

## Original article

# MUL+DO: A multicomponent index for the quick diagnosis of peritonitis in peritoneal dialysis patients<sup>☆</sup>

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## ABSTRACT

Peritoneal infection is a common problem that has a negative impact on the survival of patients and the technique. The early administration of peritoneal infection treatment reduces complications.

The goal of this study is to propose a multicomponent index (MUL+DO) for the quick and efficient diagnosis of peritoneal infection.

We selected a training cohort of peritoneal effluent samples which were analyzed by Multistix<sup>®</sup> 10 SG Siemens test strips for leukocyte detection. Then, each sample was examined according to the gold standard: number of leukocytes, polymorphonuclear percentage and microbiological culture. We constructed the MUL+DO index by adding one point to the MULTISTIX [0-1-2-3] modified chromatic scale if the patient reported pain. The MUL+DO index ranged from 0 to 4. A model validation cohort was then created. MUL+DO was applied to each sample and leukocytes and polymorphonuclear percentage were also assessed.

The training cohort ultimately included 134 samples, 34 of which with infection (25.4% [17.6–33.1]). Samples with a MUL+DO value greater than 1 presented a sensitivity and specificity of 100%. The validation cohort included 100 samples with 16 infections (16% [8.3–23.7]).

Assuming a sample with a MUL+DO value greater than 1 to be positive, we obtained a sensitivity of 100% and a specificity of 95.2%.

The MUL+DO index applied to the training cohort showed a perfect separation of the positive and negative populations. All positive patients presented a score  $\geq 2$ . In the validation cohort, the MUL+DO reported a sensitivity of 100% and a specificity of 95.2%.

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## MUL+DO: índice multicomponente para el diagnóstico rápido de peritonitis en pacientes de diálisis peritoneal

### R E S U M E N

#### Palabras clave:

Diálisis peritoneal  
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Diagnóstico

La infección peritoneal es un problema frecuente que afecta negativamente a la supervivencia del paciente y de la técnica. El inicio rápido del tratamiento de la infección peritoneal reduce las complicaciones.

Se busca diseñar un índice multicomponente (MUL+DO) para el diagnóstico rápido y eficiente de infección peritoneal.

Con ese objetivo, se crea una cohorte de construcción con muestras de efluente peritoneal que se analizaron con tiras Multistix<sup>®</sup> 10 SG Siemens para la detección de leucocitos. Después, se examinó cada muestra según el patrón oro: número de leucocitos, porcentaje de polimorfonucleares y cultivo microbiológico. Se construyó MUL+DO sumándole un punto a la escala cromática modificada MULTISTIX [0-1-2-3] si el paciente reporta dolor. MUL+DO toma valores de 0 a 4. Posteriormente, se creó una cohorte de validación del modelo. MUL+DO se aplicó a cada muestra, determinándose también leucocitos y porcentaje de polimorfonucleares.

La cohorte de construcción incluyó 134 muestras, 34 tenían infección (25,4% [17,6-33,1]). Las muestras con un valor MUL+DO >1, presentaron una sensibilidad y especificidad del 100%. La cohorte de validación incluyó 100 muestras con 16 infecciones (16% [8,3-23,7]).

En la cohorte de validación asumiendo como positiva una muestra con un valor MUL+DO > 1, se obtuvo una sensibilidad del 100% y una especificidad del 95,2%.

MUL+DO aplicado en la cohorte de construcción, mostró una separación perfecta de las poblaciones positiva y negativa. Todos los pacientes positivos presentaron una puntuación  $\geq 2$ . En la cohorte de validación, el índice MUL+DO presentó una sensibilidad del 100% y una especificidad del 95,2%.

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## Introduction

The impact of peritonitis (IP) within a peritoneal dialysis (PD) unit is determined by the effect on the patient's long-term survival (not by its direct effect on lethality rate<sup>1</sup>), the close relationship with the failure of the technique,<sup>2</sup> and the loss of residual renal function.<sup>3</sup>

Although the incidence of IP in PD has decreased in recent years, possibly due to advances in systems of tubing connection, control of carriers of nasal *Staphylococcus aureus*,<sup>4,5</sup> improvement of modalities,<sup>6</sup> use of more biocompatible solutions<sup>7-9</sup> and innovations in the care of the exit orifice,<sup>10</sup> the peritoneal infection, still remains the most frequent complication in PD.

The diagnosis of "typical" bacterial peritonitis is based on the peritoneal liquid turbid effluent, specifically in a leukocyte (L) cell count greater than 100 L/microliter (L/ $\mu$ L) and more than 50% polymorphonuclear (PMN) in the formula.<sup>11</sup>

In the case of "atypical" IP, the presence of at least two of the following three conditions is required<sup>12</sup>:

- Abdominal symptoms, mainly pain.
- Cloudy effluent liquid, with the cell count and formula specified above.
- Gram stain or peritoneal fluid culture demonstrating the presence of microorganisms.

A rapid onset of antibiotic treatment, even without waiting for confirmation of diagnosis, is essential to reduce the complications of IP.<sup>11</sup>

The test strips, commonly used for the diagnosis of urinary infection, have shown excellent diagnostic validity (in terms of sensitivity and specificity) for the diagnosis of IP in PD,<sup>13-17</sup> although without reaching 100% sensitivity and specificity.

The frequent multicomponent nature of the diagnostic tests<sup>18</sup> (in the sense that, usually, more than one characteristic must be attended) led us to consider the construction of a multicomponent model (MUL+DO) for the diagnosis of peritoneal infection.

The MUL+DO model is formed, by the use of Multistix<sup>®</sup> 10 SG Siemens test strips, for the detection of leukocytes in effluent peritoneal fluid and self-reported pain by the patient. With this objective, a cohort was used to build the model (CCM), with subsequent validation in another independent cohort (CVM). The resulting model should be useful in clinical practice if it is quick, simple and valid.

## Methods

To construct the MUL+DO model, between January 1 and June 30, 2014, information was collected on all peritoneal effluent samples obtained after minimum of a 2-h of peritoneal fluid in the cavity and a minimum infusion volume of 1500 cc.

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