.61**
	95% CI	(1.11, 1.21)	(0.99, 1.11)	(1.27, 1.41)	(1.53, 1.70)
	P value	<0.001	0.083	<0.001	<0.001
Pharmacy	***IRR***	**1.35**	**1.82**	**1.85**	**3.85**
	95% CI	(1.31, 1.39)	(1.76, 1.89)	(1.78, 1.91)	(3.72, 3.97)
	P value	<0.001	<0.001	<0.001	<0.001
Skilled nursing facility	***IRR***	**1.36**	**1.14**	**1.92**	**3.99**
	95% CI	(1.16, 1.59)	(0.92, 1.40)	(1.61, 2.30)	(3.39, 4.71)
	P value	<0.001	0.227	<0.001	<0.001

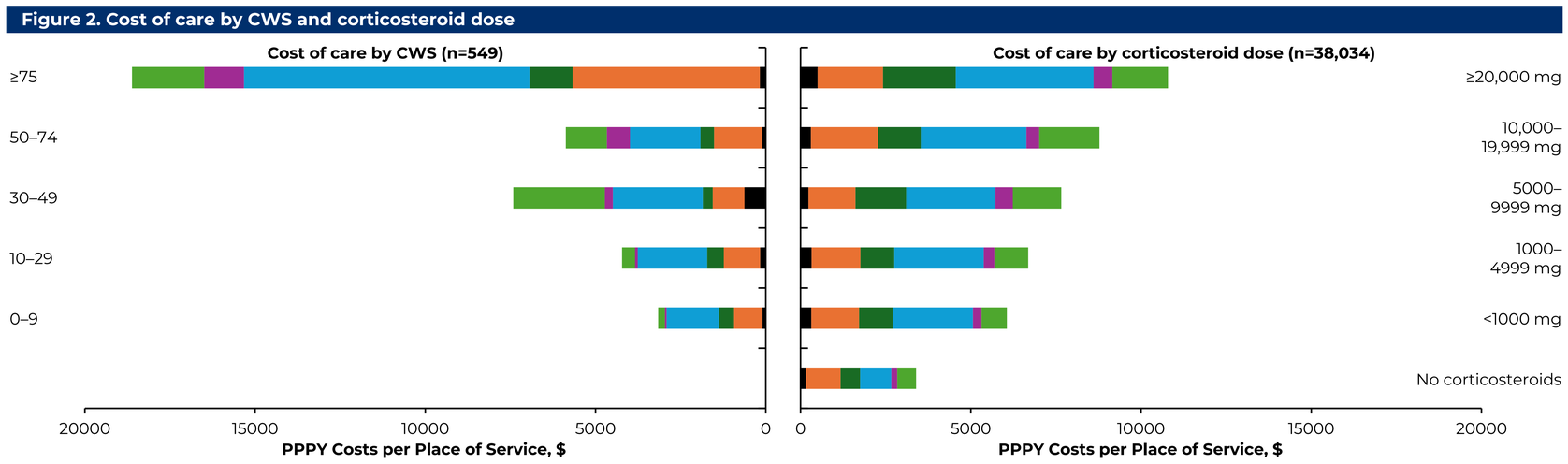
Reference group is CWS=0–9; n=146.
IRRs, 95% CIs, and *P* values were generated using negative binomial mixed effects regression models with repeated measures; models were adjusted for age, sex, and payer type.
[a]Outpatient status was determined by the place of service for professional claims or type of billing for institutional claims.
CI, confidence interval; CWS, cumulative worsening score; gMG, generalized myasthenia gravis; HCRU, healthcare resource utilization; ICU, intensive care unit; IRR, incidence rate ratio.

Table 4. HCRU by corticosteroid dose

Encounters		Corticosteroid Dose				
		<1000 mg	1000–4999 mg	5000–9999 mg	10,000–19,999 mg	≥20,000 mg
		n=7509	n=5133	n=2820	n=2242	n=898
Emergency department	***IRR***	**1.33**	**1.46**	**1.35**	**1.63**	**2.44**
	95% CI	(1.30, 1.35)	(1.43, 1.50)	(1.32, 1.39)	(1.58, 1.67)	(2.36, 2.53)
	P value	<0.001	<0.001	<0.001	<0.001	<0.001
Non-gMG hospital	***IRR***	**1.12**	**1.26**	**1.32**	**1.44**	**1.85**
	95% CI	(1.05, 1.19)	(1.18, 1.35)	(1.21, 1.43)	(1.32, 1.58)	(1.64, 2.08)
	P value	<0.001	<0.001	<0.001	<0.001	<0.001
Non-gMG ICU	***IRR***	**1.04**	**1.28**	**1.45**	**1.74**	**1.70**
	95% CI	(0.92, 1.18)	(1.12, 1.45)	(1.24, 1.70)	(1.49, 2.04)	(1.33, 2.16)
	P value	0.519	<0.001	<0.001	<0.001	<0.001
Outpatient[a] hospital	***IRR***	**1.23**	**1.42**	**1.41**	**1.80**	**2.24**
	95% CI	(1.21, 1.24)	(1.40, 1.43)	(1.40, 1.43)	(1.78, 1.83)	(2.20, 2.28)
	P value	<0.001	<0.001	<0.001	<0.001	<0.001
Outpatient[a] office	***IRR***	**1.29**	**1.28**	**1.28**	**1.37**	**1.52**
	95% CI	(1.28, 1.29)	(1.27, 1.29)	(1.27, 1.29)	(1.36, 1.38)	(1.50, 1.54)
	P value	<0.001	<0.001	<0.001	<0.001	<0.001
Pharmacy	***IRR***	**3.91**	**4.46**	**5.09**	**6.05**	**6.95**
	95% CI	(3.90, 3.93)	(4.44, 4.48)	(5.06, 5.11)	(6.02, 6.08)	(6.91, 6.99)
	P value	<0.001	<0.001	<0.001	<0.001	<0.001
Skilled nursing facility	***IRR***	**1.07**	**1.30**	**1.37**	**1.62**	**1.81**
	95% CI	(1.06, 1.08)	(1.28, 1.32)	(1.35, 1.40)	(1.59, 1.66)	(1.76, 1.86)
	P value	<0.001	<0.001	<0.001	<0.001	<0.001

