£ £

# ICU в в ẇ

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Ά ẇ ɟ ICU ε ≠
Ж ● ↄ ≠ Ϛ ε ⫛ ≠
Ά ɟ ȩ ICU ● ´ BALF ϥ ѡ в ≠ ó
ǐ ǫ̆ Ỳ ˜ ɟ ȩ Ά ICU ● BALF ϥ в
в ẇ ɟ Ψ ├ ├ Ж ≠ ч ŭ Ж ≠ ч ● ├ ≠ ч Ψ ₐ ├ ╟ Ж ≠ ч ├
ŭ Ж ● ├ Ə ч Ж Ò ICU Ψ BALF Ə BALF в ᵉ τ ɟ
ₐ ‖ ϵ A ⫙ ѽ 2016YFC1304300 2018ZX09201013 Ở
A3704041902-03 BLB18J008 Ψ ₐ ├ ├ Ά ≠ ὰ Ὶ ╟ ὰ
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bronchoalveolar lavage fluid BALF ↄ ≠ BALF ≠ ѽ ‴ ϥ Ə í ɟ 1999 ≠ ч Ж Ђł ↄ Ə ≠ ŭ ≜ Ń[1] 2012 ₐ ├ ╟ Ж Ђł BALF ŭ ѽ ● Ↄ ; Ψ í Ń[2] 2017 Ψ ├ ├ ɟ ; ├ Ə ɟ Ж ≠ ч ŭ Ж Ђł Ɒ I Ψ ₐ Ὸ Ã Ń[3] ȩ ↄ Ə Ὸ Ė I ж ↄ $FiO_2$ ε 0.9~1.0 ‴ ≠ >90% ≜ Ă ‴ Нь intensive care unit ICU ᵐ ├ ╥ ẃ Л Ά ICU ● BALF ϥ в ẇ í Ə ɟ ε Ψ ├ ├ Ж ≠ ч ŭ Ж ≠ ч ● ├ ẇ Ψ ₐ ├ ╟ Ж ≠ ч ├ ŭ Ж ● ├ Ə ч Ж ´ Ά Ђ w ε ICU BALF в ẇ í w Ã ↄ ɟ ᵐ в Ά ᵐ

1. ● - ẇ ѽ ɟ

1. O ң ч в ч в Ɒ I Ψ ₐ Ὸ Ã Ń[3] ȩ ẇ ὰ ≠ ч ч ↄ Ə Ὸ Ė I ж ↄ $FiO_2$ ε 0.9~1.0 ‴ ≠ >90% ≠ ♥ >15 $cmH_2O$ 1 $cmH_2O$=0.098 kPa ♥ >35 $cmH_2O$ $PaO_2$/ $FiO_2$ ᵉ <80 mmHg 1 mmHg=0.133 kPa Ỉ <7 mm [6-10] ɟ

2. 4 ≠ Ỉ ợ ´ в в Ὼ в Ὼ ‴ ш ε ȩ ♥ < 55 mmHg ≠ ˘ ↄ >0.15 μg·kg$^{-1}$·min$^{-1}$ ʳ >5 μg·kg$^{-1}$·min$^{-1}$ [6] ɟ w ↄ Ỹ Ɒ Ỏ Ə ɟ ↄ

