**DIAGNOSTICS**

Polymorph count for predicting non-gonococcal urethral infection: a model using *Chlamydia trachomatis* diagnosed by ligase chain reaction

L J Haddow, A Bunn, A J Copas, R Gilson, M Prince, G L Ridgway, S T Sadiq

**Background/objectives:** The criteria for the diagnosis of non-gonococcal urethritis (NGU) on a Gram stained urethral smear are derived from previous studies which used culture as a diagnostic test for *Chlamydia trachomatis*. Our objectives were (1) to re-assess the relation between urethral polymorph count and *C trachomatis* infection, using ligase chain reaction (LCR) as the diagnostic test; and (2) to assess other possible predictors of *C trachomatis* infection such as symptoms, signs, demographic and behavioural variables.

**Methods:** We collected data from 363 men consecutively attending a genitourinary medicine clinic (excluding those with gonorrhoea and follow up visits) who had a urethral smear and a urethral LCR test for *C trachomatis*. The sensitivity and specificity of a discrete cut off in urethral polymorphonuclear leucocyte (PMNL) count as a diagnostic test for chlamydia urethritis were calculated. The associations between other variables, such as age and symptoms, and this infection were also estimated.

**Results:** 8% of men had *C trachomatis* infection and 26% of men had a PMNL count of 5 or more. Of those men with chlamydia 37% did not have NGU; 20% of men with NGU had chlamydia. Adjusted odds ratios for risk of chlamydial infection were significant for age less than 30 relative to 40 years and over (adj OR 13.6; 95% confidence interval 1.69 to 110), a PMNL count of 20 or more (6.56; 2.15 to 20.0), a PMNL count of 5–19 (3.59; 1.41 to 9.15), and the symptom of dysuria (3.27; 1.32 to 8.08). However a PMNL count of 5 or more was only 63% sensitive and 77% specific for *C trachomatis* infection. No association between sexual behaviour and chlamydial infection was found in this setting.

**Conclusions:** The PMNL count is associated with presence of chlamydial infection but a large proportion of men with chlamydia have PMNL counts below the recommended cut off for a diagnosis of NSU. Lower age and the presence of symptoms may be as predictive as the urethral polymorph count for chlamydial urethritis and possibly for other urethral infections.

Non-specific or non-gonococcal urethritis (NGU) is a frequent cause of symptoms in men and may be associated with pelvic inflammatory disease (PID) in female sexual contacts. The diagnosis in men is made by the absence of Gram negative intracellular coci on a urethral smear and the presence of five or more polymorphonuclear leucocytes (PMNL) per high power field (hpf), averaged over five fields, and/or the presence of 10 or more PMNL per hpf on a Gram stained preparation from a first pass urine specimen. The diagnostic threshold is derived from studies showing an association with the clinical syndrome of urethritis. Previous work used culture as a diagnostic test for *Chlamydia trachomatis* and appeared to demonstrate an association between this organism and the presence of urethritis as defined by microscopy. Newer nucleic acid amplification tests (NAATs) have a higher sensitivity than culture (90–98% compared to 60–80%). It is pertinent to re-evaluate the relations between urethral infection, their clinical presentation, and PMNL counts from urethral smears.

The objective of the study was to determine the relation between *C trachomatis* infection in men and urethral polymorph count by collecting data using ligase chain reaction (LCR) as the diagnostic test. The current recommended cut off in the polymorph count was to be assessed. We aimed to look at other predictors of *C trachomatis* infection using routinely collected clinical data such as sexual behaviour, symptoms, and signs.

**METHODS**

Data were collected on all men having STI screens during a 4 week period in 2001. Regardless of symptoms, all subjects had urethral swabs for Gram stained urethral smear and LCR testing. Men who had concomitant gonococcal urethritis were excluded. From the Gram stains the average number of PMNL per hpf (×1000 magnification) in the five fields of greatest density was calculated. A standard kit (LCx, Abbott Laboratories, Chicago, IL, USA) was used for detection of *C trachomatis*. All LCR results were retested for confirmation. Further information was retrieved from standardised pro formas in the case notes including symptoms, sexual history, and examination findings. Self reported discharge and its presence on examination were recorded as two separate variables.

To analyse possible factors associated with chlamydia, the χ² test was used for categorical variables and the Mann-Whitney test for continuous variables. Spearman rank correlation was used to assess the relation between time since last passing urine and urethral polymorph count, and interactions between these two variables and the LCR result were tested. Logistic regression was used to calculate adjusted odds ratios for those factors significantly associated at univariate analysis.

