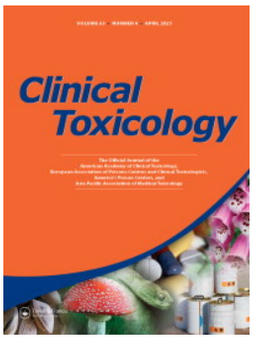

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CLINICAL RESEARCH

Analysis of clinical challenges and prognostic risk factors for 195 cases of iatrogenic botulism in China

Yaqing An[a], Baopu Lv[a], Tuokang Zheng[a], Yu Gong[a], Jianhang Hou[a], Heyule Tian[a], Fangyu Chen[a], Bokai Wei[a], Jiajia Lu[a], Yiming Yun[a], Penglong Yang[a], Muchao Zhang[a], Zeqing Hu[b], Yang Wu[c], Hengbo Gao[a], Yingping Tian[a] and Dongqi Yao[a]

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ABSTRACT

Introduction: Improper use of botulinum neurotoxin may result in poisoning. This study aimed to investigate the causes, characteristics, and risk factors of iatrogenic botulism incidents in China.

Methods: Patients diagnosed with iatrogenic botulism who presented to the emergency department of the Second Hospital of Hebei Medical University between June and July 2024 were included. We assessed baseline demographics, clinical symptoms, disease grade, and botulinum toxin type A-related variables. Multivariate regression analysis was used to identify independent risk factors influencing the 30-day prognosis.

Results: A total of 195 patients were included in the study, with a median age of 38 years (IQR: 33–47 years) and a male-to-female ratio of 1:38. Blurred vision was the most common early feature (82.1%), followed by dizziness and ptosis (75.9%), fatigue (65.1%), and dysarthria (63.1%). The most frequently observed complications were acute gastroenteritis (9.7%), followed by aspiration pneumonia (7.2%). Fifty-one patients experienced severe poisoning with early ocular, facial, limb muscle, and respiratory muscle involvement. Thirty-two patients (16.4%) required mechanical ventilation. The median latent period was 3 days (IQR: 2–4 days), with a median interval of 7 h (IQR: 4–10 h) observed between symptom onset and antitoxin administration. The median duration of hospitalization was 6 days (IQR: 4–8 days). Adverse reactions to the antitoxin included serum sickness in 11 patients and allergic reactions in 20 patients. Based on the presence or absence of clinical signs 30 days post-discharge, we categorized the cohort into good and poor prognostic groups; 87 patients (44.6%) had a poor prognosis. Independent risk factors for a poor prognosis included a latent period ≤3 days, increased time from onset of features to antitoxin treatment, longer hospital duration, disease severity, and need for mechanical ventilation.

Discussion: Iatrogenic botulism frequently leads to severe outcomes due to delayed diagnosis and intervention. We identified a disease severity grading system alongside additional risk factors to predict patient prognosis.

Conclusion: Our study underscores the critical importance of early recognition and timely treatment of iatrogenic botulism. Clinicians should implement prompt treatment to mitigate disease progression.

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Botulism; causes of poisoning; characteristics of poisoning; prognosis; risk factors

Introduction

Botulism toxin is a neurotoxin produced by *Clostridium botulinum* in strictly anaerobic conditions. It is highly toxic and classified as a Class A biological threat agent, posing a significant risk to human health. Botulism toxin is categorized into nine distinct antigenic types: A, B, C, D, E, F, G, H, and X [1]. Botulism toxin began its transformative application in medical aesthetics nearly 140 years after Dr Justinus Kerner's seminal discovery of botulism toxin in spoiled sausage [2]. In 1992, Carruthers and Carruthers [3] first reported the cosmetic application of botulism toxin type A in the medical literature. Subsequently, botulism toxin type B has also been reported for use in the treatment of spasmodic torticollis. Currently, botulism toxin types A and B are the primary variants approved for clinical applications. Botulism toxin type A is particularly favoured due to its high potency and favourable safety profile, making it the primary choice for wrinkle removal globally. In 2002, the United States Food and Drug Administration formally approved botulinum toxin for cosmetic purposes. Botulinum toxin was introduced into China in 2009, accompanied by the establishment of specific regulations by the government and medical institutions governing the source, transportation, storage, and clinical utilization. In particular, the use of botulinum toxin must be carried out by medical personnel who are qualified to inject the substance.

