

The Role of the C-Reactive Protein as a Marker of Infection and the Judicious Use of Antibiotics in Diabetic Ketoacidosis

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Introduction

- Diabetic Ketoacidosis (DKA) carries a significant mortality risk in the order of 2-5%, increasing in the elderly to about 50%.¹
- Infection is the leading cause of DKA and accounts for 30-40% of the cases.¹
- It is already known that neutrophil counts can be non-specifically raised in DKA as a stress response or secondary to infection.²
- Inappropriate use of antibiotics leads to antibiotic-induced infections, such as from *Clostridium difficile* and other multiple resistant organisms.³
- In 2006, there were 55620 cases of *Clostridium difficile* in England.⁴

Aim

- Our aim was to investigate if the C-reactive protein (CRP) was an appropriate marker of infection, and, therefore, the basis of judicious use of antibiotics in patients with DKA.

Methods

- This was a single-centre study done at the Milton Keynes General Hospital.
- Medical notes were studied with the ICD-10 codes, E10.0 (DKA in T1DM without coma) and E10.1 (DKA in T1DM with coma).
- The study was retrospectively done between 1/11/4 and 30/6/6.
- 50 consecutive diabetic patients, aged 14-57 years were studied.
- DKA was defined as:
 - a laboratory plasma glucose level of >11.1 mmol/L or an arterial pH of <7.35
 - a venous bicarbonate of <15 mmol/L, and
 - urinary ketones of ++ or more.
- History and examination findings in support of infection were noted from the case notes. All laboratory and radiological data was collected from the hospital's electronic data systems.
- The data collected was as follows:
 - presence of fever
 - symptoms of respiratory, urinary, abdominal, skin or central nervous system infections
 - measurement of CRP, neutrophil counts, and liver function tests
 - blood and urine cultures
 - chest x-rays
- where clinically indicated, skin swabs, abdominal x-rays, ultrasound of the abdomen, lumbar punctures and CT brains were performed.

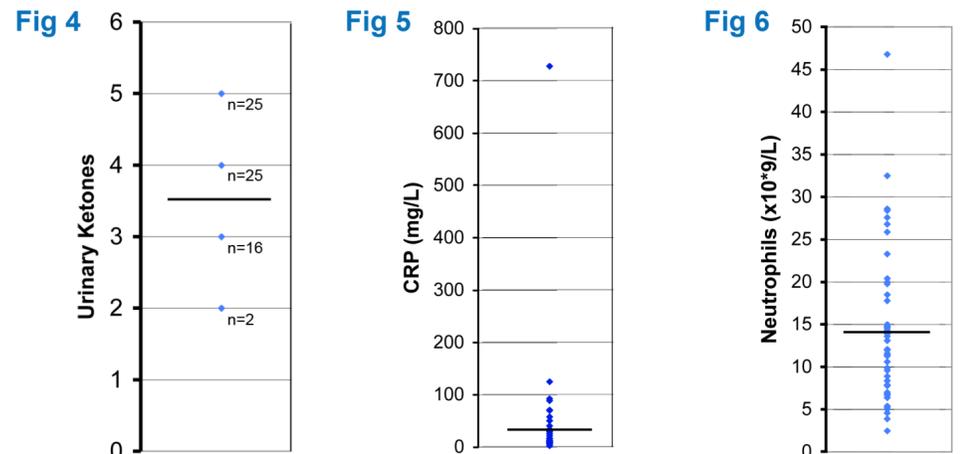
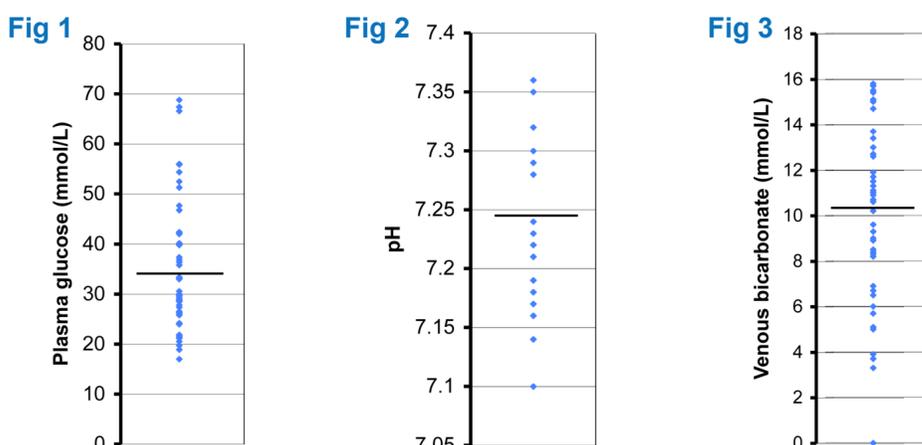
Results

Clinical details of the 50 patients with DKA

- Below are the symptoms at presentation:

Symptoms	No. of Patients Affected (proportion of total)
Cough, yellow sputum	1 (2%)
Shortness of breath, cough	1 (2%)
Bilateral flank pain	1 (2%)
Dysuria	1 (2%)
Headache	1 (2%)
Mouth ulcers	1 (2%)
Enlarged and red tonsils	1 (2%)
Sore throat	2 (4%)
Enlarged tonsils	1 (2%)
Pyrexia: 38°C	1 (2%)

- The data for venous glucose (Fig. 1), pH (Fig. 2), venous bicarbonate (Fig. 3), urinary ketones (Fig. 4), CRP (Fig. 5) and neutrophils (Fig. 6) is shown below. The horizontal bars in the figures represent the mean values.



- The laboratory and radiological data is shown below:

Investigations with findings	No. of Patients Affected (Total no. tested)
Liver function tests	1 (50)
Blood cultures:	
<i>Staphylococcus epidermidis</i>	1 (18)
<i>Streptococcus pneumoniae</i>	1 (18)
Urine cultures	0 (29)
Chest X-ray:	
Patchy left hilar consolidation	1 (24)
Bilateral lower lobe pneumonia	1 (24)
Abdominal X-ray	0 (2)
Ultrasound of the abdomen:	
Bladder flow obstruction and hydronephrosis in a right kidney transplant	1 (1)
CT Brain	0 (2)

Clinical details of patients with both clinical and laboratory evidence of infection

We found that in the fifty patients we studied with DKA and a raised CRP, only one had both clinical and laboratory-based evidence of infection. The data for this particular case is as follows:

- Shortness of breath, cough and reduced consciousness
- Temperature: 35.8°C
- Venous bicarbonate: <3
- Urinary ketones: 4+
- CRP: 727
- Neutrophil count: 32.5
- *Streptococcus pneumoniae*
- Chest X-ray: Bilateral lower lobe pneumonia

Discussion

This study highlights that the usage of antibiotics can be judged on parameters over and above the CRP levels, which include the history, other laboratory data and radiological evidence of an infection.

Conclusion

We conclude that in order to avoid the emerging problem of multiple resistant organisms and antibiotic-induced infections, such as *Clostridium difficile*, antibiotics should be used judiciously in patients with DKA and a raised CRP, only when there is hard evidence of an infection in their history, clinical examination and/or on investigations.

Acknowledgement

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References

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