

Effects of the working experience, educational background, professional titles, and hospital grades of intensive care unit doctors on clinical glucocorticoid use in acute respiratory distress syndrome

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Abstract

Although glucocorticoids are commonly used for patients with acute respiratory distress syndrome in the intensive care unit, the exact attitudes of different intensive care unit (ICU) doctors about glucocorticoid usage are largely unknown. Herein, we investigated the practice of glucocorticoid application for acute respiratory distress syndrome (ARDS) by ICU doctors in China. Questionnaires were developed and sent to ICU doctors at 45 hospitals to perform statistics and analysis. ICU doctors with more working experience and professional titles had more knowledge of ARDS. Glucocorticoids were more likely to be used for ARDS caused by chemical inhalation. Doctors with longer working experience, better educational background, and higher professional titles used fewer glucocorticoids. In addition, 97.2% of the doctors considered using methylprednisolone or hydrocortisone first, 50.9% used glucocorticoids within 24 hours of onset, and 37.1% insisted that steroid therapy should last 3 to 5 days. Although ICU doctors with more working experience and professional titles have a better understanding of glucocorticoid use in ARDS, the majority of clinical practices and attitudes are similar among different doctors regardless of working experience, educational background, professional titles, or hospital grades.

Abbreviations: ARDS = acute respiratory distress syndrome, ECMO = extracorporeal membrane oxygenation, ICU = intensive care unit.

Keywords: acute respiratory distress syndrome, glucocorticoid, intensive care unit

1. Introduction

Acute respiratory distress syndrome is a life-threatening disease characterized by hypoxemia and diffuse alveolar infiltrates. Since it was first reported in 1967, the diagnostic criteria for acute respiratory distress syndrome (ARDS) have been continuously updated.^[1] Among them, the American-European Consensus Conference criteria in 1994 and the Berlin Standard in 2012 are

widely accepted.^[2,3] A survey including 435 intensive care units (ICUs) from 50 countries reported that ARDS patients represented 10% of the patients admitted to the ICU, and the hospital mortality ranged from 35% to 46%.^[4] Despite the tough mortality, a heterogeneous and complicated pathogenesis seldom leads to a consistently effective pharmacotherapy for ARDS.^[5-9]

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Because of the dysregulated inflammatory response in the lungs, glucocorticoids have been applied as an effective treatment for ARDS since the syndrome was first defined in 1967.^[1,10] Studies have also found that glucocorticoids can reduce collagen deposition and inhibit fibrosis.^[11] Despite the theoretical benefits, the outcomes of clinical trials have been controversial, and the management of glucocorticoids in ARDS remains conflicting. The RECOVERY trial Preliminary Report announced that dexamethasone decreased the mortality of patients with acute respiratory failure caused by COVID-19.^[12] Other clinical trials have found a poor long-term prognosis when methylprednisolone was used for >2 weeks.^[13,14] These reports emphasize the importance of the individualized use of glucocorticoids in the clinical setting according to the different pathogenesis of ARDS. To this point, the practical use of glucocorticoids in ARDS depends on the doctors' judgments.

However, few studies have previously reported ICU doctors' opinions on glucocorticoids for ARDS. To address this issue, we performed a survey concerning the knowledge and clinical practice of glucocorticoid use for ARDS for different ICU doctors stratified by different seniority levels, educational background, titles, and hospital grades, attempting to investigate how these factors would affect the habits and use of glucocorticoids for ARDS in practice.

2. Material and methods

2.1. Ethical issues

The ethical aspects of this study were reviewed and approved by the Second Affiliated Hospital of Zhejiang University School of Medicine Ethics Committee and informed consent was obtained from all participants (Ethical code: 2020881).

2.2. Designing of the questionnaire

The study was carried out from June 26, 2016, to July 28, 2016. The questionnaire was designed based on the 1994 American-European Consensus Conference and the 2012 Berlin definition,^[2,3] and divided into 2 parts. The first part was the general situation of respondents, while the second part was about the attitudes on glucocorticoids in the management of ARDS.