While individuals benefit from the therapeutic effects of botulism toxin, its improper use presents considerable risks

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of poisoning. With the commercialization of botulism toxin, incidents of illegal use have progressively emerged, accompanied by a corresponding increase in reported cases of botulism toxin type A poisoning. In 2004, the United States Centers for Disease Control and Prevention reported the first four laboratory-confirmed cases of botulism associated with botulism toxin type A injections [4]. Since then, other researchers have documented sporadic incidents [4–6]. By March 2023, 87 poisoning cases attributed to excessive use of botulism toxin type A for weight loss had been reported from Europe [7].

With the growing demand for medical aesthetics in China, iatrogenic botulism cases have surged, affecting an expanding population and demonstrating extensive geographic dispersion, thereby presenting formidable challenges to regulatory authorities.

This study aims to explore the causes, characteristics, and risk factors of iatrogenic botulism incidents in China, thereby increasing the vigilance of clinicians generally toward such patients and providing data-driven support for relevant regulatory bodies.

Methods

This retrospective study was conducted from June to July 2024 at the Second Hospital of Hebei Medical University in China. A total of 195 patients were included. Inclusion criteria included a history of botulinum toxin type A injection and clinical manifestations. Excluded were those other routes of botulism, clear intracranial lesions, peripheral neuropathy from other causes, incomplete medical records, and loss to follow-up.

Data collection was initiated using a pre-designed questionnaire administered to patients, accompanying individuals, and other informants (Supplementary Table 1). The questionnaire covered demographic characteristics (age, gender, place of residence, education level), detailed variables related to botulism toxin type A injections (brands, institutions, dosages, number of injections, injection time, onset time), and antitoxin treatment time. Clinical manifestations were meticulously documented. Laboratory parameters from peripheral blood samples were analyzed within 24 h of admission. Electromyography of the zygomatic branch of the facial nerve was performed and recorded. Complications associated with poisoning and antitoxin treatment were also recorded. The clinical treatment process was comprehensively documented by the medical staff of the emergency department.

Upon arrival at the emergency department, the severity of iatrogenic botulism was assessed using a clinical grading system. Patients were classified into three grades according to the severity of clinical manifestations.

Grade I: subjective symptoms consistent with botulism (e.g., dizziness, fatigue, headache) without objective muscle damage.

Grade II: subjective symptoms with early muscular involvement (ocular, facial, or limb muscles) but without respiratory muscle involvement.

Grade III: severe cases with respiratory muscle involvement, building on Grade II criteria.

We consider this grading system crucial for identifying severely poisoned patients requiring immediate intensive care unit admission (Supplementary Table 2).

Statistical analyses

The SPSS 23.0 statistical software was used for the analysis. Normal data are presented as mean and standard deviation (SD), and non-normally distributed data are presented as median (IQR). Categorical variables were expressed as frequency counts. The Fisher's exact test was employed to evaluate the association between categorical variables, while continuous variables were analyzed using either the Mann–Whitney U-test or the *t*-test. Multivariate regression analysis was performed to determine significant predictors of the outcomes. A *P* value of less than 0.05 was considered statistically significant.

Results

Table 1 summarizes the socio-demographic and laboratory characteristics of patients in this study. The median age of the patients was 38 years (IQR: 33–47 years). There were 190 females (97.4%), with a male-to-female ratio of 1:38. Urban residents constituted 50.3% of the total patient group, and rural residents the remainder. The ratio of subsequent to first-time exposures was approximately 4:1. Non-authorized

Table 1. Socio-demographic data and laboratory investigations.