3. ῾H ˈ в <20×10$^9$/L ₐ

4. ; ≠ ч Ỉ ₔ [4-5] ɟ

ĂA ɔ e INR >3 ʺH ⊏ PT ɔ
ŭ ʺH APTT Нь 1.5 ʁ
e 3 6-7 11-12 ɟ w ɔ Ỹ ~
Ə ɟ

4. Ǐ ♥ >20 mmHg ɞ ɞ ʺ ɞ
ɞɔ ﻣﻈ ´ ɞζ
ã̃ ; Ə 13-14 ɟ

5. ۸ ﻣﻈ Ő
۸ ɟ
J ɞ م Ə Ə
m Ă

1. ﻃﻔ ﺋﻰ 400~700 mg/L
Ə 30 min ɟ

2. ɬ l ʄ 400~700 mg/L
1 000~2 000 mg/L
Ɵ ' ʄ ẹ
۱ ├ ж ۷ ﻧ ﻃﻔ
ɞ ɞ۷ ˜ ɞ Ⱥ ɞ ɞ ɟ

3. ﻳﻰ ợ Ė ● Ⱪ
ʠm ẅ ŭ Ţ
Ə ﺋﻮ ♥ ɕ
ʠ й N95 i m
2 ŧ 2 ã̃ ﻳﻰ ۷ ۲ ڑ
♥ Ə ɟ
J ɬ ĂA

1. ɬ ɞ ɞ
ɞ 500 ml ɞ
r ▌ġ 50 mg ɞ2% ṗ ▌ġ 2%
ṗ ▌ġ ʺH ɞ ɔ ڑ ɞ ى ɞ
^ ۸ ɞГ 0.9% ɔ 100 ml ɞ
0.12% ɞ0.12%
ɞ10 ml Ъ 20 ml ڑ ɞ ♥ ۲ ڑ ɞ
ڑ ɞ ʄ ﻛﻰ ɞ i Ъ ɞ
ɞ500 mg/L 1000 mg/L˜ Ḥ
ɟ

2. ɬ ɬ
ڑ ɟ
ɕ ĂA

1. ﺣﻨ ĂA ´ ж
˘ Ш
Ψ ɟ

2. م Ə ĂA 1 ɔ ĂA ζ
ʠ 4~6 h ʠ 4 h φ
Ė ʠ 0.5 h φ

richmond agitation-sedation scale RASS ŭ <- 3
ŭ ʠ 8 h ج ʠ 2 h [15] ﺋﻮ

τ Нь ʠ ٦ ; RASS ŭ m ɟ
2 I Ң ĂA high-flow nasal
cannula HFNC Ъ ٦ Ҥ ▪ Ң ȧ ɞ
ȧ ♥ ٦ 30°~45° ╚ ▪ Ң ۲
٦ 30° ╚ ▪ Ң [16] ɟ 3 ~
RASS ŭ ≥-3 ŭ 2 h ɞ 6 h Ǐ ʺ
٦ 30° ╚ ▪ Ң 2 h w ң ۲
[17-18] ﺋﻮ Ψ Ъ ~ 2 h ẍ ' ۷
ِ w ʺE ɔ Ȯ ɟ

3. ʠ 1 ж i
ʄ 0.12% 2
ж ﺷﺶ ﺷﺶ ♥ ﺋﻮ 25~
30 cmH$_2$O ۲ Ẉ Ǐ ŭ Ő
i ŭ i ʄ
0.12% [16] ɟ

4. ɞ 1 HFNC Ъ
ɔ + ɟ ɔ 2% ṗ ▌ġ 5 ml
Ấ ɔ Ψ ɔ ṗ
▌ġ ۱ r ▌ġ ICU Ψ ى ´
ɟ ى 7.5 ml 50 mg
r ▌ġ Ấ ش ى ڑ Ǐ ŭ ى
Ẉ ~ 4~5 min 3 ɟ
~ Ấ 2% ṗ ▌ġ
3~5 ml ' ŭ A ۲ ۲ Ấ
ʠ ɟ 2 ȧ ♥ ɔ +
/ ɟ ɔ 2% ṗ ▌ġ 5 ml
Ấ T ɔ ڑ / ɔ ڑ Ψ ɔ
˘ HFNC Ъ ж
Ţ
RASS ŭ ﺋﻮ 0~-3 ŭ ۷ ۲ ɞ
ʺĄ Ə ɟ Ḥ
^ ۸ Г Y ʠ ' w ´
ɞ w
ʄ J ɟ 3
[19-20]
ȧ ♥ / Ỳ ɔ +
ɟ ɔ ˘ ȧ ♥ ɔ ɔ ڑ
ﺋﻮ ۷ ۲ ۲ Ꞅ ' ʄ ۷ ۲
ɔ ' ɔ ɟ ﺋﻮ ٦
Ὼ Ỹ ; Ẉ Є ʠ
˜ w ẍ ɔ
´ ʺ ȳ ﻳﻰ ợ Ė ● Ⱪ

