



Original Article

Characteristics and outcomes of Ludwig's angina in patients admitted to the intensive care unit: A 6-year retrospective study of 29 patients



Qing-Ling Lin ^a, Hong-Liang Du ^b, Huai-Yu Xiong ^c, Bin Li ^a, Jian Liu ^a, Xiao-Hua Xing ^{d*}

^a Department of Intensive Care Unit, The First Hospital of Lanzhou University, Lanzhou, Gansu, China

^b Department of Oral and Maxillofacial Surgery, The First Hospital of Lanzhou University, Lanzhou, Gansu, China

^c Lanzhou University, Lanzhou, Gansu, China

^d Department of Dentistry, Affiliated Hospital of Gansu University of Chinese Medicine, Lanzhou, Gansu, China

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KEYWORDS

Ludwig's angina;
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Length of hospital stay;
Mortality

Abstract *Background/Purpose:* Ludwig's angina (LA) still presents regularly and various characteristics are documented, but patients admitted to the Intensive Care Unit (ICU) has not been studied. The purpose of this study was to investigate the clinical characteristics and outcomes of patients with LA who were admitted to ICU.

Materials and methods: We retrospectively reviewed all 29 patients with LA who were admitted to the ICU of a university hospital from January 2013 to October 2018. Results were evaluated via descriptive analysis. The Log–Rank test was used to analyze the hospital/ICU length of stay (LOS).

Results: The male: female ratio was 2.63:1. Mean age was 53.41 ± 16.57 years (range 8–78 years). Concomitant conditions comprised diabetes mellitus in 10 patients (34.48%), and hypertension in six (20.69%). The main reason for ICU admission was surgical (44.83%). The mean Acute Physiology, Age, Chronic Health Evaluation II (APACHE II) and the Sequential Organ Failure Assessment (SOFA) scores were 13.52 ± 3.18 and 3.83 ± 2.89 , respectively. Twenty-eight patients (96.55%) received respiratory support. Sixteen patients (55.17%) had positive bacterial culture results. Fourteen bacterial strains were detected, most of which were gram-positive (72.72%). Mean LOS was 6.89 ± 14.39 days (range 0.5–73 days), and 24.79 ± 16 days in the hospital. The ICU mortality rate was 10.34%. Compared with LA patients without descending

* Corresponding author. Department of Dentistry, Affiliated Hospital of Gansu University of Chinese Medicine, 732 West Jiayuguan Road, Chengguan District, Lanzhou, 730000, Gansu, China.

E-mail address: 51942366@qq.com (X.-H. Xing).

necrotizing mediastinitis (DNM), those with DNM had longer ICU and hospital LOS. The laboratory investigations were higher.

Conclusion: LA patients in ICU were predominantly male, with a wide range age, high incidence of complications, long hospital LOS.

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Introduction

Ludwig's angina (LA) is the term used to describe life-threatening cellulitis that spreads rapidly to the surrounding tissues.¹ It was identified as the strongest predictors in terms of development of complications.² Serious complications, such as septic shock, upper airway obstruction, mediastinitis, empyema, and respiratory failure can lead to death.^{3,4} Sepsis is particularly common in LA.⁵ It is reported that mortality rate of cervical necrotizing fasciitis increased to 41% in the presence of descending necrotizing mediastinitis (DNM), and 64% if sepsis occurred.⁶

When life-threatening complications occurred, patients may suffer from failure of one or more of their systems. The common condition is, to shift the patient to the intensive care unit (ICU) in which patient need high-quality care supported by state of the equipment. LA patients with septic shock need admittance to ICU for high-quality care therapy.⁷ Recent studies show that an increasing number of patients with LA require admission to the ICU for tracheal intubation and mechanical ventilation.^{8,9} However, it is unclear whether intensive care reduces the mortality of LA patients with complications or reduces the length of stay (LOS) in hospital. Therefore, the present study primarily aimed to investigate the mortality of LA patients with and without DNM and longer hospitalization duration in patients with LA who were admitted to the ICU. Secondly, we analyzed the demographics, bacterial strains, therapeutic interventions, laboratory results.

Materials and methods

This retrospective study analyzed data collected from all patients with LA who were admitted to the ICU of the First Hospital of Lanzhou University in Gansu, China from January 2013 to October 2018. Clinical data were collected within the first 24 h after ICU admission including laboratory results. Assessed data included the sex, age, Acute Physiology, Age, Chronic Health Evaluation II score (APACHE II score), the Sequential Organ Failure Assessment score (SOFA score), therapeutic interventions, type of bacterial source, reason for admission, systemic diseases, complications (cervical abscess, DNM, empyema, pneumonia), laboratory results, and LOS in the ICU and in hospital. Laboratory investigations included the white blood cell count, neutrophil percentage, procalcitonin concentration, prothrombin time, activated partial thromboplastin time, serum albumin concentration, and blood lactic acid

concentration. The study was approved by the ethics committee of the First Hospital of Lanzhou University.