**RESULTS**

After excluding 19 men with gonococcal urethritis, 363 men were studied. The study population had a median age of 31.9 years (range 18–76), 82.0% (228/278) were white, and 50% (182/363) were men who have sex with men.

**Abbreviations:** LCR, ligase chain reaction; NAATs, nucleic acid amplification tests; NGU, non-gonococcal urethritis; PID, pelvic inflammatory disease; PMNL, polymorphonuclear leucocytes.
The point at which the lines cross was 95.9%. The point at which the lines cross for chlamydia was only 19.8%, although the negative predictive value of 5 or more PMNL per hpf for chlamydia, and the specificity is 76.9%. In our sample the positive predictive value of 5 or more has a sensitivity of 63.3% for urethral chlamydia, and the specificity is 76.9%. Hence the diagnosis by a urethral smear as if it were a test for chlamydia. More than one third of cases of chlamydia (11/30) had counts of less than 5 PMNL per hpf. Thus the prevalence of NGU diagnosed on urethral smear, was 26.4% (96/363) and the prevalence of C trachomatis was 8.3% (30/363). Prevalence of C trachomatis was greater at higher urethral polymorph counts—4.1% in men with less than 5 PMNL per hpf compared to 31.0% in men with 20 or more PMNL per hpf (p<0.001).

Figure 1 displays the specificity and sensitivity of the urethral smear as if it were a test for chlamydia. More than one third of cases of chlamydia (11/30) had counts of less than 5 PMNL per hpf. Hence the diagnosis by a urethral smear as if it were a test for chlamydia, and the specificity is 76.9%. In our sample the positive predictive value of 5 or more PMNL per hpf for chlamydia was only 19.8%, although the negative predictive value was 95.9%. The point at which the lines cross is at 3 PMNL per hpf, defining a cut off where the specificity and sensitivity are balanced.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
<th>No of chlamydia LCR positive (%)</th>
<th>Unadjusted odds ratio (95% CI)</th>
<th>p Value</th>
<th>Adjusted odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
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<tr>
<td></td>
<td>&lt;30</td>
<td>18/141 (12.8)</td>
<td>10.5 (1.38 to 80.6)</td>
<td>0.009*</td>
<td>13.6 (1.69 to 109.7)</td>
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<tr>
<td></td>
<td>30–39</td>
<td>11/148 (7.4)</td>
<td>5.8 (0.73 to 45.7)</td>
<td></td>
<td>7.6 (0.91 to 63.0)</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>1/73 (1.4)</td>
<td>1</td>
<td></td>
<td>1</td>
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<tr>
<td>PMNL per hpf</td>
<td>&lt;5</td>
<td>11/267 (4.1)</td>
<td>&lt;0.001*</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5–9</td>
<td>4/30 (13.3)</td>
<td>4.08 (1.65 to 10.1)</td>
<td></td>
<td>3.59 (1.41 to 9.15)</td>
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<tr>
<td></td>
<td>10–19</td>
<td>6/37 (16.2)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>20+</td>
<td>9/29 (31.0)</td>
<td>10.5 (3.89 to 28.2)</td>
<td></td>
<td>6.56 (2.15 to 20.0)</td>
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<td>Symptoms</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Dysuria</td>
<td>Yes</td>
<td>13/61 (21.3)</td>
<td>4.54 (2.07 to 9.95)</td>
<td>&lt;0.001</td>
<td>3.27 (1.32 to 8.08)</td>
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<td>No</td>
<td>17/302 (5.6)</td>
<td>1</td>
<td></td>
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<tr>
<td>Discharge</td>
<td>Yes</td>
<td>8/36 (22.2)</td>
<td>3.96 (1.62 to 9.71)</td>
<td>0.001</td>
<td>2.02 (0.67 to 6.07)</td>
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<tr>
<td></td>
<td>No</td>
<td>22/327 (6.7)</td>
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<tr>
<td>Penile discomfort</td>
<td>Yes</td>
<td>2/51 (3.9)</td>
<td>0.41 (0.096 to 1.79)</td>
<td>0.224</td>
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<tr>
<td></td>
<td>No</td>
<td>28/312 (9.0)</td>
<td>1</td>
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<tr>
<td>Testicular discomfort</td>
<td>Yes</td>
<td>1/15 (6.7)</td>
<td>0.79 (0.10 to 6.19)</td>
<td>0.818</td>
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<tr>
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<td>No</td>
<td>29/348 (8.3)</td>
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<td></td>
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<tr>
<td>Known STI contact</td>
<td>Yes</td>
<td>8/58 (13.8)</td>
<td>2.06 (0.87 to 4.88)</td>
<td>0.095</td>
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<tr>
<td></td>
<td>No</td>
<td>22/305 (7.2)</td>
<td>1</td>
<td></td>
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<td>Signs:</td>
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<td>Balanitis</td>
<td>Yes</td>
<td>1/19 (5.3)</td>
<td>0.57 (0.072 to 4.40)</td>
<td>0.581</td>
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<tr>
<td></td>
<td>No</td>
<td>28/313 (9.0)</td>
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<tr>
<td>Discharge</td>
<td>Yes</td>
<td>10/46 (21.7)</td>
<td>3.90 (1.68 to 9.05)</td>
<td>0.001</td>
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<tr>
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<td>No</td>
<td>19/286 (6.6)</td>
<td>1</td>
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<td>Epididymal tenderness</td>
<td>Yes</td>
<td>0</td>
<td>0</td>
<td>0.376</td>
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<tr>
<td></td>
<td>No</td>
<td>29/324 (9.0)</td>
<td>1</td>
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</tbody>
</table>