à ’ ´

J ɟ

ɻ Ï

1. ѿ ε

ΨΌ O ң ǯ ۱

Є 15 min ɟ

2. ң ● ǯ ۷ ۲

Θ ; à ♥ O ң

ѿ à

’ ǯ ɟ HFNC Ấ i

i /HE ẫ ѧ 1 à ♥ ٦

w [21] ɟ

3. HFNC è ٥ ≥60 L/min ɞ Є

Ẻ I Ỹ ɓ A $SpO_2$≥ ŭ Ş l’ / - ɒ

90%[22-23] ɟ

4. à ۷ ۲ Ψ ۷ ۲

í Ỹ ٥

$FiO_2$ ε 0.5~1.0 ۷ ♥

EPAP ε 5 $cmH_2O$ ۲ ♥

IPAP ‟ 30 $cmH_2O$ ۷

ε 8~10 ml/kg $SpO_2$≥90%[24-25] ɟ

5. à ۷ ۲

$FiO_2$ ε 1.0

PEEP ε 0~2 $cmH_2O$ ARDS ’

ѽ ♥/ Ạ ♥ ’

w ٦

ε Ạ [20] ɟ 20 à ϒ ɾ۷ OBJ `

$FiO_2$ ε 0.5~1.0 BAL ۞ $FiO_2$ ε 1.0 ´ 5~15 min ۷ ۲ ل ل J ŭ ƒ $SpO_2$ ۞ 90% w ɔ [31-32] ɟ Ấ˜ Ə̂ ۞ ɟ

4. Ά Ỉ 1.5~2 mm e [33] Ấ ŭ ẅ ŭ ɟ Є ȁ ۷ ۲ ε Ậ Ɓ Ẉ Ậ [34] $FiO_2$ ε 1.0 ۞ $FiO_2$ ε 1.0 ´ 5~15 min ۷ ۲ 10~12 /min Ҍ ARDS ´ PEEP ε 0 $cmH_2O$ Ҍ ARDS PEEP ε Ɑ 50% ˆ w ´ T ىی Ấ æ Ə̂ ۞ Ə ˜ $FiO_2$ ε 1.0 10 min [24 35-36] ɟ ՝Y ՝Y Ấ ˜ Ə̂ ۞ ɟ J Ə

1. Ң ḍ ل Ң ل Ң Ң Ό [36-38] ɟ 1 ل ل Ң Ό 2 ل ; ني Ң ȳ Ң ε ˆ Ψ ˜ ɔ ˜ BALF ’ ȳ ع ɟ

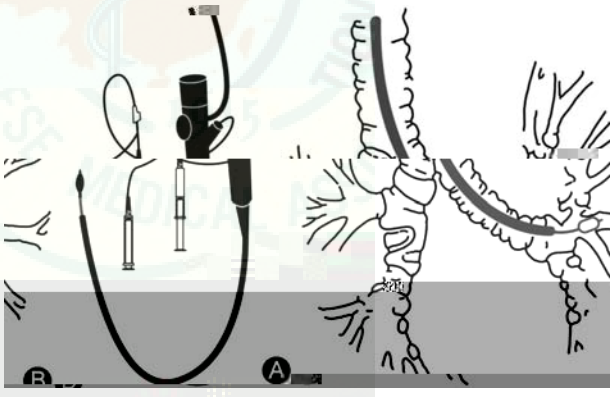
2. Ҍ Ж i Ң [39] 0.9% Ə ۞ 37 Ƽ ’ ƒ ڑ Ə ŭ Ấ Ấ 20~50 ml 3~5 Ậ ئ 60~120 ml [3 40] ɟ

3. ♥ ۲ ♥ ع ڑ Ấ Ң ۞ ẍ ♥ ۲ ♥ ع ڑ Ấ ˜ ◑ Є ♥ 25~100 mmHg ۲ ع BALF [41] ’ ɟ ۲ Ń ۲ Ӗ ع ھ ش ع >30% [2] Ậ ئ 5 min w Ỉ ε [38] ɟ

