ORIGINAL RESEARCH

Challenges in preventing pyelonephritis in pregnant women in Indigenous communities

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ABSTRACT

Introduction: Aim: To measure the quality of antenatal care in rural and remote regions of the Northern Territory, using asymptomatic bacteruria as an indicator. Background: Indigenous Australian women and their babies have a greater frequency of adverse outcomes in pregnancy than their non-Indigenous counterparts. It is well established that asymptomatic bacteriuria may have serious outcomes in pregnancy, including an increased risk of pyelonephritis and a strong association with preterm and low birth weight delivery. Ensuring good quality antenatal care can reduce the individual risks of pregnancy for mothers and their babies. In the Northern Territory there are well established guidelines for antenatal care in rural and remote Indigenous communities. These are documented in the Women's Business Manual. Audit and feedback is one method that has been shown to have a small to moderate effect in changing clinician behaviour, in this case improving compliance with guidelines.

Methods: A retrospective chart audit of antenatal clients was conducted at 10 rural and remote primary health care clinics in the Northern Territory, Australia. The audit reviewed all the available charts ($n = 268$) of pregnant women, from the participating communities, who gave birth in 2002 or 2003. The diagnosis and management of asymptomatic bacteriuria was chosen as the indicator of quality antenatal care, as it is one of five areas of antenatal care where there is evidence that appropriate management improves outcomes. The quality of care was measured against the local guidelines, the Women's Business Manual.

Results: Women frequently had urine tests with where the dipstick showed an abnormal result, with 75% (95% CI [0.70,0.80]) of women having at least one episode of abnormal urinalysis during pregnancy. Six hundred and twenty episodes of abnormal urinalysis in pregnancy were identified. The incidence of bacteriuria at first visit was 16%, (95%-confidence interval = 95% CI

[0.10, 0.21]). Compliance with the guidelines was poor. Fifty-six percent (95% CI [0.52,0.60]) of those samples testing positive on urinalysis were not sent to pathology for microscopy and culture, as recommended in the guidelines. Of those with a positive culture, 32% (95% CI 0.28,0.39) were appropriately treated with antibiotics. When antibiotics were given, good compliance of 82% (95% CI 0.76,0.87) with antibiotic guidelines was demonstrated. The positive predictive value of dipstick urinalysis in diagnosing asymptomatic bacteriuria was low in this study at 33.5%. There were 13 episodes of confirmed or probable pyelonephritis. No women with recurrent urinary tract infections were followed up according to protocol.

Conclusion: Aboriginal women have worse pregnancy outcomes than the non-Indigenous population of Australia. Pyelonephritis is a preventable condition in pregnancy. In these rural and remote communities, pyelonephritis has not been prevented due, in part, to a failure to follow the local guidelines. Structural problems were identified and need to be addressed in order to improve compliance with guidelines and hence pregnancy outcomes for rural and remote Indigenous women.

Key words: Indigenous, pyelonephritis, women.

Introduction

Aim

To measure the quality of antenatal care in rural and remote regions of the Northern Territory, using asymptomatic bacteruria as an indicator, against the local guidelines, the Women's Business Manual[1].

Background

Indigenous Australian women and their babies have a greater frequency of adverse outcomes than their non-Indigenous counterparts[2]. Australian Aboriginal babies have twice the foetal death rate compared with non-Indigenous infants[3] and maternal mortality is over three times higher[4]. Ensuring good quality antenatal care can reduce the individual risks of pregnancy for mothers and their babies[5-11].

It is well established that asymptomatic bacteriuria has serious outcomes in pregnancy. Pregnant women with asymptomatic bacteriuria have an increased risk of pyelonephritis[6] and there is a strong association between asymptomatic bacteriuria and preterm and low birth weight delivery[6,12]. Treatment of asymptomatic bacteriuria with antibiotics has been shown to reduce the rate of

pyelonephritis[6]. Asymptomatic bacteriuria is the presence of bacteria in the urine, without symptoms. It is common and in non-pregnant women does not cause complications. Pyelonephritis is an infection of the kidney.

This study is a retrospective quality audit of antenatal care that aims to measure the quality of antenatal care in a rural and remote district of the Northern Territory, Australia. The management of urinalysis was chosen as an indicator of antenatal care because asymptomatic bacteriuria is one of five areas of antenatal care where studies have shown that screening and appropriate management improves outcomes[5-10].