Reference group is cumulative corticosteroid dose=0 mg; n=19,432.
IRRs, 95% CI, and *P* values were generated using negative binomial mixed effects regression models with repeated measures; models were adjusted for age, sex, and payer type.
[a]Outpatient status was determined by the place of service for professional claims or type of billing for institutional claims.
CI, confidence interval; CWS, cumulative worsening score; gMG, generalized myasthenia gravis; HCRU, healthcare resource utilization; ICU, intensive care unit; IRR, incidence rate ratio.

Figure 2. Cost of care by CWS and corticosteroid dose



	Emergency department	Outpatient[a] office	Outpatient[a] hospital	Pharmacy	Inpatient (non-gMG)	Inpatient (all cause)
0–9	97.57	834.98	452.61	1529.40	50.06	197.32
10–29	167.21	1067.08	487.44	2040.31	78.82	380.89
30–49	627.47	931.16	292.89	2639.27	236.51	2688.15
50–74	100.72	1420.55	396.72	2071.96	677.84	1206.48
≥75	174.67	5500.95	1264.90	8385.83	1169.37	2118.17

[a]Outpatient status was determined by the place of service for professional claims or type of billing for institutional claims.
CWS, cumulative worsening score; gMG, generalized myasthenia gravis; PPPY, per patient per year

	Emergency department	Outpatient[a] office	Outpatient[a] hospital	Pharmacy	Inpatient (non-gMG)	Inpatient (all cause)
No corticosteroids	161.13	1014.87	575.24	916.34	174.56	551.05
<1000 mg	315.24	1405.43	988.42	2352.67	252.73	746.09
1000–4999 mg	325.03	1434.52	994.68	2626.15	313.53	993.81
5000–9999 mg	231.84	1382.73	1487.08	2621.27	512.18	1422.98
10,000–19,999 mg	304.38	1970.31	1256.35	3102.32	377.05	1769.52
≥20,000 mg	502.46	1918.67	2140.15	4044.03	554.37	1633.38

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Disclosures

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SUPPLEMENTAL INFORMATION

Supplemental Table 1. Reasons for hospitalization by corticosteroid dose

Admission diagnosis	Description	No steroids	<1000 mg	1000–4999 mg	5000–9999 mg	10,000–19,999 mg	≥20,000 mg
A419	Sepsis, unspecified organism	10.2%	9.5%	11.3%	14.9%	18.6%	20.6%
R531	Weakness	5.0%	4.8%	5.4%	5.3%	4.1%	10.3%
R0602	Shortness of breath	6.5%	6.4%	10.3%	5.3%	6.7%	8.2%
J189	Pneumonia, unspecified organism	4.3%	4.9%	5.7%	6.6%	6.2%	5.2%
R079	Chest pain, unspecified	4.9%	3.7%	3.2%	4.4%	4.6%	5.2%
R509	Fever, unspecified	2.8%	2.7%	3.2%	2.6%	3.1%	5.2%
J9601	Acute respiratory failure with hypoxia	1.3%	1.8%	2.5%	3.9%	2.1%	4.1%
K5720	Diverticulitis of large intestine with perforation and abscess without bleeding	0.8%	0.5%	1.5%	1.3%	1.0%	4.1%

Supplemental Table 2. IRR for cost of care by CWS

IRR for PPPY cost of care compared with 0–9 CWS					
	0–9	10–29	30–49	50–74	≥75
Emergency department	Ref.	1.71	6.43	1.03	1.79
Outpatient[a] hospital	Ref.	1.08	0.65	0.88	2.79
Outpatient[a] office	Ref.	1.28	1.12	1.70	6.59
Pharmacy	Ref.	1.33	1.73	1.35	5.48
Inpatient (non-gMG)	Ref.	1.57	4.72	13.54	23.36
Inpatient (all cause)	Ref.	1.93	13.62	6.11	10.73
Total cost of care	Ref.	1.30	1.59	1.57	5.56

[a]Outpatient status was determined by the place of service for professional claims or type of billing for institutional claims.
CWS, cumulative worsening score; gMG, generalized myasthenia gravis; IRR, incidence ratio rate; PPPY, per patient per year; Ref., reference.

Supplemental Table 3. IRR for cost of care by corticosteroid dose

IRR for PPPY cost of care compared with no corticosteroids						
	No steroids	<1000 mg	1000–4999 mg	5000–9999 mg	10000–19,999 mg	≥20,000 mg
Emergency department	Ref.	1.96	2.02	1.44	1.89	3.12
Outpatient[a] hospital	Ref.	1.72	1.73	2.59	2.18	3.72
Outpatient[a] office	Ref.	1.38	1.41	1.36	1.94	1.89
Pharmacy	Ref.	2.57	2.87	2.86	3.39	4.41
Inpatient (non-gMG)	Ref.	1.45	1.80	2.93	2.16	3.18
Inpatient (all cause)	Ref.	1.35	1.80	2.58	3.21	2.96
Total cost of care	Ref.	1.86	2.00	2.20	2.47	3.22

[a]Outpatient status was determined by the place of service for professional claims or type of billing for institutional claims.
CWS, cumulative worsening score; gMG, generalized myasthenia gravis; IRR, incidence ratio rate; PPPY, per patient per year; Ref., reference.

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