Variables	Patients (*n* = 195)
Sex	
Male, *n* (%)	5 (2.6)
Female, *n* (%)	190 (97.4)
Age (years), median (IQR)	38 (33–47)
Residence	
Urban, *n* (%)	98 (50.3)
Rural, *n* (%)	97 (49.7)
Number of injections	
First-time injection, *n* (%)	40 (20.5)
Subsequent injections, *n* (%)	155 (79.5)
Product brand	
Licensed, *n* (%)	59 (30.3)
Unlicensed, *n* (%)	32 (16.4)
Unknown, *n* (%)	104
Institution	
Authorized institution, *n* (%)	25 (12.8)
Non-authorized institution, *n* (%)	170 (87.2)
White blood cell count ($\times 10^9$/L), median (IQR)	6.1 (5.0-7.7)
Haemoglobin concentration (g/L), mean ± SD	128.8 ± 13.4
Platelet count ($\times 10^9$/L), mean ± SD	228.3 ± 61.0
Aspartate aminotransferase activity (IU/L), median (IQR)	33.6 (24.8–48.9)
Alanine aminotransferase activity (IU/L), median (IQR)	29.0 (22.6–36.5)
Activated partial thromboplastin time (sec), mean ± SD	29.0 ± 3.4
Fibrinogen concentration (g/L), mean ± SD	2.93 ± 0.67
PaO_2 (mmHg [kPa]), median (IQR)	99.4 (83.5–140) [13.2 (11.1–18.6)]
$PaCO_2$ (mmHg [kPa]), median (IQR)	36.1 (33.1–40.1) [4.8 (4.4–5.3)]
Duration of hospital stay (days), median (IQR)	6 (4–8)
Latent period (days), median (IQR)	3.0 (2.0–4.0)
Duration from onset of illness to administration of antitoxin (h), median (IQR)	7.0 (4.0–10.0)

Table 2. Comparison between studied cases according to injection institution.

Variables	Non-authorized institution ($n=170$)	Authorized institution ($n=25$)	P value
Sex			>0.05
Males, *n* (%)	5 (2.9)	0	
Females, *n* (%)	165 (97.1)	25 (100.0)	
Age (years)			>0.05
≤20 years, *n* (%)	9 (5.3)	3 (12.0)	
>20 - <40 years, *n* (%)	88 (51.8)	12 (48.0)	
≥40 years, *n* (%)	73 (42.9)	10 (40.0)	
Number of injections			>0.05
First-time injection, *n* (%)	34 (20.0)	6 (24.0)	
Subsequent injections, *n* (%)	136 (80.0)	19 (76.0)	
Product brand			0.014
Unlicensed, *n* (%)	30 (17.6)	2 (8.0)	
Licensed, *n* (%)	45 (26.5)	14 (56.0)	
Unknown, *n* (%)	95	9	
Residence			<0.000
Urban, *n* (%)	75 (44.1)	23 (92.0)	
Rural, *n* (%)	95 (55.9)	2 (8.0)	
Educational level			0.024
Junior high school or below, *n* (%)	108 (63.5)	10 (40.0)	
High school, *n* (%)	39 (22.9)	6 (24.0)	
University or higher, *n* (%)	23 (13.5)	9 (36.0)	
Need for mechanical ventilation			>0.05
Yes, *n* (%)	29 (17.1)	3 (12.0)	
No, *n* (%)	141 (82.9)	22 (88.0)	
Cumulative dose of botulinum toxin (IU), median (IQR)	100 (100–200)	100 (80–200)	>0.05
Latent period (days), median (IQR)	3.0 (2.0–4.0)	3.0 (1.5-6.5)	>0.05

Table 3. Clinical characteristics and prognosis of the patients.

