

# The conductive gel for hospital use as a culture medium for the genus *Burkholderia*

## Abstract

The *Burkholderia* genus is a group of gram-negative bacteria that inhabit soil, water, plant and animal tissues; within this genus are *B. pseudomallei*, *B. cepacia*, and *B. contaminans*, which can cause multiple infections. The objective is to describe a prospective series and study whether the use of hospital gel contributed to the development of infection in patients.

**Methods:** Descriptive and prospective study of the series with positive cultures for the genus *Burkholderia* from 2019 to 2023 in a hospital in Colombia.

**Results:** 27 cases with isolation of *Burkholderia*, 74.07% *Burkholderia cepacea* and 25.93% *Burkholderia pseudomallei*, 68.85% male and 31.15% female, 78.57% from urban areas and 21.43% rural, 62.96% had a history of chronic diseases. The mean hours of culture positivity was 40.64 hours (SD ± 23.19), 14.81% presented pneumonia, 7.40% soft tissue infections, 55.55% sepsis and 22.24% others, the mean hospital stay was 7.92 days, 100% underwent diagnostic procedures using hospital gel, *B. Cepacea* and *B. pseudomallei* growth was obtained in the gel and identification by molecular tests reported *Burkholderia contaminans*, the mortality of this study was 22.22%.

**Conclusion:** The random culture carried out on the gel in different areas of the hospital obtained growth of *Burkholderia*, for which procedures and possible solutions are reconsidered to avoid the growth of this germ in this medium and the diagnostic strengthening in the laboratory. 81% presented pneumonia, 7.40% soft tissue infections, 55.55% sepsis and 22.24% others, the mean hospital stay was 7.92 days, 100% underwent diagnostic procedures with the use of gel hospital, *B. Cepacea* and *B. pseudomallei* growth was obtained in the gel and the identification by molecular tests reported *Burkholderia contaminans*, the mortality of this study was 22.22%.

**Keywords:** *Burkholderia cepacia*, *Burkholderia pseudomallei*, sepsis, culture medium

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## Introduction

*Burkholderia* comprises Gram-negative bacilli, non-spore-forming, they are aerobic, oxidase and catalase positive, they inhabit the soil, water, and plant and animal tissues.<sup>1,2</sup> Some of the components of this genus are opportunistic in humans, such as *B. pseudomallei*, *B. mallei* and *B. cepacia*.<sup>3,4</sup>

*B. pseudomallei* survives in various environmental niches, reflecting the ability to detect and respond to changes in the environment through specific survival mechanisms; its transmission is by inoculation into skin continuums, inhalation, or ingestion, has a high capacity to adapt and survive in stressful conditions.<sup>5-7</sup>

The clinical manifestations are varied, from asymptomatic to septicemia and multi-organ failure, this depends on the bacterial load at the time of exposure, the infection route (inhalation or percutaneous), the virulence of the strain and the immunological status of the individual. Contributing risk factors are chronic diseases such as diabetes, chronic renal failure, alcoholic hepatitis or chronic obstructive pulmonary disease.<sup>8</sup>

The diagnosis of this disease is late and difficult to perform, because this bacterium has specific characteristics and the microbiological assessment is complicated by its unusual behavior.<sup>8</sup>

*B. cepacia* emerged as an opportunistic pathogen affecting immunocompromised patients with cystic fibrosis and chronic granulomatous disease that prevent normal lung activity, causing pneumonia, septicemia and even death.<sup>9</sup>

This bacterium is difficult to isolate; differential culture media, automated identification systems, and complementary biochemical assays must be used, which generates a higher cost, but they are tests that have greater sensitivity and specificity.<sup>10</sup>

Cultures are the Gold Standard, the CDC recommends that all patients request blood cultures, pharyngeal cultures, and urine cultures, in addition to localized samples from the affected site; In reference laboratories or endemic areas there are other techniques such as real-time PCR, immunofluorescence with polyclonal or monoclonal antibodies for direct detection of clinical samples, and latex agglutination for identification from cultures. Serological tests such as indirect hemagglutination and ELISA can also be performed, which are useful for exposed laboratory workers, military personnel or people from endemic areas.<sup>11</sup>

The aim is to present a prospective series of cases with isolation of *Burkholderia cepacea* and *pseudomallei* with risk factors in those who underwent procedures where hospital gel was used.