Statistical analysis

Statistical analyses were performed with SPSS software (version 22.0, IBM Corporation, New York, USA). The data were evaluated via descriptive analysis, and the Log–Rank test was used to analyze the length of hospital/ICU stay for patients with LA with DNM versus patients with LA without DNM. All data are presented as the mean \pm standard deviation.

Results

During the study period, there were 6072 patients admitted to the ICU in the First Hospital of Lanzhou University. Thirty-three of these patients were diagnosed with LA; however, four patients had missing data. Thus, the data from 29 patients were analyzed (Fig. 1).

The patient characteristics are reported in Table 1. The mean patient age was 53.41 ± 16.57 years (range 8–78 years). There were 21 males and eight females, giving a male: female ratio of 2.63:1. The patient age distribution is shown in Fig. 2. The mortality rate is 10.34%.

Complications of LA during treatment were cervical abscess ($n = 23$ patients, 79.31%), DNM ($n = 8$, 27.59%), empyema ($n = 5$, 17.24%), pneumonia ($n = 16$, 55.17%), severe sepsis ($n = 10$, 34.48%), and death ($n = 3$, 10.34%) (Fig. 3). Three of eight DNM patients died. The patients with DNM had a high mortality rate of 37.5%.

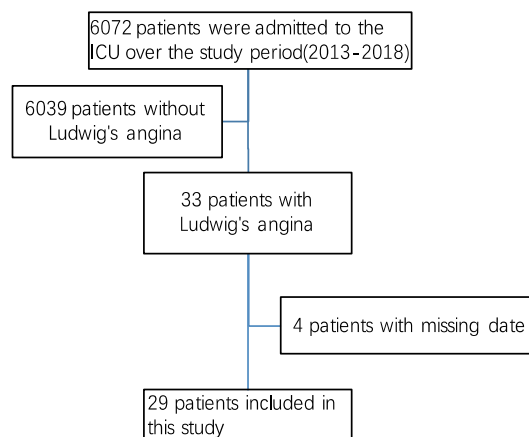


Figure 1 Flowchart of the study.

Table 1 Patient characteristics.

Variable	
Sex	
Female, No.(%)	8 (28%)
Men, No.(%)	21 (72%)
Age (mean ± SD),y	53.41 ± 16.57
Systemic disease, No.(%)	
Diabetes	10 (34.48%)
Hypertension	6 (20.69%)
Etiology of Ludwig’s angina, No.(%)	
Odontogenic	21 (72.41%)
Nonodontogenic	8 (27.59%)
Reason for admission, No.(%)	
Sepsis	2 (6.89%)
Surgical	13 (44.83%)
Respiratory disorder	3 (10.34%)
Sepsis and surgical	2 (6.89%)
Surgical and respiratory disorder	3 (10.34%)
Sepsis, surgical and respiratory disorder	6 (20.69%)
APACHE II score, (mean ± SD)	13.52 ± 3.18
SOFA score, (mean ± SD)	3.83 ± 2.89
Respiratory support, No.(%)	28 (96.55%)
Length of stay in ICU	6.89 ± 14.39
Length of stay in hospital	24.79 ± 16
ICU mortality, No.(%)	3 (10.34%)

ICU: intensive care unit.

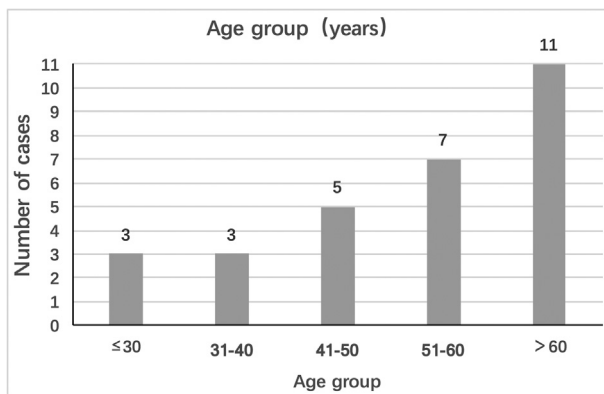


Figure 2 Age distribution of patients with Ludwig’s angina.

