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ORIGINAL ARTICLE

Retrospective Study

Distribution and drug resistance of pathogens in burn patients in China from 2006 to 2019

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Abstract

BACKGROUND

In this study, recent trends in the distribution and drug resistance of pathogenic bacteria isolated from patients treated at a burn ward between 2006 and 2019 were investigated.

AIM

To develop more effective clinical strategies and techniques for the prevention and treatment of bacterial infections in burn patients.

METHODS

Clinical samples with positive bacteria were collected from patients at the burn ward in Beijing Jishuitan Hospital in China between January 2006 and December 2019. The samples were retrospectively analyzed, the distribution of pathogenic bacteria was determined, and the trends and changes in bacterial drug resistance during different period were assessed. Drug resistance in several main pathogenic bacteria from 2006 to 2011 and from 2012 to 2019 was comparatively summarized and analyzed.

RESULTS

Samples from 17119 patients were collected and analyzed from 2006 to 2019. Surprisingly, a total of 7960 strains of different pathogenic bacteria were isolated at this hospital. Among these bacteria, 87.98% (7003/7960) of the strains were isolated from burn wounds, and only 1.34% (107/7960) were isolated from the blood of patients. In addition, 49.70% (3956/7960) were identified as Gram-positive bacteria, 48.13% (3831/7960) were Gram-negative bacteria, and the remaining 2.17% (173/7960) were classified as fungi or other pathogens. Importantly, *Staphylococcus aureus* (21.68%), *Pseudomonas aeruginosa* (14.23%), and

Staphylococcus epidermidis (9.61%) were the top three pathogens most frequently isolated from patients.

CONCLUSION

In patients treated at the burn ward in this hospital from 2006 to 2019, *Staphylococcus aureus* and *Pseudomonas aeruginosa* were the predominant clinical pathogens responsible for bacterial infections. The circumstantial detection and detailed monitoring of the intensity and growth of different pathogenic bacteria in clinical patients as well as tests of drug sensitivity during burn recovery are particularly important to provide guidelines for the application of antibiotics and other related drugs. Careful collection and correct, standard culture of bacterial specimens are also crucial to improve the efficiency of bacterial infection detection. Effective monitoring and timely clinical treatment in patients may help reduce the possibility and rate of infection as well as alleviate the effects of drug resistance among patients in burn centers.

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Core Tip: This retrospective study analyzed the pathogenic bacteria isolated from clinical samples from patients on burn wards at our hospital between 2006 and 2019 to determine the distribution of different bacterial species and the long-term trends in bacterial drug resistance. Our findings may direct effective strategies, based on scientific evidence, for the prevention, control, and treatment of infections in burn patients.

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INTRODUCTION

Bacterial infection is one of the major causes of death of burn patients[1]. Highly effective therapeutic treatment against bacterial infection is very important for the prevention and control of infection. Antibiosis is frequently observed in clinical patients. The condition leads to dramatic changes in the bacterial distribution and resistance to drugs used for the treatment of pathogenic bacterial infections, resulting in clinical difficulties throughout the treatment of infectious diseases. Moreover, in burn patients, there are always bacterial evolutions and changes in spatial and regional sites as well as diverse temporal phases during infection. For hospitalized patients with burns, the distribution of pathogens can directly affect the treatment options and therapeutic effectiveness. It has been shown in both domestic and international studies that there are some differences in the distribution of pathogens in burn wounds in different locations and striking differences in drug resistance also exist[2-4].

There are several major clinical strains responsible for severe infections in burn centers or units in hospitals. For example, *Staphylococcus aureus* (*S. aureus*) is the predominant species responsible for burn infections. This organism is easily transmitted *via* close contact, especially to wounds that require long-term treatment. This organism is easy to detect but difficult to eliminate, especially during progression to systemic infection[5]. The rate of occurrence of methicillin-resistant *S. aureus* (MRSA) has gradually declined according to recent reports. This decline of drug resistance in *S. aureus* is related to the initiation of antimicrobial rectification measures in 2011 and the limitation of unreasonable applications of third-generation cephalosporins and third-generation quinolone antibiotics.