2.3. Respondents and recycling criteria

The questionnaire was sent to 340 intensivists from 45 ICUs in Zhejiang Province, China. Finally, 340 questionnaires were collected, among which 321 were valid.

2.4. Statistical methods

MATLAB (R2014b) was used to count the results. Statistical analysis was performed using SPSS (SPSS version 22.0; IBM Corporation, Armonk, NY). The chi-square test was used to compare the rates. Use Fisher exact probability method instead when the frequency did not meet the condition of the chi-square test. $P < .05$ was considered statistically significant. Finally, draw the graph with R Studio (Version 3.5.3).

3. Results

3.1. Basic information of respondents

A total of 321 questionnaires were collected. Stratified by seniority level, 147 (45.8%) doctors had worked for 0 to 5 years,

Table 1

Summary of basic information of respondents.

| Total number of questionnaires | 321 |
|---|-------------|
| Layered by seniority | |
| Work for 0–5 years | 147 (45.8%) |
| Work for 6–10 years | 78 (24.3%) |
| Work for over 11 years | 96 (29.9%) |
| Layered by educational background | |
| Graduate | 145 (45.2%) |
| Undergraduate | 176 (54.8%) |
| Layered by hospital grades | |
| Second Grade Class-A (Grade 2A) | 41 (12.8%) |
| First Grade Class-B (Grade 3B) | 82 (25.5%) |
| First Grade Class-A (Grade 3A) | 198 (61.7%) |
| Layered by professional titles of doctors | |
| Junior | 107 (33.3%) |
| Intermediate | 116 (36.1%) |
| Senior | 98 (30.5%) |

78 (24.3%) had worked for 6 to 10 years, and 96 (29.9%) had worked for 11 years and longer. According to educational background, there were 176 (54.8%) undergraduates and 145 (45.2%) graduates. Regarding the hospital grades, 41 (12.8%) respondents worked in second grade class-A hospitals (termed Grade 2A), 82 (25.5%) in first grade class-B hospitals (termed Grade 3B), and 198 (61.7%) in first grade class-A hospitals (termed Grade 3A). A total of 107 (33.3%) doctors had junior titles, 116 (36.1%) had intermediate titles, and 98 (30.5%) had senior titles (Table 1).

3.2. The understanding of ARDS

Our survey showed that whether doctors were familiar with the Berlin definition was related to their working times and professional titles but not to their educational backgrounds and hospital grades. A total of 17.0% of the respondents who had worked for 0 to 5 years, 10.3% who had worked for 6 to 10 years, and 5.2% who had worked for 11 years and longer ($P < .05$) were unfamiliar with the definition; 18.7% of those with junior titles, 7.8% with intermediate titles, and 9.2% with senior titles were unfamiliar with the definition ($P < .05$) (Fig. 1A). The higher the degree of education and grade of the hospitals, the more profound the doctors' awareness of ARDS was.

Treatment strategies for ARDS are associated with hospital grades and have little to do with working years, educational background, and professional titles. A total of 13.4% of the doctors working in Grade 3A hospitals chose extracorporeal membrane oxygenation (ECMO), while 9.2% of those in Grade 3B hospitals and 5.2% of those in Grade 2A hospitals chose ECMO ($P < .05$) (Fig. 1B). A total of 30.2% of the doctors working for 11 years and longer (0–5 years: 8.8%, 6–10 years: 7.7%, $P < .05$) and 24.5% with senior titles (junior: 10.2%, intermediate: 12.1%) hardly used small tidal volumes in practice. In terms of hospital grades, 17.7% of the respondents working in Grade 3A hospitals seldom used small tidal volumes (7.3% for Grade 3B and 13.4% for Grade 2A hospitals, $P < .05$), while the percentage of undergraduate students who used small tidal volumes was higher than that of graduate students (18.8% vs 11.0%, $P < .05$) (Fig. 1C).