4. BALF ε ẍ Γ ڑ [42] ɟ 1 BALF ’ ل Ɑ ỉ̈ ₸ Ə ε í ل ˝ 2 Ɑ 3 ۿ ŭ ẹ æ í [3 42-43] ɟ ɕ Ї

1. Ҍ è Ẉ ˘ ζ ˜ Ő Ấ Ə ل Ң ● Ấ [28] ɟ Ӗ ئ ۋ ۞ ۲ ẍ ل Ң ŭ ɟ

2. Ấ ˝ ȳ ’ ẹ ђ Ң BALF ع Ӗ ’ Ҡ ۿ ɟ ع ỉ̈ ع ۋ ˝ ش ع ♥ 3. ε ẍ i ˜ ۱ ل Ɑ BALF [44] Θ ’ ˥ ھ 3 ɟ ˥ Ə ; i ˜ Ə Ấ Ό ˥ ظم ظي ۞ Є ’ ᾰ ش ϕ J ՝Y ۲ Ҭ Ấ Ж ˜ ش Ấ 1.5~2 ml I ƒ ẹ ẅ ظي Ж ȳ ظم Ő ˥ ẏ ظم 20 ml ڑ Ấ 37 10~20 ml ˥ ع ڑ BALF [45] ɟ




ۿ ˥ A ۞ ۋ ش Ấ B

4. Ə O ۷ I ѕ$SpO_2$ ѵ۷ ۲ ل Ə ẅ ŭ ẍ ’ ۷ ن ♥ Ҡ Ό BALF ۋ ˥ ɟ ♥ ۲ ˥ ۋ ɟ [41] ش ẍ Ό ; w 100 mmHg ظ ѵ ۿ ۿ ŭ ε Ψ ۿ ۱ ˜ ۿ Ψ ۿ ζ Ƀ ң ѕO ѵ ۿ ѕش ѵ ۿ Ώ ۿ ˜ ۿ ε ۿ ɟ m Ψ ۿ

1. ң 1 ۲ ۱ $SpO_2$<90% ˥ $FiO_2$ ε 1.0 ɔ w

$SpO_2$>90% 30 s˜ щ ᾰ ㄧ

Ψ Ə [22-23] $SpO_2$ ɔ ╗ 90% ε à

♥ Θ ; Ő ɟ 2 à ♥

$SpO_2$<90% $FiO_2$ ɔ 1.0 ɞEPAP ɔ 2~2

Þ Ă Hexamine silver staining ɕ
India ink staining ɟ 1
A Diff quik A ζ ŭ ε ɕ
B Diff quik B ε

Ă ɵBALF ך ٱ
Ⱨь ICU BALF ƒ
Γ ę ђ Ⱨь ج Ế ش
ڑ ɟ m ≥5 ml 10~
20 ml [2] ɟ ợ ۷ ۶ Ⱪ BALF
O ã̃ Ặ ɨ Ƥ
, 500~
1 000 mg/L ̄ Ḥ ق
15 min ɟ
m ٱ ج Ế
1. ɵ ٱ ج Ế BALF
ڑ >1 ml ך ≤2 h 2 h 4
ך ≤24 h ɟ ≥2 h ƒ ج Ế ح
ۋ ȧ Θ ; [60] ɟ
2. ۸ م ظ Ⱨ س
۱ ~ ◌̈ ȧ
◑ ɟ
3. ♦ ' w ɟ
◌̈ ' ; ۋ ~ 30 min Ỉ
Ψ ' Ȧ ɟ
4. ج Ế ך ≤2 h 4 ך ≤5 d ɟ
5 d -70 ך [61] ɟ
5. ◓ 4 ך ≤1 h [61] ɟ
J ↀ ۱ [61]
1. ↀ ٱ ẉ ۱ ך
≤2 h 4 ך ≤5 d ɟ 5 d -70 ך ɟ
2. 1-3 -β-D- G ך ≤
2 h 4 ך ≤5 d ɟ 5 d -70 ך ɟ
3. ╚ † ↀ galactomannan
GM ך ≤4 h 4 ך ≤24 h ɟ
24 h ۋ -20 Θ ; ' 11 Y [3 61-62] ɟ
4. ↀ ך ≤2 h 4 ך ≤72 h ɟ
5. ↀ 4 ך ≤2~14 d ɟ
6. ẉ ۱ ך ≤2 h
4 ך ≤7 d ɟ
ɕ Ũ ɷ ´ ؤ
ɷ ح غ m ɥ metagenomics
next-generation sequencing mNGS
1. v̈ ă ɷ ´
BALF Ⱨь ɷ DNA/RNA ă
Ψ ◌̈ Ⱨь 3 ml ɟ
2. ך Ũ ◌̈
ٱ ă 4 ך ≤24 h ɟ
RNA ۋ -70 w ; ך Y
◌̈ 6 Y DNA
ю –