Pseudomonas aeruginosa (*P. aeruginosa*) is one of the most serious causes of lifethreatening infections in patients with heat injury[6]. This organism usually colonizes the skin and medical devices. Long lasting colonization of burn wounds can result in prolonged hospitalization, the long-term use of broad-spectrum antibiotics, delayed wound recovery, severe *P. aeruginosa* infection, and a risk of drug resistance[7].

Another pathogen, called *Staphylococcus epidermidis* (*S. epidermidis*), is a constituent of the normal flora of the skin and mucous membranes[8] and is the most commonly detected strain among the coagulase-negative staphylococci. Patients with this organism with low virulence are generally asymptomatic. However, in patients with immunosuppressive conditions (such as thermal injury), coagulase-negative staphylococci are considered to be as pathogenic as *S. aureus* and often transmit genetic resistance to susceptible *S. aureus*, converting them into multidrug-resistant *S. aureus*[5].

Impaired immunity and decreased susceptibility to *S. epidermidis* have been found in patients who receive various invasive treatments and extensive administration of hormones and immunosuppressive agents[4] This may lead to prosthetic valve endocarditis, venous catheter, peritonitis, blood vessel and artificial joint infections, and other complications.

S. epidermidis has become an important opportunistic pathogen in patients with impaired immune function. For burn patients, *S. epidermidis* is a common colonizer. Coagulase-negative staphylococci mainly colonize the skin and mucous membranes and the detection rate of this organism has clearly risen in recent years. Strict disinfection procedures to avoid nosocomial infections should be employed. Microbiological sampling procedures also need to be improved and optimized to reduce the potential for bacterial contamination.

Based on previous studies, it is important to monitor the distribution of pathogens, the characteristics and profiles of pathogenic bacteria and drug resistance in pathogenic bacteria in burn patients for the rapid and accurate selection of antibacterial regimens in clinical practice[2,9]. This retrospective analysis of batches of pathogenic bacteria isolated from clinical samples from patients treated at the burn ward in our hospital between 2006 and 2019 provides a new perspective regarding the distribution of bacterial species and drug resistance over a long-term period. Our findings provide useful and valuable scientific evidence and information for the development of new and effective strategies for the prevention, control, and treatment of bacterial infections in burn patients.

MATERIALS AND METHODS

Clinical specimens

All bacteria in this study were isolated from the wound secretions, blood, catheters, and sputum of patients in the burn ward at Beijing Jishuitan Hospital (a Third-Class A hospital) between January 2006 and December 2019. The burn severity in patients was classified according to the classification method adopted at the 1970 National Burn Conference, namely: (1) Mild burn; (2) Moderate burn; (3) Severe burn; and (4) Extremely severe burn.

Isolation and identification of bacterial strains

The VITEK-60 automatic bacterial analysis system (bioMérieux, France) was used to detect common bacteria. The standard reference strains used for quality control were *Escherichia coli* (*E. coli*) ATCC25922, *S. aureus* ATCC25923, *P. aeruginosa* ATCC27853, and *Klebsiella pneumoniae* (*K. pneumoniae*) ATCC700603, which were obtained from the Health Planning Commission Inspection Center.

Drug susceptibility test

The sensitivity to drugs was tested with GNS-121 and GPS-107 detection cards (bioMérieux). Microdilution (bioMérieux) and the K-B paper diffusion method were used to test for drug susceptibility. Antibiotic papers were used for drug resistance tests according to the Clinical and Laboratory Standards Institute criteria[1,4].

Statistical analysis

Categorical data were presented as frequencies and percentages. Categorical variables were analyzed using Pearson’s ^{2} test. The Fisher exact probability method was used when the theoretical frequency of cells was < 5. The Cochran-Armitage trend test was used to analyze the detection rate of pathogenic bacteria and the rate of drug resistance. The statistical analysis was performed with SPSS 19 software. *P* values < 0.05 were considered statistically significant.