Variables	Patients ($n=195$)
Severity of poisoning	
Grade I, *n* (%)	42 (21.5)
Grade II, *n* (%)	102 (52.3)
Grade III, *n* (%)	51 (26.2)
Latent period (days)	
≤3 days, *n* (%)	94 (48.2)
>3 days, *n* (%)	101 (51.8)
Common clinical manifestations at presentation	
Dizziness, *n* (%)	148 (75.9)
Fatigue, *n* (%)	127 (65.1)
Blurred vision, *n* (%)	160 (82.1)
Ptosis, *n* (%)	148 (75.9)
Dysarthria, *n* (%)	123 (63.1)
Facial numbness, *n* (%)	30 (15.4)
Dysphagia, *n* (%)	25 (12.8)
Chest tightness, *n* (%)	46 (23.5)
Shortness of breath, *n* (%)	22 (11.2)
Nausea and vomiting, *n* (%)	85 (43.6)
Diarrhoea, *n* (%)	42 (21.4)
Abdominal distension, *n* (%)	31 (15.8)
Fever, *n* (%)	27 (13.8)
Complications	
Aspiration pneumonia, *n* (%)	14 (7.2)
Acute gastroenteritis, *n* (%)	19 (9.7)
Venous thrombosis, *n* (%)	5 (2.6)
Urinary incontinence, *n* (%)	3 (1.5)
Intestinal obstruction, *n* (%)	6 (3.1)
Cumulative dose of antitoxin ($\times 10^4$ IU), median (IQR)	6.0 (4.0–10.0)
Need for mechanical ventilation, *n* (%)	32 (16.4)
Adverse reactions to antitoxin	
Serum sickness, *n* (%)	11 (5.6)
Allergic reaction, *n* (%)	20 (10.3)
Other, *n* (%)	24 (12.3)
30 day outcome	
Good prognosis, *n* (%)	108 (55.4)
Poor prognosis, *n* (%)	87 (44.6)

institutions were the most common, with 170 cases, representing 87.2% of the total. The median time from exposure to onset was 3.0 days (IQR: 2.0–4.0 days). The median time from symptom onset to antitoxin administration was 7.0 h (IQR: 4.0–10.0 h), and the median duration of hospitalization was 6.0 days (IQR: 4.0–8.0 days).

Table 2 presents a comparison of poisoning patients who have previously sought treatment at non-authorized institutions versus authorized institutions. Compared to patients admitted to non-authorized institutions, those treated at authorized institutions demonstrated a significantly higher prevalence of using certified products. Furthermore, individuals living in urban areas exhibit a markedly higher propensity for undergoing cosmetic treatments at authorized institutions compared to those in rural regions. Those with a junior high school education or lower often prefer non-authorized institutions for cosmetic treatments, in contrast to individuals with a university degree or higher.

Table 3 summarizes the clinical characteristics and prognosis of the patients. Only 51 patients (26.2%) were classified as Grade III and 51.8% of patients had a latent period of >3 days. Blurred vision was the most common early clinical symptom (82.1%), followed by dizziness and ptosis (75.9%), fatigue (65.1%), and dysarthria (63.1%). The most frequently observed complications were acute gastroenteritis (9.7%), followed by aspiration pneumonia (7.2%). Thirty-two patients (16.4%) required mechanical ventilation. Patients were treated with antitoxin in the emergency department, with a median cumulative amount of 6.0 doses (IQR: 4.0–10.0 doses). Adverse reactions to the antitoxin included 11 cases (5.6%) of serum sickness and 20 cases (10.3%) of allergic reactions. Based on the presence or absence of clinical signs 30 days post-discharge, the cohort was categorized into good and poor prognostic groups. The results revealed that 87 patients (44.6%) had a poor prognosis.