*p Values listed refer to the χ² test, except for variables asterisked which were analysed using the wilcoxon rank sum test. Multivariate analysis included variables found to be statistically significant on these tests.
variation associated with microscopy,
particularly at low
PMNL counts, and questions the utility of a cut off in
diagnosing urethral infection. Furthermore, our analysis
showed symptoms of dysuria and even age to be about as
strongly associated with chlamydia infection as urethral
polymorph count, while the presence of discharge had no
additional predictive power once a history of dysuria was
elicited.

Despite the increasing availability of NAATs for chlamydia
diagnosis, many questions regarding non-chlamydia NSU
and asymptomatic urethritis are unanswered. Urethritis has
been associated with *Trichomonas vaginalis*, although results
were inconclusive when the diagnosis was made by PCR, and
*Mycoplasma genitalium* (which has also been associated
with PID), but routine sensitive testing for these infections in
men is generally unavailable. Microscopy still has a central
diagnostic role in sexual health clinics and clinicians are
advised to treat all men with NGU on the basis of this,
supported by evidence of an association with pelvic inflam-
matory disease. Our data suggest that urethral polymorph
count is not as strongly associated with *C. trachomatis* as
previously assessed, and that age and symptoms should be
incorporated into the predictive algorithm of urethral
infection. Many clinicians adopt such an approach already.
The epidemiology of chlamydia negative NGU may become
easier to define as more sensitive tests for other organisms
become available.

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CONTRIBUTORS

All authors reviewed and commented on the manuscript; LH helped
develop the study, collected and analysed data; AC performed
statistical analysis and co-wrote relevant sections of the manuscript;
RG developed the study and co-wrote the paper; MP helped develop
the study and recorded laboratory data; STS conceived and developed
the study and co-wrote the paper.

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REFERENCES

1 Kamwendo F, Johansson E, Mai H, et al. Gonorrhoea, genital chlamydial
infection, and non-specific urethritis in male partners of women hospitalised
and treated for acute pelvic inflammatory disease. Sex Transm Dis
2 Clinical Effectiveness Group (AGUM and the MSSVD). National guideline on
the management of non-gonococcal urethritis. Sex Transm Infect
3 Swartz SL, Kraus SJ. Persistent urethral leukocytosis and asymptomatic
4 Arya OP, Mallinson H, Andrews BE, et al. Diagnosis of urethritis: role of
polymorphonuclear leukocyte counts in Gram-stained urethral smears. Sex
5 Hedin G, Abrahamsson G, Dahlberg E. Urethritis associated with Chlamydia
trachomatis: comparison of leukocyte esterase dipstick test of first-voided urine
and methylene blue-stained urethral smear as predictors of chlamydial
6 Swartz SL, Kraus SJ, Herrmann XL, et al. Diagnosis and etiology of
7 Davies PO, Ridgway GL. The role of polymerase chain reaction and ligase
chain reaction for the detection of Chlamydia trachomatis. Int J STD AIDS
1997;8:731–8.
8 Smith R, Copas AJ, Prince M, et al. Poor sensitivity and consistency of
microscopy in the diagnosis of low-grade non-gonococcal urethritis. Sex
9 Wendel KA, Erbolding EJ, Goydos CA, et al. Use of urine polymerase chain
reaction to define the prevalence and clinical presentation of *Trichomonas
10 Horner PJ, Thomas B, Gilroy CB, et al. Do all men attending departments
of genitourinary medicine need to be screened for non-gonococcal urethritis?
11 Taylor-Robinson D, Horner PJ. The role of *Mycoplasma genitalium* in non-
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