RESULTS

Basic information

A total of 17119 patients with an average age of 36.43 ± 17.07 years (95% confidence interval: 1–98) were treated in the burn ward at our hospital from 2006 to 2019, of which 12899 (75.35%) were male and 4220 (24.65%) were female. In our study, patients with mild burns accounted for 70.41% of cases, those with moderate burns accounted for 17.03%, those with severe burns accounted for 5.19%, and those with extremely severe burns accounted for 7.37%.

Proportions of pathogenic bacteria types and temporal trends of bacteria

A total of 7960 strains of pathogenic bacteria were detected among clinical specimens from patients treated at the burn ward in our hospital between January 2006 and December 2019. The pathogenic bacteria were mainly isolated from burn wounds (87.98%, 7003/7960). Only 1.34% (107/7960) isolated from the blood of patients. Gram-positive bacteria accounted for 49.70% (3956/7960) of the isolates, Gram-negative bacteria accounted for 48.13% (3831/7960) and fungi and other pathogens accounted for 2.17% (173/7960).

During 2006–2011, the average number of positive samples was 235 per year, compared with 819 per year in 2012–2019 ($P < 0.05$; Table 1). The proportion of Gram-negative bacteria was higher than that of Gram-positive bacteria during the first 6 years (2006–2011). However, the proportion of Gram-negative bacteria detected in 2012–2015 was lower than that of Gram-positive bacteria. In 2016–2019, the proportions Gram-negative bacteria and Gram-positive bacteria were not significantly different ($P > 0.05$; Figure 1 and Table 1).

Prevalence of respective species of pathogenic bacteria

The eight most frequently detected pathogens in this study were *S. aureus* (21.68%, 1726/7960), *P. aeruginosa* (14.23%, 1133/7960), *S. epidermidis* (9.61%, 765/7960), *Acinetobacter baumannii* (*A. baumannii*) (7.11%, 566/7960), *Enterococcus faecalis* (*E. faecalis*) (5.58%, 444/7960), *Enterobacter cloacae* (5.19%, 413/7960), *E. coli* (4.92, 392/7960) and *K. pneumoniae* (4.57%, 364/7960) (Figure 2 and Table 2).

Over the past 14 years, *S. aureus* has been the most frequently isolated pathogen (17.06%–26.55%) in the burn ward, with no obvious upward or downward trend in the detection rate ($\chi^2 = 0.027$, $P = 0.870$). The second most common pathogen isolated from the burn patients was *P. aeruginosa*. As the predominant Gram-negative bacterium, its detection rate increased from 10.59% in 2006 to 17.68% in 2019 with statistical significance ($\chi^2 = 32.351$, $P \leq 0.0001$). *S. epidermidis* showed a similar trend, with its isolation rate increasing significantly starting from 2011. From 2012 to 2019, *S. epidermidis* was the third most frequently isolated strain in burn patients, with the detection rate increasing from 2.35% in 2006 to 10.99% in 2019. This increasing trend was statistically significant ($\chi^2 = 32.793$, $P \leq 0.0001$). In contrast, the detection rate of *A. baumannii* decreased from 15.88% in 2006 to 7.55% in 2019 ($\chi^2 = 79.007$, $P \leq 0.0001$). Significant trends were not observed for any of the other common bacterial species ($P > 0.05$).