Table 4 compares the prognostic outcomes of poisoned patients. The hospitalization duration, need for mechanical ventilation, mean time from onset to antitoxin treatment, cumulative dose of antitoxin, and disease grade were significantly higher in patients with poor prognosis compared to those with good prognosis. Patients classified as Grade III had the worst prognosis, followed by those in Grade II. Additionally, the latent period, amplitude of facial nerve zygomatic branch, and PaO_2 were significantly reduced in patients with a poor prognosis. Finally, the important clinical parameters ($P \leq 0.05$) in Table 4 were analyzed using multiple regression analysis (Table 5). This analysis demonstrated that a latent period ≤3 days, prolonged duration from onset to antitoxin treatment, longer hospitalization duration, disease severity, need for mechanical ventilation, and decreased PaO_2 were independent risk factors associated with poor prognosis.

Table 4. Comparison of the prognosis among the patients.

Variables	Good prognosis ($n=108$)	Poor prognosis ($n=87$)	P value
Age (years), median (IQR)	37 (33–45)	41 (34–48)	>0.05
Duration of hospital stay (days), median (IQR)	4.5 (3.0–6.0)	7 (6.0–8.0)	<0.001
Severity of poisoning			<0.001
Grade I, *n* (%)	34 (31.5)	8 (9.2)	
Grade II, *n* (%)	65 (60.2)	37 (42.5)	
Grade III, *n* (%)	9 (8.3)	42 (48.3)	
Need for mechanical ventilation			<0.001
Yes, *n* (%)	5 (4.6)	27 (31.0)	
No, *n* (%)	103 (95.4)	60 (69.0)	
Latent Period (days)			0.001
≤3 days, *n* (%)	41 (38.0)	53 (60.9)	
>3 days, *n* (%)	67 (62.0)	34 (39.1)	
Duration from onset of illness to administration of antitoxin (h), median (IQR)	6.0 (3.0–8.7)	8 (5.0–12.0)	<0.001
Number of injections			>0.05
First-time injection, *n* (%)	18 (16.7)	22 (25.3)	
Subsequent injections, *n* (%)	90 (83.3)	65 (74.7)	
Product brand			>0.05
Unlicensed, *n* (%)	21 (19.4)	11 (12.6)	
Licensed, *n* (%)	31 (28.7)	28 (32.2)	
Unknown, *n* (%)	56	48	
Cumulative dose of botulinum toxin (IU), median (IQR)	100.0 (85.0–180.0)	200.0 (100.0–216.0)	<0.001
Cumulative dosage of antitoxin ($\times10^4$ IU), median (IQR)	6.5 (4.0–10.0)	6.0 (4.0–8.0)	>0.05
Electromyography of the zygomatic branch of the facial nerve			
Amplitude (mV), mean ± SD	1.27 ± 0.30	1.16 ± 0.32	0.017
Latency (msec), mean ± SD	2.17 ± 0.43	2.15 ± 0.41	>0.05
White blood cell count ($\times10^9$/L), median (IQR)	5.9 (4.8-7.6)	6.4 (5.2-8.0)	>0.05
Haemoglobin concentration (g/L), mean ± SD	129.45 ± 14.49	128.13 ± 12.01	>0.05
Platelet count ($\times10^9$/L), mean ± SD	224.87 ± 57.82	232.65 ± 64.89	>0.05
Aspartate aminotransferase activity (IU/L), median (IQR)	34.9 (24.6–51.4)	32.5 (24.9–46.9)	>0.05
Alanine aminotransferase activity (IU/L), median (IQR)	29.6 (22.1–37.7)	27.4 (22.8–33.4)	>0.05
Activated partial thromboplastin time (sec), mean ± SD	28.42 ± 3.95	29.76 ± 2.43	>0.05
Fibrinogen concentration (g/L), mean ± SD	2.86 ± 0.77	3.03 ± 0.51	>0.05
PaO_2 (mmHg [kPa]), median (IQR)	109.0 (89.0–146.2) [14.5 (11.8–19.4)]	90.0 (72.0–118.0) [12.0 (9.6–15.7)]	<0.001
$PaCO_2$ (mmHg [kPa]), median (IQR)	35.7 (33.3–39.5) [4.8 (4.4–5.3)]	37.1 (33.1–40.6) [4.9 (4.4–5.4)]	>0.05

Table 5. Multiple linear regression analysis of independent risk factors of poor prognosis.