All 29 patients with LA underwent surgical treatment, either before or after admission to the ICU. Twenty-eight of 29 patients (96.55%) received mechanical ventilation; most of these patients were intubated, while only one patient underwent noninvasive ventilation. Eleven patients (37.93%) were in septic shock and were administered vasopressor medication to maintain normal blood pressure. More patients received enteral nutrition (48.28%) than parenteral nutrition (41.38%). 10.34% patients using enteral nutrition combined with parenteral nutrition. Blood transfusion was performed in 20.69% of patients because of abnormal coagulation and thrombocytopenia caused by infection (Fig. 4).

Bacteria were cultured in infected site from 29 patients. Of 29 surgical patients, 16 (55.17%) were positive for

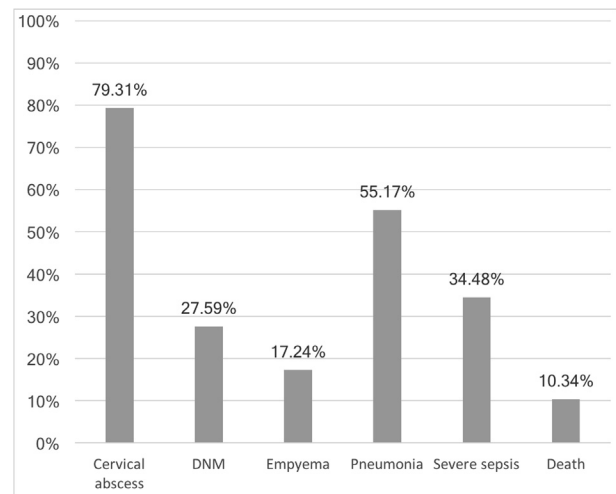


Figure 3 Complications experienced by patients with Ludwig’s angina. DNM: descending necrotizing mediastinitis. Three of eight DNM patients died.

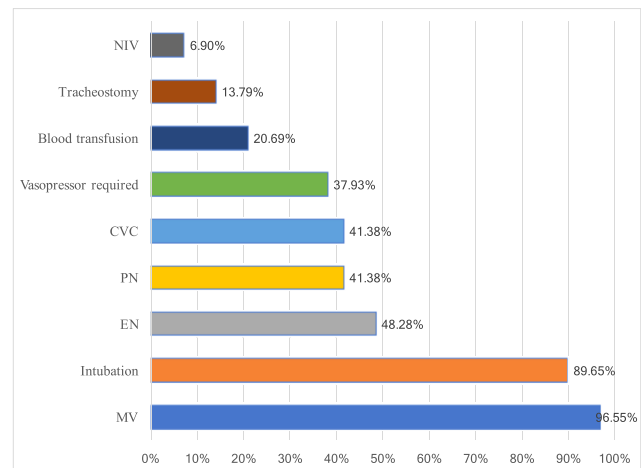


Figure 4 Therapeutic interventions in patients with Ludwig’s angina. CVC: central venous catheterization; NIV: noninvasive ventilation; MV: mechanical ventilation; EN: enteral nutrition; PN: parenteral nutrition.

bacterial culture. A total of 14 bacterial strains were isolated from 16 positive samples of surgical sites. Most bacterial strains (72.72%) were gram-positive. The most commonly detected bacterial species was *Streptococcus* (Fig. 5).

The average ICU LOS was 6.89 ± 14.39 days (range 0.5–73 days). The mean hospital LOS was 24.79 ± 16 days (Table 1). LA Patients with DNM had a longer ICU LOS than those without DNM (log-rank $P = 0.001$). LA Patients with DNM had a longer hospital LOS than those without DNM (log-rank $P = 0.045$) (Fig. 6).

The laboratory investigation results are shown in Table 2. The white blood cell count, neutrophil percentage, and procalcitonin concentration in patients with LA were greater than the respective normal ranges. The mean

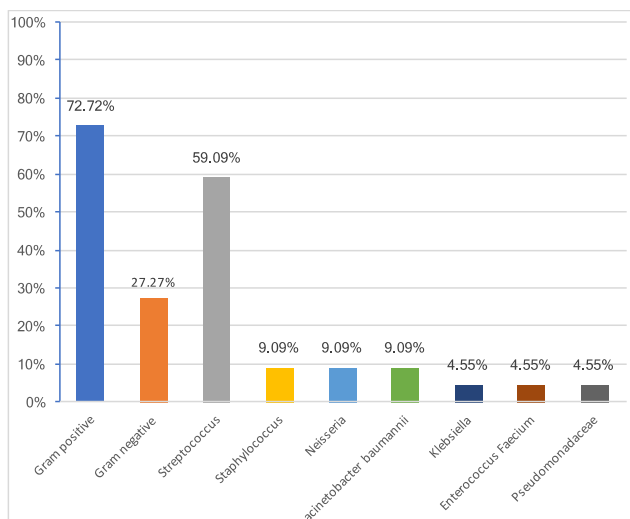


Figure 5 Bacterial etiology of Ludwig's angina.

prothrombin time and activated partial thromboplastin time were abnormal in patients with LA. The average blood lactic acid concentration was 2.06 ± 1.36 mmol/L.