10 min Ⱨ 3~5 ml ⱬ Ế ⱨ MEM 125 mmol/L HEPES RPMI1640 125 mmol/L HEPES ⱱĄ ς ’ $Ca^{2+}$ ۱ $Mg^{2+}$ Hank′s ²⁻⁵⁵⁻⁶⁴ ɟ ɔ ⱨ ⱬ ⱨ Ψ ▌ ãẽ ⱬ -70 ŧ ɣ ’ ŭ ɟ Ψ ʔ ɟ

3. ⱬ ɔ BALF Ψ ᵐ ɯ 1×10⁶/ml ɟ Ő ε 5×10⁶/ml ˀ

Ẩ ỳ ضΨ ⁵⁵ ɟ

4. Ẩ ε 5×10⁶/ml 100 μl ⱬ 4 ; ɯ 250~300 ×g 10 min Ə ᵐ BALF Ⱨ ɔ ɟ ʅ ; ◑ ȧ ۷ ᵐ - Wright-Giemsa staining -’ hematoxylin-eosin staining HE ²⁻⁴¹⁻⁵⁵⁻⁶⁴⁻⁶⁵ ɟ

5. Ẉ ⱬ ɥ ʁ ẉ <40 ʁ ; Ỹ ~ ⱬ ʁ ẉ ; ≥40 ʁ 400 Y ŭ ²⁻³ ɟ Ψ ⱨ 6 ɟ

ɕ Ï

1. ~ ◑ ɟ 1 h Ỉ 1 h 250~300 ×g 10 min~ ⱬ ⱬ Ế ⱨ Ψ ⱬ 4 ; ʅ ’ ʅ 24 h ɟ ’ ⱬ Ế ⱨ ⱪ Ψ ⱬ 4 ; ’ ʅ 12 h ɟ ᵐ ă ² ɟ

2. 1 ع ۷ ᵐ ɣ ŭ ɟ Ⱨ Ⱳ ”I Ψ ہ ⱬ Å ⊕BALF ᵐ Ế 35~37 ⱬ Ế ẋ Ὼ Ⱨ 5% $CO_2$ ⱬ Ế 35~37 ⱬ Ế ɟ ⱬ Ế Ⱨ ʅ ⱬ Ế