Variable	β	Standard error	Hazard ratio	95% confidence interval	P value
Latent period (reference is >3 days)	1.04	0.39	2.81	1.30–6.13	0.009
Duration from onset of illness to administration of antitoxin	0.10	0.04	1.10	1.01–1.20	0.026
Cumulative dose of antitoxin	−0.03	0.04	0.97	0.89–1.06	0.494
Electromyography amplitude of the zygomatic branch of the facial nerve	−0.99	0.62	0.37	0.11–1.24	0.107
Severity of poisoning					
Moderate (reference is Grade I)	1.22	0.54	3.39	1.17–9.85	0.025
Severe (reference is Grade II)	3.07	0.66	21.58	5.89–79.01	<0.001
Duration of hospital stay	0.13	0.05	1.13	1.03–1.25	0.012
Need for mechanical ventilation (reference is "No")	2.06	0.74	7.88	1.86–33.35	0.005
PaO_2	−0.12	0.01	0.98	0.97–0.99	0.036

Discussion

Iatrogenic botulism is uncommon in clinical practice, with most cases attributed to cosmetic injections. Clinicians often overlook this patient population, resulting in severe consequences due to delayed diagnosis and treatment. To enhance the understanding of iatrogenic botulism in medical institutions, this study aimed to investigate its clinical characteristics and prognostic risk factors. We identified a latent period of ≤3 days, delayed initiation of antitoxin therapy, prolonged hospitalization, disease severity, necessity for mechanical ventilation, and reduced PaO_2 as independent risk factors significantly associated with poor prognosis.

Of the total participants, 190 were female (97.4%), yielding a male-to-female ratio of 1:38, which is markedly lower than ratios documented in prior studies [8]. The median age of the patients in our study was 38 years, with a range of 20 to 69 years. Similarly, Bai et al. [9] reported an age range of 17 to 63 years. The age distribution exhibited a comparable pattern, with the majority of patients in the 20- to 60-year age groups. Our findings indicate that most patients received multiple injections. The therapeutic course of botulism toxin type A typically lasts about 4 to 6 months, with some effects extending up to one year [10]. Although repeated injections are generally considered safe [11], administering botulism toxin type A multiple times within a short period can lead to toxic episodes due to potential drug overdoses. Additionally, frequent injections may saturate local cholinergic nerve endings, allowing unbound toxins to disperse to neighboring

structures or enter the bloodstream, potentially resulting in poisoning [12]. Currently, there is no conclusive evidence to guide recommendations on the optimal therapeutic dose and administration interval for botulism toxin type A injections. We recommend that both the frequency and dosage should not be indiscriminately increased in pursuit of therapeutic outcomes.

The majority of cases (87.2%) occurred in non-authorized institutions. We compared patients from authorized and non-authorized institutions and identified significant differences in the choice of botulism toxin type A brands, residence locations, and educational attainment. In China, rural populations often have lower levels of education and relatively modest incomes. Consequently, they tend to prioritize price and convenience over the quality of products and services, which leads to a preference for non-authorized institutions. Authorized institutions typically prefer to use licensed botulism toxin type A brands. Furthermore, only about half of the patients noticed the botulism toxin type A brands, and only 59 of them were aware that the botulism toxin type A used was a licensed brand, corroborating findings from international studies [13]. It is widely recognized that labelled dosages of botulism toxin type A from unknown sources may lack reliability and could contain elevated concentrations of the toxin. Our analysis revealed that non-authorized institutions did not use high dosages of botulism toxin type A, and dosages were not increased in patients with poor prognosis. This may suggest that the poisoning could be attributed to the use of products containing abnormally elevated concentrations of the toxin.