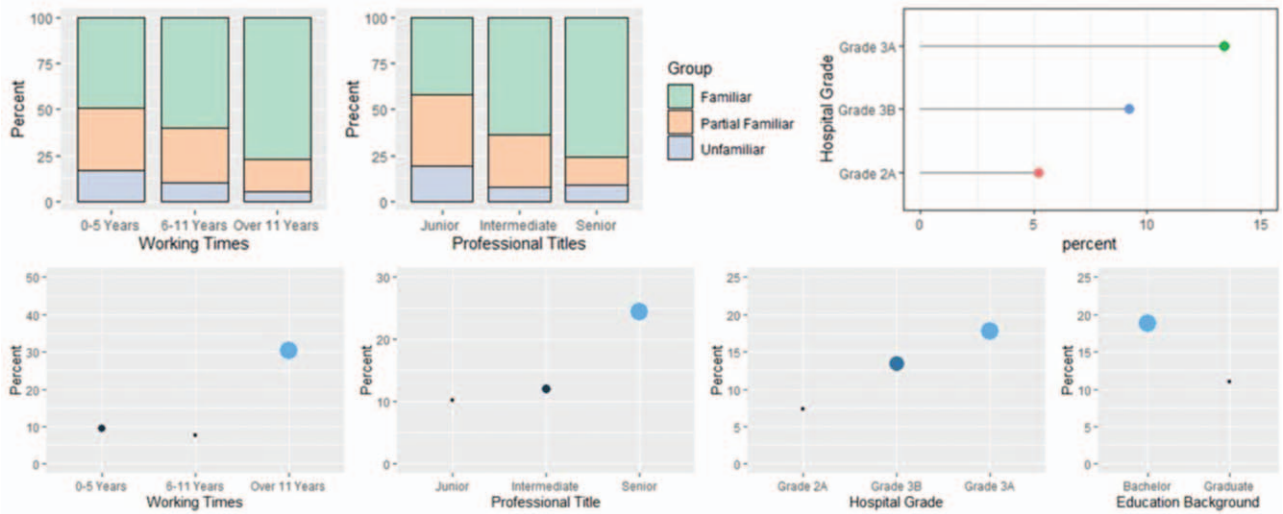


Figure 1. The understanding of the ARDS. (A) Respondents' familiarity with the 2012 Berlin Guidelines. (B) Use ratio of ECMO in respondents from different levels of hospitals. (C) The percent of respondents that seldom use small tidal volume in practice. ARDS=acute respiratory distress syndrome, ECMO=extracorporeal membrane oxygenation.

3.3. The realization of glucocorticoids in management of ARDS

A total of 73.8% of the respondents believed that glucocorticoids should be used individually according to the specific cause of ARDS, and 17.4% rarely used them (no significant difference in each stratification) (Fig. 2A). Regarding the specific causes, most respondents used glucocorticoids for ARDS caused by chemical inhalation. The longer the working times and the higher the professional titles, the higher the proportion of doctors who chose to use glucocorticoids for ARDS caused by chemical inhalation (working for 0–5 years: 79.4%, 6–10 years: 80.2%, 11 years or longer: 96.9%, $P < .05$; junior title: 74.8, intermediate

title: 87.9%, senior title: 92.9%, $P < .05$). The difference was significant and was similar to that of ARDS caused by aspiration pneumonia. In addition, 61.7% of the respondents chose to use glucocorticoids for patients with adrenal insufficiency (Table 2).

In addition, the majority (57.0%) of the respondents did not agree on the routine use of glucocorticoids (Fig. 2B). Doctors with long working experience, high educational background, and high professional titles used fewer glucocorticoids (percentage of those who agreed to use glucocorticoids: worked 0–5 years vs 6–10 years vs 11 years and longer: 29.3% vs 28.2% vs 16.7%, respectively, $P < .05$; undergraduates vs graduates: 31.3% vs 17.9%, respectively, $P < .05$; junior titles vs intermediate