Discussion

LA is a potentially lethal, rapidly spreading type of cellulitis that was first described in 1836.¹⁰ Previous studies have shown that males are more likely to develop LA than females, with reported male: female ratios of patients with LA of 2.32:1 and 5.5:1.^{11,12} In our study, the number of male patients with LA was also higher than the number of female patients with LA. The critically ill patients with LA in our study had a wide age range from 8 to 78 years, which is a wider age range than in previous studies of patients with LA.^{11,13} This is because children and older adults have low resistance to disease, and are therefore more likely to progress into critically ill patients requiring intensive care.

In our study, the overall mortality rate of LA who were admitted to ICU is 10.34%. However, previous study

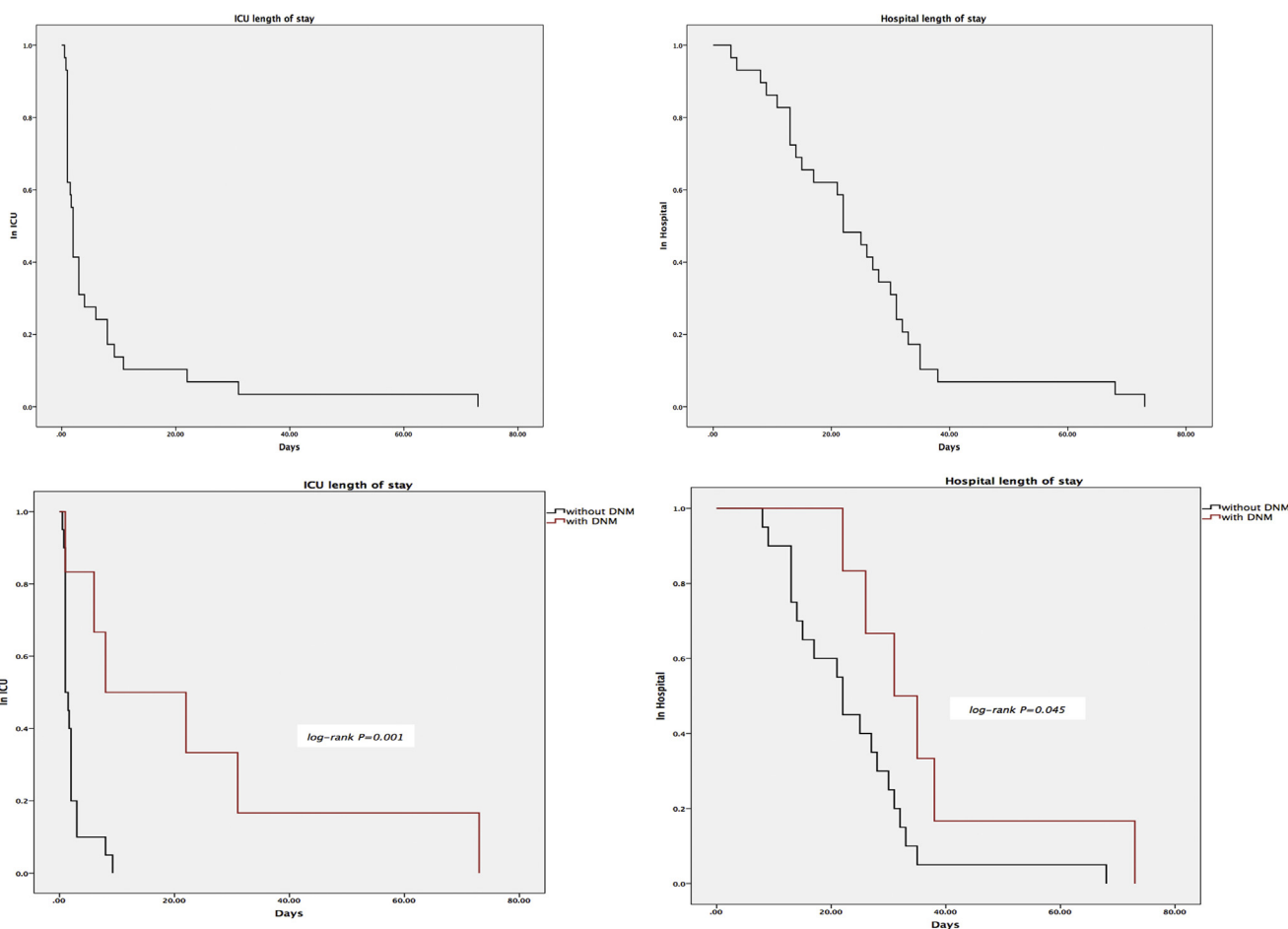


Figure 6 Intensive care unit (ICU) and hospital length of stay for patients with Ludwig's angina with or without descending necrotizing mediastinitis (DNM).

Table 2 Laboratory results for patients with Ludwig's angina.

Test	Mean \pm SD	Minimum	Maximum
WBC	12.78 \pm 4.45	2.34	21.58
N%	88.50% \pm 4.47%	80.2%	95.7%
PCT	11.08 \pm 23.00	0.02	100
PT(s)	14.49 \pm 2.82	11.1	24.1
APTT(s)	33.53 \pm 6.68	25	50.9
ALB	32.03 \pm 6.90	20.6	46.1
Lac	2.06 \pm 1.36	0.6	6.7

WBC: white blood cell count; N%: neutrophil percentage; PCT: procalcitonin concentration; PT: prothrombin time; APTT: activated partial thromboplastin time; ALB: serum albumin concentration; Lac: blood lactic acid concentration.

reported that mortality rate in patients with LA is 15.35%.¹⁴ It is also reported that mortality rate of cervical necrotizing fasciitis increased to 41% in the presence of descending necrotizing mediastinitis (DNM), and 64% if sepsis occurred.⁶ Because in our study, these are 34.47% patients had sepsis and 27.59% patients had DNM. The mortality rate of LA is 37.5% in the DNM patients and 30% in sepsis patients. Maybe intensive care reduces the mortality of LA patients with DNM and sepsis. Therapeutic interventions in the present patients with LA included mechanical ventilation, intubation, enteral nutrition, parenteral nutrition, central venous catheterization, vasopressor administration, blood transfusion, tracheostomy, and noninvasive ventilation. The high-quality care therapy may decrease the mortality.