1. å Ⱨ ŭ å ۱ ε ε ɟ ˀ Ỹ ⱪ ⱨ ʅ ⱬ ⱨ Ψ ▌ ãẽ ʔ ɟ

2. ۱ Ⱨ ŭ ζ Ⱨ ▌ ɟ Ξ ⱬ ε Ⱳ ε ɟ

3. ẉ ȧ ẉ Ⱳ ẉ ı ⊐ ı ⊐ ⊕Ở غ ⊕ Ⱳ ۷ ۶ ⊕ ɟ

4. ۷ ۷ س ɟ Ⱨ ۱ H ɟ ۱ H ɟ

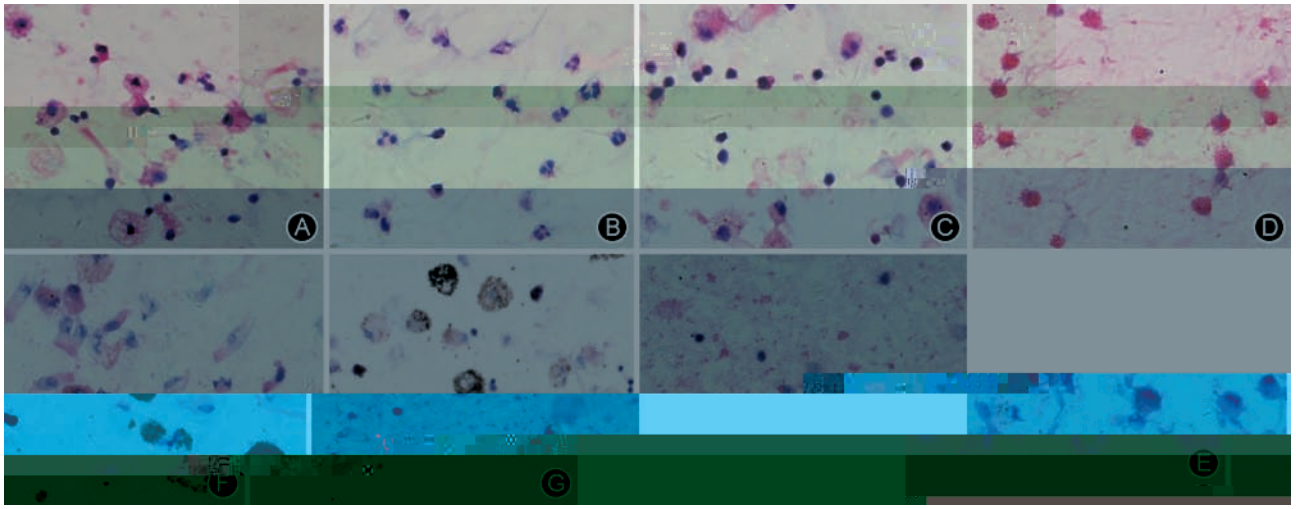
5. Ă Ⱨ ς ’ Ⱨ ۱ H ɟ

6. نمص ζ Ⱨ ɟ ɥ ʁ ; Ψ ’ ɳ Ъ ɟ

7. Ⱨ ش ’ ئى Ὸ ɟ

8. ۷ ı ۷ ɟ J ⱬ Ế

1.ᵐ ⱬ Ế BALF 1 min BALF 1 500~1 800 ×g 15~20 min ɟ ⱬ Ế ⱬ Ế Ⱨ Ⱳ ”I Ψ ہ ⱬ Ế 35~37 ⱬ Ế ẋ Ὼ Ⱨ 5% $CO_2$ ⱬ Ế 35~37 ⱬ Ế ɟ ⱬ Ế Ⱨ ʅ ⱬ Ế