## Materials and methods

A prospective series of patients who were seen in a hospital with culture of any type of sample positive for the *Burkholderia* genus in the period from 2019 to 2023 was carried out. Patients seen with cultures, urine cultures or blood cultures positive for *Burkholderia cepacia* and *pseudomallei* were included of patients treated in the years 2019 to 2023, in a hospital. Patients who underwent some type of culture of any sample and who had culture positivity for *Burkholderia* ruled out were excluded. The extraction process was

carried out by the researchers, consisted of reviewing the records of the selected clinical histories of patients with requested cultures and after reviewing each of the clinical records and culture reports, the study series was obtained with a total of 27 records of patients who met the criteria pointed out. The following variables were recorded: socio demographic: age, gender, area and municipality of origin, type of admission, cause of admission, medical history; clinical variables: complications, procedures performed (Where conductive gel will be used, which is a product specially formulated for medical use as an ultrasonic transducer or electric current transducer. This acts as a conductor of waves or electricity on the skin to be used with medical equipment (Ultrasonography, electrocardiogram, echocardiogram, etc.), hospital stay, conduct and outcome; and variables strict to the studied genus (*Burkholderia*), culture positivity time, detected species, and sample and resistance profile were worked on. An instrument was developed with the study variables and they were collected in it with the data obtained from the clinical records and later transferred to Excel version 2013 for analysis. The univariate analysis was carried out by means of a descriptive statistic for the selected series, determining absolute and relative frequency expressed in percentages, in the quantitative variables measures of central tendency (mean, median) and measures of dispersion (standard deviation and range were calculated). Interquartile) and 95% confidence intervals were calculated.

### Results

A database of all the cultures carried out in the study period 2019 to 2023 was obtained (Figure 1).

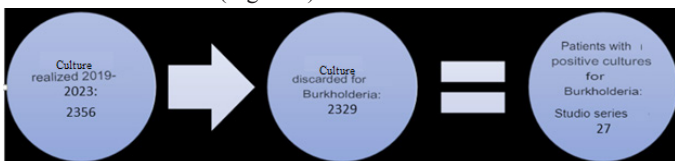


Figure 1 Scheme for obtaining the study series.

The average age of the patients who reported a positive culture for the *Burkholderia* genus was 57.04 years (SD ± 18.33) (IQR 45 - 72.5) (95%CI 50.12 - 63.95). Regarding sex, it was found that 68.85% were male and 31.15% female.

Table 1 Hours of positivity of the cultures

Time in hours	Absolute frequency n=27	Relative frequency n= 27
12-24 hours	8	29.63%
24-48 hours	15	55.56%
48-72 hours	3	11.11%
>72 hours	1	3.70%
Total	27	100.00%

Source: DGH Laboratory records.

Table 2 Antimicrobial resistance and susceptibility profile of *B. cepacea*

Series	CTX	MER	TGC	TMS	DOR	NOR	AMK	CZO	EFF	C.I.P.	GENE	MPI	TZP	ATM	CRO
1	>32	8		<=1		4	>32		>32	2	>8				>32
2	>32	4	2	<=1		2	16	>32	8	1	>8		32		>32
6	8	4		<=1		4	>32		2	1	>8				8
7	16	2		<=1		2	16		2	0.5	>8				8
8	32	4		<=1		8	>32		4	2	>8				16
10		2	>4		2		>32		8	1	>8	<=.25	<=4		8
11		2	>4		4		>32		32	2	>8	<=.25	<=4		32
12	16	4		<=1		2	>32		2	2	>8				16

According to the origin, it was evidenced that 78.57% were from urban areas and 21.43% from rural areas, distributed by municipalities (Figure 2).

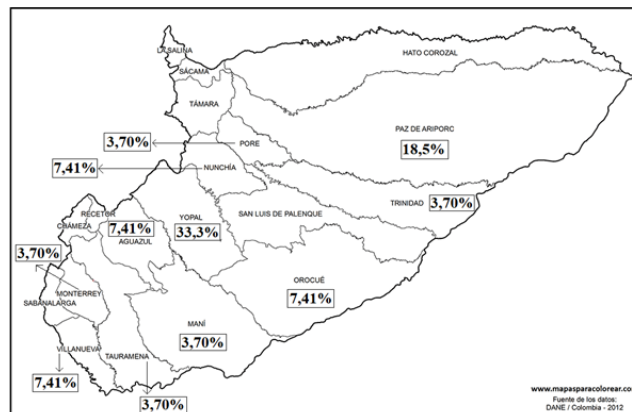


Figure 2 Distribution by municipalities.