Systemic diseases such as diabetes mellitus and hypertension can increase the severity of LA. In our study, 48.28% of patients had systemic disease, which is higher than the incidence reported in previous studies.¹¹ Diabetes mellitus was the most common systemic disease in our study, which is in accordance with other studies.^{15,16} Diabetes mellitus leads to compromised immunity and increased incidence of infection, such as that seen in LA.¹⁷

Most cases of LA in critically ill patients (72.41%) were due to odontogenic infection, which is similar to previous reports.^{18,19} The bacterial strains detected in patients with LA in our study were similar to those previously reported in odontogenic infections.²⁰

Complications are common in patients with LA.¹⁴ In our study, the complication rates were very high for cervical abscess (79.31%), DNM (27.59%), pneumonia (55.17%), and empyema (17.24%). Because of the high incidence of complications, patients with LA developed into critically ill patients.

The hospital LOS ranged from 3 to 73 days, which is longer than that reported in a previous study (2 days in the ICU, 5 days in hospital).²¹ Because its patients are mild and some patients are not admitted to ICU. Furthermore, we found that patients with LA who had DNM had a longer ICU LOS than those with LA without DNM (log-rank $P = 0.001$). From Fig. 6 we can see that LA patients without DNM had shorter ICU LOS. Patients with LA who had DNM had a longer hospital LOS than those with LA without DNM (log-rank $P = 0.045$). This is accordance with Gunaratne DA et al.²²

study in which patients with cervical necrotizing fasciitis who get DNM was associated with a significantly longer length of hospital stay (34.34 ± 28.05 days).²² But why LA patients with DNM have longer ICU and hospital LOS? Maybe because this complicated management associated with severe sepsis, endotracheal intubation and tracheostomy. This thereby requiring a longer stay in hospital.

The data were collected within the first 24 h of admission to the ICU. Patients received antibiotics upon hospital admission before they were admitted to the ICU. Thus, further study is needed to determine the associations between laboratory investigation results and the ICU and hospital LOS.

In conclusion, LA patients who were admitted to the ICU were predominantly male, with a wide range age, high incidence of complications, long hospital LOS and relatively low mortality rate.

Declaration of Competing Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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