Resistance of the predominant bacterial pathogens to antibiotics

In this study, bacterial drug resistance was evaluated. Four commonly used antimicrobial agents, imipenem, ceftazidime, cefepime, and levofloxacin, were selected for the evaluation of bacterial resistance. Compared with the results from the 2006-2011 period, the resistance of *S. aureus* to oxacillin decreased significantly over the following 6 years (2012–2019; $\chi^2 = 88.0448$, $P < 0.001$). The resistance of *Enterococcus* to vancomycin also decreased in 2012–2019, and the difference was statistically significant ($\chi^2 = 31.265$, $P < 0.001$; Figure 3 and Table 3). The resistance of *P. aeruginosa* to all four common antimicrobial agents showed a downward trend in 2012–2019 compared with the trend during the first 6 years (2006–2011), particularly the resistance to cefepime ($\chi^2 = 36.2767$, $P < 0.001$), ceftazidime ($\chi^2 = 6.7138$, $P = 0.001$) and levofloxacin ($\chi^2 = 13.0306$, $P < 0.001$). Similarly, the resistance of *A. baumannii* to cefepime ($\chi^2 = 21.3591$, $P < 0.001$), ceftazidime ($\chi^2 = 14.7418$, $P < 0.001$) and levofloxacin ($\chi^2 = 71.5236$, $P < 0.001$) decreased significantly over the latter 6 years, whereas the

Table 1 Annual distribution of Gram-positive and Gram-negative bacteria detected in samples

Year	Strains identified	Gram-positive bacteria, *n* (%)	Gram-negative bacteria, *n* (%)	Fungi, *n* (%)
2006	170	67 (39.41)	102 (60.00)	1 (0.59)
2007	232	99 (42.67)	131 (56.46)	2 (0.86)
2008	129	62 (48.07)	65 (50.39)	2 (1.55)
2009	239	87 (36.4)	144 (60.25)	8 (3.35)
2010	293	133 (45.39)	159 (54.26)	1 (0.34)
2011	349	152 (43.56)	194 (55.59)	3 (0.86)
2012	621	358 (57.65)	257 (41.38)	6 (0.97)
2013	606	326 (53.8)	268 (44.22)	12 (1.98)
2014	785	441 (56.18)	329 (41.91)	15 (1.91)
2015	678	356 (52.51)	310 (45.72)	12 (1.77)
2016	785	390 (49.68)	392 (49.94)	3 (0.38)
2017	810	400 (49.38)	401 (49.51)	9 (1.11)
2018	1098	560 (51.00)	508 (46.27)	30 (2.73)
2019	1165	525 (45.06)	571 (49.01)	69 (5.92)
Total	7960	3956 (49.70)	3831 (48.13)	173 (2.17)

resistance to imipenem remained at a very high level, evidenced by no statistical difference between the two time periods (Table 3).

DISCUSSION

This retrospective analysis was conducted with 7960 potential microbial pathogens found in clinical specimens from burn patients treated at our hospital between January 2006 and December 2019. The study participants consisted of patients from 36 provinces in China; 84% of the patients originated from north China and 11 patients were foreigners. Our findings revealed that the distribution of both Gram-positive and Gram-negative bacteria changed dynamically over time, consistent with previous studies showing that the distribution of bacterial species differed depending on the location of the hospital and the time period investigated[10-12]. The average number of bacteria-positive specimens increased from 235 cases per year in 2006–2011 to 819 cases per year in the subsequent 8 years (P < 0.001). This may reflect the fact that more samples were subjected to etiological diagnosis in our hospital. Our results, which were largely based on culture data, revealed that antibiotic resistance among Gram-positive (*S. aureus*, *E. faecalis*) and Gram-negative (*P. aeruginosa*, *A. baumannii*) bacteria decreased after antibiotics were used (Figure 3 and Table 3). Taken together, these findings indicate that more clinical samples should be collected for diagnosis to guide the effective utilization of antibiotics. That would help reduce the level of antibiotic resistance and antibiotic misuse.

This study showed that *S. aureus* was the primary pathogen in burn wards over the 12-year period from 2006 to 2019, accounting for 25.0% of the total positive isolates and consistent with most burn centers in domestic and international hospitals[2,4]. A significant downward trend was observed in the rate of MRSA detection in burn specimens, decreasing from 80% in 2006 to 30.09% in 2019.