A latent period of ≤3 days was associated with a poor prognosis, indicating the importance of early symptom recognition and prompt treatment. This finding aligns with previous studies on foodborne botulism and emphasizes the need for rapid medical intervention. Qian Ma et al. [14] proposed that a shorter latent period correlates with a worse prognosis. According to a consensus report [15], the latent period of iatrogenic botulism typically ranges from 1 to 10 days, with a mean of 4 days. We found that the latent period of iatrogenic botulism was 3 days, which exceeds the 12 to 72 h range typically observed in cases of foodborne botulism. This may indicate that the severity of iatrogenic botulism could be milder compared to foodborne botulism, a hypothesis that warrants further investigation in future studies.

Our study confirmed that early administration of antitoxin significantly improves the prognosis for patients with iatrogenic botulism. This finding is consistent with observations in foodborne botulism [16]. A 2017 study [17] similarly indicated that early antitoxin administration, especially within 48–96 h of symptom onset, is associated with lower mortality rates compared to delayed treatment. In our study, the median time from symptom onset to antitoxin administration was 7 h, suggesting the potential for further reduction in the time interval between symptom onset and initiation of treatment. Moreover, our study demonstrates that prolonged hospitalization duration is an independent risk factor for adverse outcomes in patients with iatrogenic botulism. The median duration of hospitalization in patients with iatrogenic botulism was 6 days. Previous studies have reported variable durations of hospitalization. A case series from Egypt [18] ($n=9$) reported 3-10 days, a Chinese study [9] ($n=86$) found up to 36 days, and Carruthers et al. [13] ($n=31$) reported a mean of 13 days. Prolonged hospitalization, often linked to disease severity, comorbidities, and suboptimal treatment response, may have a clinically significant impact on patient prognosis.

Our research further confirmed that the severity of muscle involvement and the need for mechanical ventilation are independent risk factors for a poor prognosis. Disease severity was assessed by the extent of muscle involvement. This observation is consistent with the prognostic patterns seen in other conditions, such as intensive care unit-acquired weakness [19]. Furthermore, the need for mechanical ventilation typically indicates severe respiratory compromise, which may result in extended hospitalization and higher mortality rates. Studies have shown that patients undergoing mechanical ventilation can experience significant respiratory degradation and reduced PaO_2, complicating their overall prognosis [20]. Moreover, our study demonstrates that a reduction in PaO_2 is an independent predictor of poor prognosis in patients with iatrogenic botulism. Consistent with our findings, in patients experiencing acute exacerbations of chronic obstructive pulmonary disease, hypoxaemia within the first 24 h following admission is significantly correlated with survival outcomes over the subsequent 14 days [21]. Botulinum toxin can induce hypoxia via two principal mechanisms: diaphragmatic paralysis and partial or complete upper airway obstruction. In botulism, inadequate inspiration or airway obstruction usually precedes ventilation insufficiency, with hypoxia or respiratory distress manifesting shortly prior to respiratory failure [22].

Our study provides a detailed analysis of a large number of patients with iatrogenic botulism, offering valuable insights into the clinical characteristics and risk factors associated with the condition. The study highlights the importance of standardized management and supervision of botulism toxin type A to reduce the incidence of iatrogenic botulism.

However, the study has some limitations. The cases analyzed were from a single centre, which may limit the generalizability of our findings. Multicentre studies are needed to validate our results across different populations and settings. Our study did not include quantitative data regarding the detection of botulism toxin type A, which could have provided additional insights into the toxin concentrations and their correlation with clinical outcomes.

Conclusions

Our study delineates the clinical characteristics and outcomes of iatrogenic botulism. We identified a latent period of ≤3days, delayed initiation of antitoxin treatment, extended hospitalization duration, severe intoxication grading, requirement for mechanical ventilation, and reduced PaO_2 as independent risk factors associated with a poor prognosis. Accordingly, we underscore the critical importance of early recognition and timely intervention. Moreover, clinicians should remain vigilant to these risk factors and implement prompt interventions to mitigate disease progression.

Disclosure statement

No potential conflict of interest was reported by the authors.

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