Regarding the way of admission to the hospital, 55.55% were admitted referred from other health institutions and 44.45% entered by their own means, 62.96% had a history of chronic diseases such as Diabetes Mellitus, HTA, Chronic Kidney Disease, COPD, 11.11% autoimmune diseases such as SLE, RA, EM, Others, and 25.93% did not refer any pathological history. In 85.18% the cause of admission was general illness, 7.40% due to surgical pathology and 7.40% due to trauma (traffic accident).

66.96% of the isolation occurred in a blood sample (blood culture), 7.40% in urine (urine culture) and 25.64% was isolated in other secretions (special cultures). 74.07% corresponded to *Burkholderia cepacea* and 25.93% to *Burkholderia pseudomallei*.

The mean hours of positivity of the cultures was 40.64 hours (SD ± 23.19) (IQR 22.8 - 48) (95%CI 33.64 - 51.13) and the distribution was as follows Table 1.

Regarding the resistance profile and susceptibility to antimicrobials obtained, it is emphasized that they did not have it standardized for *B. pseudomallei*, for which reason only what pertains to *B. cepacea* is presented in the study series, which can be appreciate in Table 2.

Table 2 Continued...

Series	CTX	MER	TGC	TMS	DOR	NOR	AMK	CZO	EFF	C.I.P.	GENE	MPI	TZP	ATM	CRO
13	>32	4		<=1		8	>32		>32	>2	>8				>32
14		4	>4	<=1			>32	>32	4	2	>8		>64	16	8
15		8	>4	<=1			>32	>32	8	1	>8		>64	>32	32
16		1	>4		1		8		2	<=.25	8	<=.25	>64		2
17		4	2				16		16	0.5	>8	>8	>64		>32
18		4	2	<=20			16	>32	>32	0.5	>8		>64	>32	>32
19		<=.25	<=.5	<=20			16	<=4	<=1	<=.25	4		<=4		<=1
20		4		<=20			<=2	>32	2	2	<=1				8
22		1	>4				>32		8	2	>8	<=.25	<=4		8
25		1		>160		<=.5	16	>32	4	<=.06	>8				8
26		4	2				16		16	0.5	>8	>8	>64		>32
27		4					>32		>16	>2		>8	>64	>32	

**Source:** antibiotic susceptibility to *B. cepacea* is shown according to laboratory standard and CLSI (13) (\*CTX, Cefotaxime; MER, meropenem; TGC, tigecyclin; TMS, trimethoprim sulfamethoxazole; DOR, doripenem; NOR, norfloxacin; AMK, amikacin; CZO, ceftazidime; FEP, cefepime; CIP, ciprofloxacin; GEN, gentamicin; IPM, imipenem; TZP, piperacillin tazobactam; ATM, astreonom, CRO, ceftriaxone).

The reason for which they took the cultures corresponded to complications in each of the patients in the study series and showed that 14.81% presented pneumonia, 7.40% soft tissue infections, 55.55% sepsis and the 22.24% other complications such as urinary tract infection.

It was evidenced that all of this study series underwent diagnostic procedures and interventions where hospital use gel was required, the frequency found was: 40.74% ultrasonography of any type, 11.11% transthoracic echocardiography (TTE), 29.62% underwent procedures using hospital-use gel, for these cases placement of a central catheter guided by ultrasound, and 18.53% of the patients required ultrasound and TT echocardiography.

The hospital stay in time measured in hours in this series was: 3.70% stayed for 48 hours and in this case the patient was referred to a level of greater complexity, and 96.30% stayed for more than 72 hours in the hospital, with an average of 7.92 days of hospital stay (SD ± 2.88) (IQR 6 - 10) (95% CI 6.83 - 9.01).

The final behavior with the patients with positive cultures for the genus *Burkholderia* was: 48.14% were discharged to their homes with successful treatment, 29.62% were referred to a more complex level due to the severity of the complications and the 22.22% were transferred to the morgue, indicating the mortality of this study.