The detection rate of *P. aeruginosa* in the burn wounds of patients increased from 2006 to 2019. From 2012 to 2019, *P. aeruginosa* remained the second most commonly isolated pathogen and the predominant Gram-negative bacteria. Another study also found that the detection rate of *P. aeruginosa* was on the rise in samples from the burn ward at Ruijin Hospital in China from 2007 to 2014[3]. A 20-year retrospective study in Germany also showed an increase in the detection rate of *P. aeruginosa*[2]. In our study, *P. aeruginosa* resistance to cefepime, ceftazidime, and levofloxacin showed a significant downward trend in the years before and after 2011. It has been suggested that the widespread use of antibacterial drugs has led to gradual bacterial resistance[13]. We

Table 2 Pathogens detected annually from 2006 to 2019, *n* (%)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total[1]
Staphylococcus aureus	29 (17.06)	52 (22.41)	29 (22.48)	44 (18.41)	51 (17.41)	76 (21.78)	149 (23.99)	131 (21.62)	169 (21.53)	180 (26.55)	175 (22.29)	164 (20.25)	261 (23.77)	216 (18.54)	1726 (21.68)
Pseudomonas aeruginosa	18 (10.59)	13 (5.6)	14 (10.85)	33 (13.81)	49 (16.72)	46 (13.18)	69 (11.11)	72 (11.88)	75 (9.55)	86 (12.68)	141 (17.96)	158 (19.51)	153 (13.93)	206 (17.68)	1133 (14.23)
Staphylococcus epidermidis	4 (2.35)	8 (3.45)	8 (6.2)	8 (3.35)	23 (7.85)	21 (6.02)	68 (10.95)	64 (10.56)	73 (9.3)	68 (10.03)	77 (9.81)	100 (12.35)	115 (10.47)	128 (10.99)	765 (9.61)
Acinetobacter baumannii	27 (15.88)	51 (21.98)	8 (6.2)	35 (14.64)	32 (10.92)	53 (15.19)	38 (6.12)	32 (5.28)	39 (4.97)	21 (3.1)	49 (6.24)	35 (4.32)	58 (5.28)	88 (7.55)	566 (7.11)
Enterococcus faecalis	16 (9.41)	21 (9.05)	5 (3.88)	6 (2.51)	14 (4.78)	17 (4.87)	22 (3.54)	24 (3.96)	43 (5.48)	37 (5.46)	54 (6.88)	57 (7.04)	59 (5.37)	69 (5.92)	444 (5.58)
Enterobacter cloacae	8 (4.71)	13 (5.6)	10 (7.75)	20 (8.37)	16 (5.46)	14 (4.01)	32 (5.15)	33 (5.45)	39 (4.97)	49 (7.23)	38 (4.84)	45 (5.56)	45 (4.1)	51 (4.38)	413 (5.19)
Escherichia coli	10 (5.88)	21 (9.05)	12 (9.3)	15 (6.28)	15 (5.12)	24 (6.88)	29 (4.67)	29 (4.79)	26 (3.31)	37 (5.46)	57 (7.26)	41 (5.06)	43 (3.92)	33 (2.83)	392 (4.92)
Klebsiella pneumoniae	7 (4.12)	6 (2.59)	7 (5.43)	7 (2.93)	12 (4.1)	13 (3.72)	18 (2.9)	24 (3.96)	29 (3.69)	30 (4.42)	27 (3.44)	37 (4.57)	75 (6.83)	72 (6.18)	364 (4.57)
Proteus mirabilis	6 (3.53)	5 (2.16)	5 (3.88)	9 (3.77)	8 (2.73)	11 (3.15)	5 (0.81)	14 (2.31)	14 (1.78)	21 (3.1)	20 (2.55)	28 (3.46)	19 (1.73)	14 (1.2)	179 (2.25)
Enterococcus faecium	7 (4.12)	8 (3.45)	4 (3.1)	6 (2.51)	2 (0.68)	9 (2.58)	13 (2.09)	12 (1.98)	14 (1.78)	8 (1.18)	17 (2.17)	19 (2.35)	19 (1.73)	25 (2.15)	163 (2.05)
Sum	170	232	129	239	293	349	621	606	785	678	785	810	1098	1165	7960 (100.00)

[1]2006-2019.

speculated that the observed decline in resistance rates may be due to the increasing rational use of antimicrobials in China since 2011. The changes in treatment regimens have undoubtedly contributed to a reduction in the transmission and prevalence of *P. aeruginosa*-resistant strains in burn wards.