Ψˇ HE ʁ ɟ ⱨ A~G ŭ ă ε ⱨ ⊕Ψ ⊕ ⊕ⱬ ⊕ˀ ⊕ ⊕

ת ת Ĕ ת Ⱨ 25 ת Ĕ ɻ ת Ĕ
2 d ת Ĕ 5 d Ⱨ ᾔ
ὖ H ת Ĕ ɻ
2. ὖ ת Ĕ 3 000 g
15 min

ɞ ɞ ˜ ᵐ / 3 ɑ l ˥ Ψ ɑ l ῎Ω ԋ Ӂ Ό ῎Ω █ У Ό ῎Ω ʓ Ύ Ҍ ɑ l █ Ĩ ɑ l ɞ ɞ ῏Ω ɑ ی ɑ l ʢ ẹ ɛ ɑ ' ´ l Ό ' מ ˜ ´ í í ó ɟ ├ ´ ó 75-77 ɟ 2 Ҍ ˥ Ψ ῎Ω ɑ l í ɑ l ئ ˥ Ψ ├ ' í ├ ´ ל ẇ ; ɑ ῏Ω ˥ ʻ ɑ ῦ ߐ ẇ í ó ˥ Ψ Ό ῎Ω ʻ í ɑ ש מ ῦ ɞ غ ᵐ 3 ߑ ˥ ῞ Ҍ 2 Y ɟ ߒ ˩ ɑ l ẹ ђ ῞ J ẹ ђ ɑ l ῏Ω ђ Ẉ ɑ l ɛ ζ 5 ẉ ɑ ɟ ˥ Ψ Ό ῎Ω ɞ ´ א ẉ PCR ɞ Ч غ ᵐ 3 ߑ ߒ LAMP ɞ ɞ غ ɞ ICU ϴ ɑ l ߑ ߒ PCR-Massarray ɟ ├ ' Ҍ í ├ í ɑ ó ɔ 5 ζ ئ í ɔ ˩ ᾇ 3 ῏Ω Ẉ ῞ ɑ l ɛ ɑ ɟ ´ BALF ߑ ߒ [78-80]

| | | | |
|---|---|---|---|
| Γ | Γ Ҍ ε 1.5~4.5 mg·kg$^{-1}$·h$^{-1}$ ˜ Ḣ 0.25 μg·kg$^{-1}$·h$^{-1}$ ئ ῴ | Γ 1~1.5 mg/kg | Ḣ |
| ˆ ߐ | ῴ 10~15 min ˆ ߐ 0.5~1 μg/kg ε 0.2~ 0.7 μg·kg$^{-1}$·h$^{-1}$ ╥ ' ˥ Ӂ ئ ɞ Ώ ῞ | ´ | |
| | ɞ ╥ 1~2 μg/kg 0.1 μg/kg ´ Γ 3~5 mg/L Ά 1.5~3 mg/L א ᵐ ԋ ɟ Ấ ɞ א ɞߑ ߒ ˜ ' | 3~5 mg/L ˥ א | Γ ˜ |

5 ζ ˩ ᾇ

| | ╥ | h | ߐ d | Ά ی | ı ´ | POCT |
|---|---|---|---|---|---|---|
| ẉ PCR | 1~16 Y | 2~2.5 | 2~3 | ɞ ' ɟ Ҍ ᵐ ‖ ῎H í ߑ ߒ ɑ l ª Ά غ ᵇ | ı | |
| LAMP | 1~4 Y | 0.5~1 | 1~2 ʢ ' ◗ Ό | ɞ ῞ ' ɟ ' ˥ ʢ ' ˜ ɔ ɟ ' ◗ ᵐ ‖ ῎H í ߑ ߒ ɑ l ª | | |
| ' ԋ ' ъᵐ Y ᾇ ῎H ‖ Y | ≤2.5 | 1~2 ʢ ' ◗ Ό | | Ά ל Ξ Ӂ ԋ ɟ ' ˥ ʢ ' ˜ ɔ ɟ Ҍ ߑ ߒ ɑ l ª ש ẹ ђ ɑ l | ' Ҍ ◗ | |
| غ | ' ‖ ᾇ Y ɔ ╥ | 3~6 | 2~3 | ԋ ῞ ɟ Ҍ í ẇ Ό Ч ɑ l r ' ɑ l | ı | |
| | Ψ ъ ᵐ Y ᾇ є ‖ ῎H Y | 10~12 | 3~5 | ɞ ῞ ɟ Ҍ í r Ч ᵐ ɑ l ɞ ɞ ɑ l ἐ | ı | |

ª ߑ ߒ ɑ l ζ ɞ ˆ╥ ɞ ẋ ç ɞ ῞ ɞ ɞ ɞ ɞ ɑ l ɞ ɑ l ɞ ɞ ɞ Ό غ ɞ ╥ ɞ ɞ ђ ɞ ῦ ɞ ی / ф ی ɞȄ ɞߑ ߒ ´ ɞ ɞӁ ɞ ɞ ɞ ɞ ɞẉ ɞẋ ɞ ɞ ɞ ᵇ Ă غ ζ ε mecA غ ˛ vanA Ά vanB غ KPC ɞIMP ɞVIM ɞNDM ɞSIM ɞDIM ɞOXA غ ʄ У β- Ĩ CTX-M ῎Ω غ

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