In the context of this study, the respective cultures were performed on samples obtained from the gel containers driver for hospital use, obtaining the following result: growth of the two species *B. Cepacea* and *B. pseudomallei* was obtained in the container and the gel for ultrasound recording, and this strain was sent for a study to identify another bacterium (strain) by molecular tests. Which finally reported: Microorganism *Burkholderia contaminans*.

## Discussion

The *Burkholderia* genus affects patients suffering from diseases that include the main risk factors such as diabetes, chronic renal failure, and alcoholic hepatitis, among others.<sup>4</sup> This is consistent with what was reported in this study.

*B. cepacia* is an enigmatic microorganism that has emerged as an opportunistic pathogen causing various infectious processes such as pneumonia, bacteremia, and urinary tract infection, among others, especially in debilitated, immunosuppressed patients, with cystic

fibrosis or in critical care units;<sup>12</sup> Despite not being found in patients with these last characteristics, this is the most frequent species in this analysis.

Symptoms will depend on several variables and may be asymptomatic or present with fever, leukocytosis, pulmonary infiltrates, respiratory distress, and sepsis, predominantly in patients who are immunocompromised (cystic fibrosis, chronic granulomatous disease, and diabetes mellitus), and less frequently in people immunocompetent.<sup>13</sup> These clinical manifestations occurred in the case series, highlighting sepsis followed by other complications such as urinary tract infections, pneumonia, and soft tissue infection.

Infection in humans is acquired through exposure to contaminated water or soil, in agricultural activities, and is inoculated by inhalation or ingestion.<sup>14</sup> In the reported series, they have in common the use of gel for hospital procedures.

The incubation time is variable, and depends on the species, whether it is *cepacea* or *pseudomallei*, but approximately they can be seen with the naked eye after 24 hours of incubation, however, in some cases it is necessary to wait until the third day.<sup>15</sup> For this study the mean exceeded 24 hours.

Regarding management, antibiotic therapy can be administered with medications that usually include tobramycin, trimethoprim-sulfamethoxazole, ceftazidime, meropenem, and minocycline. It should be noted that resistance to these antimicrobials and their combinations is increasingly common.<sup>16</sup>

The antibiotics meropenem and ciprofloxacin are the ones with the lowest minimum inhibitory concentration, they were administered in some cases according to the antibiogram, which agrees with the literature on the class of drugs that are administered.<sup>17</sup>

A systematic review to identify studies that caused *Burkholderia* spp outbreak due to contamination of US gels identified 14 outbreak reports, in most studies *B. cepacia* was the most common organism isolate. Other members such as *B. ambifaria*, *B. contaminans*, and *B. stabilis* caused outbreaks in two studies.<sup>18</sup> In this study, cultures were taken in random gel vials in different hospital services where growth of the genus *Burkholderia* was obtained and *B. Contaminans* was identified by molecular test.

*Burkholderia* contaminans in an emerging pathogen, is closely related to the complex *B. cepacea*, present in the environment and

capable of infecting people with cystic fibrosis and has been isolated in Argentina, Spain, Portugal, Australia, Canada, USA,<sup>19</sup> in this series it was possible to isolate the conductive gel for the take ultrasonography.

Nunvar J et al, carried out a comparative analysis of the whole genome of two isolates of *Burkholderia contaminans* in sputum and blood culture of a patient with cystic fibrosis in Argentina, managing to distinguish two phenotypes of *B. Contaminants* that coexisted in the host and entered its bloodstream, revealing that sputum and bloodstream isolates each represented a distinct phenotype.<sup>20</sup>

The limitations presented in the present study is the non-confirmation by genetics of the *Burkholderia cepacia* and *pseudomallei* isolates, since the hospital where the study was carried out does not have these tests.

## Conclusion

A common factor was found in this prospective series, which was the use of hospital gel for ultrasonography imaging. Having a positive culture result for *B. cepacia* and *B. pseudomallei* generated a high suspicion that this bacterium would be entering the hospital. patients by this means leading to an improvement plan within the health institution, with specific actions to control this infection and with the strengthening of diagnosis at this level with molecular tests to confirm if it is *B. cepacia*, *pseudomallei* or *contaminants*, determining the importance of molecular identification in patients from whom this pathogen is isolated for decision making in the initiation of antibiotics.

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## Conflicts of interest

There are no conflicting interests declared by the authors.

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