Our study showed that the detection rate of *S. epidermidis* increased significantly after 2011. In addition, the detection rate of *A. baumannii* decreased dramatically from 2006 to 2019. As a conditional pathogen, *A. baumannii* is widely distributed in natural environments and is universally found in patients with impaired immunity, which can lead to nosocomial infections[13]. In recent years, owing to the implementation of control measures for nosocomial infection, the infection rates in hospitals have decreased significantly, and not surprisingly, the detection rate of *A. baumannii* has also declined.

Our results suggest that the sensitivity of Gram-negative bacteria to third and fourth generation cephalosporins has recovered remarkably, whereas the sensitivity to imipenem has not increased. One possible explanation for this finding is that imipenem is still used as the main treatment for Gram-negative bacilli[14]. High usage of carbapenems leads to the emergence of high levels of drug resistance, and the treatment of carbapenem-resistant *P. aeruginosa* may become a huge challenge for infections in the future.

Table 3 Comparison of antimicrobial resistance of major pathogens in burn patients, *n* (%)

		2006-2011		2012-2019		χ^2	*P* value
		Strain	Resistant strains	Strain	Resistant strains		
Staphylococcus aureus	Oxacillin	281	191 (67.97)	1445	545 (37.72)	88.0448	< 0.001
	Vancomycin	281	0 (0.00)	1445	0 (0.00)	NA	NA
Enterococcus	Vancomycin	115	13 (11.30)	492	6 (1.22)	31.265	< 0.001
Pseudomonas aeruginosa	Cefepime	173	109 (63.01)	960	369 (38.44)	36.2767	< 0.001
	Ceftazidime	173	78 (45.09)	960	334 (34.79)	6.7138	0.001
	Imipenem	173	79 (45.67)	960	390 (40.63)	1.5347	0.215
	Levofloxacin	173	88 (50.87)	960	349 (36.35)	13.0306	< 0.001
Acinetobacter baumannii	Cefepime	203	181 (89.16)	360	261 (72.50)	21.3591	< 0.001
	Ceftazidime	203	173 (85.22)	360	255 (70.83)	14.7418	< 0.001
	Imipenem	203	135 (66.50)	360	233 (64.72)	0.1817	0.67
	Levofloxacin	203	177 (87.19)	360	186 (51.67)	71.5236	< 0.001

NA: Not available.

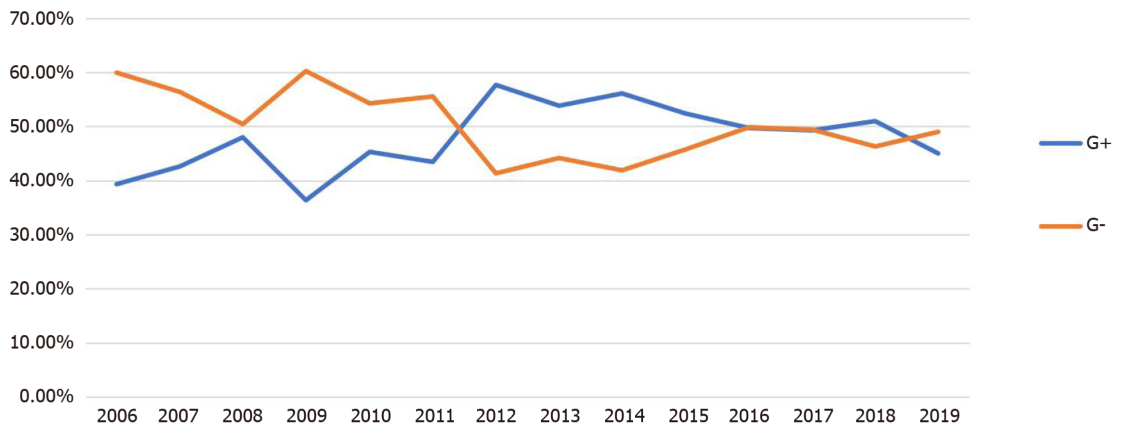

Figure 1 Changes in detection of Gram-negative bacteria and Gram-positive bacteria. G+: Gram-positive; G-: Gram-negative.