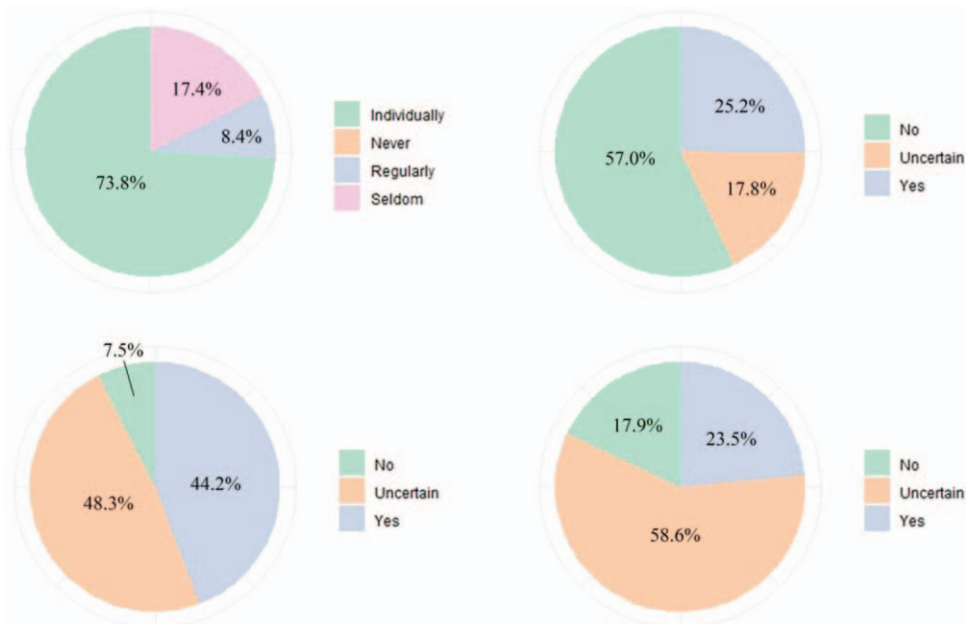


Figure 2. The knowledge of glucocorticoids when used in ARDS. (A) The frequency of glucocorticoid uses. (B) The results of whether routine use of glucocorticoids should be advocated. (C) The results of whether glucocorticoids can improve oxygen saturation and shorten the time of mechanical ventilation. (D) The results of whether glucocorticoids could improve the prognosis of ARDS and reduce the mortality rate. ARDS=acute respiratory distress syndrome.

Table 2**The results of in which case to use glucocorticoids.**

| Group | PaO ₂ /FiO ₂ <200* | PaO ₂ /FiO ₂ <100* | Circulatory failure | Adrenocortical insufficiency | Pulmonary fibrosis | No GCs [†] | Other choice | P value |
|---|--|--|---------------------|------------------------------|--------------------|---------------------|--------------|---------|
| Layered by seniority | | | | | | | | |
| 0–5 years | 11.8% | 21.4% | 20.0% | 25.4% | 20.6% | 0.3% | 0.6% | .546 |
| 6–11 years | 11.6% | 26.0% | 21.5% | 24.3% | 16.0% | 0.0% | 0.6% | |
| >11 years | 6.0% | 26.8% | 20.9% | 27.2% | 18.3% | 0.0% | 0.9% | |
| Layered by educational background | | | | | | | | |
| Bachelor | 12.8% | 24.2% | 20.2% | 25.7% | 16.5% | 0.0% | 0.5% | .096 |
| Graduate | 6.8% | 24.0% | 21.0% | 25.7% | 21.3% | 0.3% | 0.8% | |
| Layered by hospital grades | | | | | | | | |
| Grade 2A | 14.9% | 23.0% | 17.2% | 29.9% | 14.9% | 0.0% | 0.0% | .810 |
| Grade 3B | 11.8% | 24.7% | 20.4% | 23.7% | 18.8% | 0.0% | 0.5% | |
| Grade 3A | 8.4% | 24.1% | 21.3% | 25.7% | 19.5% | 0.2% | 0.8% | |
| Layered by professional titles of doctors | | | | | | | | |
| Junior | 11.9% | 22.4% | 20.5% | 25.7% | 19.0% | 0.4% | 0.0% | .686 |
| Intermediate | 10.1% | 24.5% | 20.6% | 24.2% | 19.9% | 0.0% | 0.7% | |
| Senior | 7.5% | 25.7% | 20.8% | 27.4% | 17.3% | 0.0% | 1.3% | |

* Indicates PEEP ≥5 cmH₂O.[†] GCs: glucocorticoids.

senior titles: 31.8% vs 24.1% vs 19.4%, respectively, $P < .05$). Most respondents (87.2%) used glucocorticoids due to the anti-inflammatory effect.