There were also some limitations in our study. First, we only collected data on bacteria and drug resistance from burn ward patients and did not record the clinical characteristics of the patients or their demographic information, which may affect bacterial resistance. Second, more samples were collected starting in 2011. A greater number of samples can increase the false-positive rate. Third, bacterial specimens were not subjected to more detailed in-depth molecular identification and homology analysis. In addition, this study was a retrospective analysis and therefore could not prospectively focus on the dynamic changes in pathogen resistance over different treatment periods. These limitations should be considered when interpreting our data, and further clarification and identification are required in subsequent studies.

CONCLUSION

In conclusion, we analyzed the distribution of pathogens and the long-term trends of bacterial resistance in patients in our burn ward during a 14-year period. After a series of antibacterial drug remediation activities in 2011, the number of positive cases detected increased significantly and resistance to drugs among the major Gram-positive and Gram-negative bacteria showed a downward trend. The monitoring of changes in pathogens and drug susceptibility is especially important to guide the rational use of antibacterial drugs.

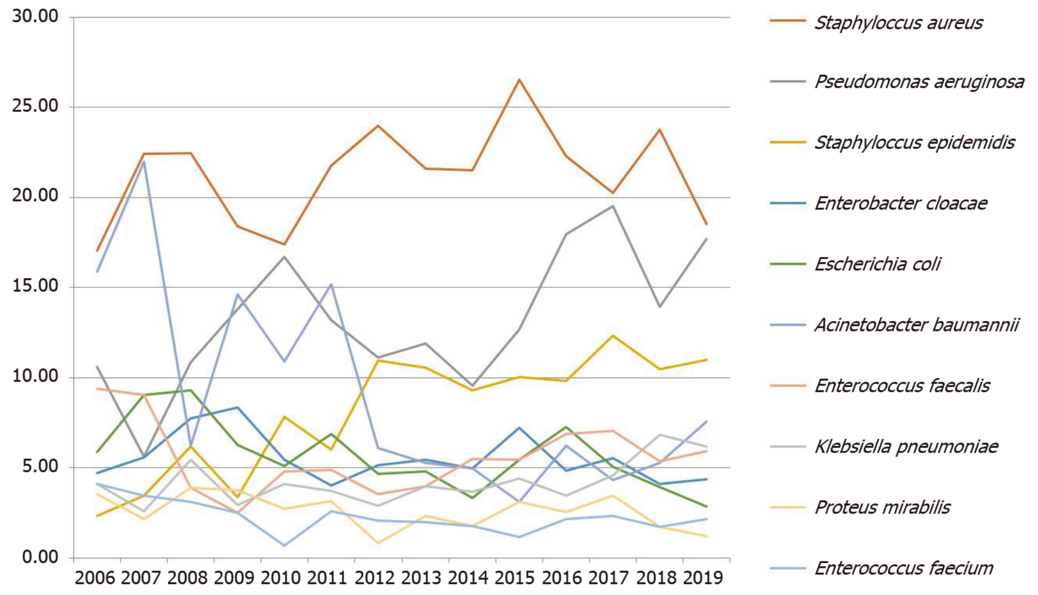

Figure 2 Annual changes in the percentage of specific bacteria among all detected pathogens from 2006 to 2019.

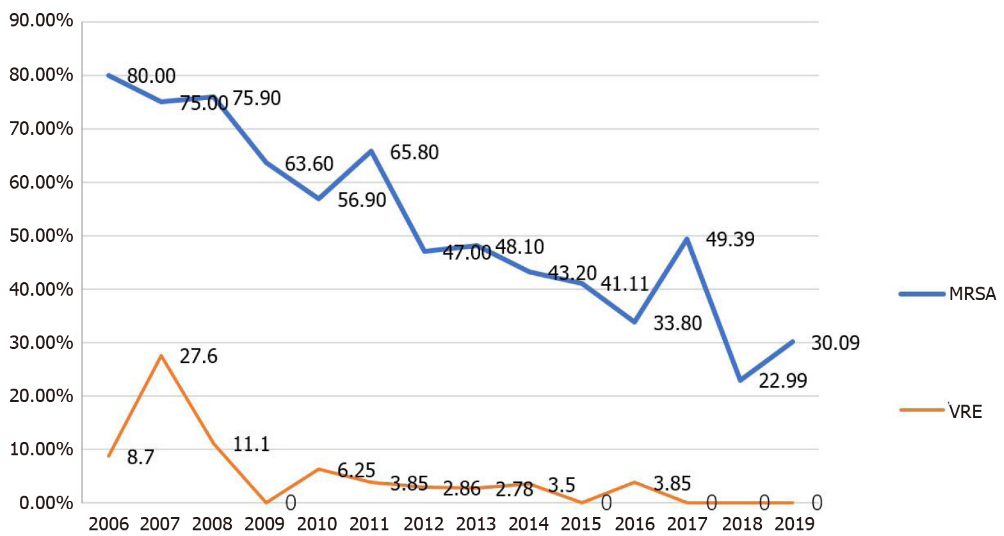

Figure 3 Annual detected multidrug-resistant bacteria from 2006 to 2019. MRSA: Methicillin-resistant *Staphylococcus aureus*; VRE: Vancomycin-resistant enterococci.

To improve the detection rate of pathogens in burn wounds, all processes for specimen collection, inspection, and testing should be standardized. Clinical treatment should be based on the identification of pathogens and profiles of drug resistance to facilitate effective personalized treatment with antibiotics. A series of tailored antibacterial drugs may be administered to combat bacterial infections and to alleviate drug resistance while avoiding the damaging side effects of non-specific antibacterial drug usage.

ARTICLE HIGHLIGHTS

Research background

Highly effective therapeutic treatment against bacterial infection is very important for the prevention and control of infection in burn patients. It is important to monitor the distribution of pathogens, the characteristics and profiles of pathogenic bacteria, and drug resistance in pathogenic bacteria in burn patients for the rapid and accurate selection of antibacterial regimens in clinical practice.

Research motivation

To provide useful and valuable scientific evidence and information for the development of new and effective strategies for the prevention, control, and treatment of bacterial infections in burn patients.

Research objectives

To develop more effective clinical strategies and techniques for the prevention and treatment of bacterial infections in burn patients.

Research methods

Clinical samples with positive bacteria were collected from patients at the burn ward in Beijing Jishuitan Hospital in China between January 2006 and December 2019. The samples were retrospectively analyzed, the distribution of pathogenic bacteria was determined, and the trends and changes in bacterial drug resistance during different periods were assessed. Drug resistance in several main pathogenic bacteria from 2006 to 2011 and from 2012 to 2019 was comparatively summarized and analyzed.

Research results

We analyzed data obtained from samples collected between 2006 and 2019 from 17119 patients. *Staphylococcus aureus* (21.68%), *Pseudomonas aeruginosa* (14.23%), *Staphylococcus epidermidis* (9.61%) were the top three pathogens most frequently isolated from patients.

Research conclusions

The circumstantial detection and detailed monitoring of the intensity and growth of different pathogenic bacteria in clinical patients as well as tests of drug sensitivity during burn recovery are particularly important to provide guidelines for the use of antibiotics and other related drugs.

Research perspectives

Bacterial specimens should be subjected to more detailed in-depth molecular identification and homology analysis.

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