Forty-eight percent of the respondents were uncertain about whether glucocorticoids can improve oxygen saturation and shorten the time of mechanical ventilation. A total of 44.2% of the respondents did not agree with these effects of glucocorticoids. Regarding whether glucocorticoids could improve the prognosis of ARDS and reduce the mortality rate, most doctors were uncertain (23.5% thought it could, 17.6% thought it could not, and 58.2% were uncertain) (Fig. 2C and D). There was no significant difference when layered by working experience, educational background, professional titles, or hospital grades.

3.4. The detailed usage of glucocorticoids in ARDS in clinical

A total of 50.9% of the respondents chose to use glucocorticoids within 24 hours, 87.2% chose to use methylprednisolone, and

10.0% chose hydrocortisone. For the dose of methylprednisolone, 52.0% selected doses of 40 to 80 mg per day, and 35.8% chose doses of 80 to 160 mg (Table 3). For hydrocortisone, 56.0% selected doses of 200 to 300 mg per day. The results were not significantly different when layered by working experience, educational background, professional titles, or hospital grades.

A total of 7.8% of the respondents used glucocorticoids for 1 to 2 days, 37.1% for 3 to 5 days, 24.6% for 5 to 7 days, and 6.9% for 1 to 2 weeks, while the remaining 21.5% thought the treatment course should be adjusted individually. No respondent chose a treatment course longer than 2 weeks (Table 3). Compared with undergraduates, graduates were more inclined to individual usage (graduates vs undergraduates: 25.5% vs 18.2%) (Table 3). A total of 85.0% of the respondents chose to withdraw glucocorticoids when the patients' oxygen saturation was improved, and 82.2% would gradually decrease glucocorticoids (Table 3). However, the results showed no significant differences regarding working experience, educational background, professional titles, or hospital grades.

Table 3**The results of which dose of methylprednisolone should be used.**

| Group | 20 ≤ dose <40* | 40 ≤ dose <80* | 80 ≤ dose <160* | 160 ≤ dose <500* | ≥500* | Never use | P value |
|---|----------------|----------------|-----------------|------------------|-------|-----------|---------|
| Layered by seniority | | | | | | | |
| 0–5 years | 7.5% | 57.8% | 26.5% | 5.4% | 0.7% | 2.0% | .067 |
| 6–11 years | 3.8% | 41.0% | 50.0% | 5.1% | 0.0% | 0.0% | |
| >11 years | 4.2% | 52.1% | 38.5% | 5.2% | 0.0% | 0.0% | |
| Layered by educational background | | | | | | | |
| Bachelor | 4.0% | 49.4% | 39.2% | 6.8% | 0.6% | 0.0% | .082 |
| Graduate | 7.6% | 55.2% | 31.7% | 3.4% | 0.0% | 2.1% | |
| Layered by hospital grades | | | | | | | |
| Grade 2A | 2.4% | 46.3% | 41.5% | 9.8% | 0.0% | 0.0% | .014 |
| Grade 3B | 3.7% | 48.8% | 34.1% | 12.2% | 1.2% | 0.0% | |
| Grade 3A | 7.1% | 54.5% | 35.4% | 1.5% | 0.0% | 1.5% | |
| Layered by professional titles of doctors | | | | | | | |
| Junior | 7.5% | 59.8% | 25.2% | 5.6% | 0.9% | 0.9% | .175 |
| Intermediate | 5.2% | 45.7% | 44.0% | 3.4% | 0.0% | 1.7% | |
| Senior | 4.1% | 51.0% | 37.8% | 7.1% | 0.0% | 0.0% | |

* Indicating the dose of methylprednisolone with the unit of mg/d.

4. Discussion

Our survey has some significant findings: almost all respondents were familiar with the ARDS definition. The overwhelming majority preferred individual usage. Although most respondents used glucocorticoids for ARDS caused by inhalation and for patients with adrenal insufficiency, they did not agree with routine usage. The most common usage was 40 to 80 mg/d of methylprednisolone within 24 hours when ARDS was diagnosed, while the course was usually no longer than 2 weeks.

Doctors with more working experience and higher titles have a more profound awareness of ARDS. Our study also found that 10.2% of the respondents who had worked for 0 to 5 years often used relevant knowledge; among those working for 11 years and longer, the proportion was 16.7%. When layered by professional titles, 10.3% of the respondents with junior titles kept up with recent knowledge, and the ratio reached 20.4% of those with senior titles ($P < .05$). In addition, we found that 21.1% of the respondents who had worked for 0 to 5 years rarely read the literature, yet the ratio was only 8.3% for those working for 11 years and longer ($P < .05$). In addition, 20.6% of the doctors with junior titles and 9.2% of those with senior titles rarely read the literature ($P < 0.05$) (Tables S1 and S2, Supplemental Digital Content, <http://links.lww.com/MD2/A937>, <http://links.lww.com/MD2/A938>). These data show that doctors with more working experience and higher professional titles are more proactive in acquiring knowledge, which partially explains why they have a deeper realization of ARDS.

Routine usage of glucocorticoids in ARDS remains controversial. Our study showed that the majority of the respondents refused to use glucocorticoids for ARDS. A recent survey showed that the usage rate of glucocorticoids in patients with COVID-19 (all patients were admitted to the ICU with a high rate of ARDS) was as high as 93%.^[15] During the same period, Erbas and Dost^[16] found that 55% of intensivists were uncertain for the indication of glucocorticoids for intubated patients with COVID-19. An earlier survey taken in 2017 reported that intensivists denied the common use of glucocorticoids for ARDS.^[17] An investigation of United Kingdom ICU physicians declared that 70% of the respondents used glucocorticoids for ARDS, with only 6% using them routinely.^[18] However, the overwhelming majority of physicians agree that glucocorticoids are a pharmacotherapy in the management of ARDS.^[16–20] Regarding the practical use of glucocorticoids, our study found that usage of 40 to 80 mg of methylprednisolone per day at the early stage of ARDS (within 2 weeks) was preferred by most doctors. Similar outcomes were reported in other studies.^[15,18] The practical usage of glucocorticoids is consistent with guidelines.^[21,22] The vast majority of our respondents supported individualized use, which was consistent with the recent literature.^[15]

In addition to mechanical ventilation, venovenous extracorporeal membrane oxygenation is commonly recommended for ARDS.^[23] However, the usage of ECMO depends on the resources of the hospitals. We find that doctors who used ECMO for ARDS mainly worked in Grade 3A hospitals. This result is similar to that of studies abroad.^[17]

Our study still has the following shortcomings. First, some of the questions and options in this study were unclear and repetitive. The stratification of both working times and professional titles was redundant. Second, the respondents were restricted to high-grade hospitals. The number of ICU doctors in Grade 2A hospitals was insufficient, which leads to biased results.

Finally, the questionnaire was designed in 2016 according to the early version of the literature; its effectiveness remains to be further discussed.

5. Conclusions

This study found that ICU doctors in Zhejiang Province hold different opinions on whether glucocorticoids should be used for ARDS. Most respondents choose small-dose and short-course treatment for glucocorticoids. Particularly, they used glucocorticoids based on specific causes of ARDS, which reflected a fairly high level of professionalism. In prospective treatment strategies for ARDS, individualized specific treatments should receive increasing attention. The majority of clinical practices and attitudes were similar among different doctors among different subgroups.

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