Because the author suspected that the adherence to local guidelines was low, evidence was sought on how to help clinicians to change practice and to follow guidelines. Cochrane reviews investigated methods of changing physician behaviour[13-15]. Audit and feedback had a small to moderate effect in changing behaviour. The one factor that predicted the effectiveness of audit and feedback was baseline non-compliance with recommended practice. The median effectiveness of audit and feedback was a 7% improvement in protocol compliance. This level increased if there was baseline non-compliance[15]. Outreach visits have a small to moderate effect in improving physician prescribing. These visits are costly and there is minimal evidence on the

cost effectiveness of the measures[13]. Interactive workshops can result in moderately large changes in professional practice, but didactic sessions alone are unlikely to change professional practice[14]. Hence, audit was used in the methodology because it not only quantifies the problem, but can also be used as a tool to improve outcomes.

The present study was conducted in rural and remote areas of the Northern Territory of Australia, a very sparsely populated area. The district is 337 000 km^2 with 17 000 inhabitants of whom 7500 are Aboriginal[16]. A total of 10 000 people live in the main township[17]. There are Aboriginal communities located up to 600 km away from the nearest hospital. The area experiences weather extremes, which isolate communities for weeks to months by the flooding of roads and airstrips. These conditions present unique challenges in the delivery of health services.

Methods

The quality of management of rural and remote Indigenous pregnant women was examined using an audit of the diagnosis and management of asymptomatic bacteriuria. All pregnant women from participating communities who delivered in 2002 or 2003 were included.

Permission for this research was obtained from the James Cook University Ethics Committee and the Northern Territory Department of Health and Community Services and Menzies School of Health Research Human Ethics Committee.

A retrospective audit tool was prepared and piloted.

A list of women eligible for the study was obtained from hospitalisation data from the Northern Territory Department of Health and Community Services.

The charts were audited against the local guidelines, the Women's Business Manual (WBM)[1]. Positive dipstick urinalysis was defined as per the WBM as a dipstick result that shows positive nitrites and/or more than 1+ leucocytes, blood or protein[1]. A positive midstream urine (MSU) specimen was defined as a pure growth >100 000 organisms in urine on laboratory culture.

The WBM states that women should have an MSU sent to pathology on the first antenatal visit. At each subsequent antenatal visit or if the woman presents with urinary symptoms, the urine should be checked. If the woman is symptomatic or if the dipstick is positive, the urine should be sent for microscopy, culture and sensitivity (MC&S) and the woman should be treated immediately with antibiotics without waiting for the MSU result. The antibiotics of choice are nitrofurantoin and cephalexin.

The data was cleaned and entered into a Microsoft Access database and analysed using Access and SPSS (SPSS Inc; Chicago, IL, USA). Results from the audit were compared with figures from the literature using approximate 95%-confidence intervals for mean values or percentages. For sample sizes below 100, exact binomial 95%-confidence intervals were calculated for categorical characteristics. Categorical variables were presented as percentages with 95%-confidence intervals.

This is a quality assurance study, which is looking at compliance of staff with protocols. As such, the data is analysed per episode of urinalysis as well as per pregnant woman where appropriate.

Results

Urinalysis Audit

The charts were audited in the respective community health centres. A total of 317 charts of pregnant women were located for auditing. Thirty-one charts contained no antenatal notes. Eleven results were excluded because the women were identified as non-Indigenous or the child was born in the wrong year. Eight women had charts audited at more than one community. The information from these charts was

combined so that these women were only counted once. This left a total of 268 different women whose charts were audited.

There were 250 women analysed for the audit of the first visit data only, because another 18 charts were excluded. In these cases, the first visit occurred in a different community to where the audit was conducted. This meant that the auditor could not guarantee that all the appropriate information was available for audit. These 18 charts were not excluded from the rest of the analysis.

The charts were audited in 10 rural and remote health centres. The number of files audited in each community ranged between seven and 102.

First visit data

There were 250 charts of different women used in this analysis. An MSU was sent to pathology on the first visit for 79% (197/250) of women. (Range between communities: 58%-92%) (95% CI 0.74,0.84). Of the MSU sent, 15.7% (29/185*) were positive, (CI 95% = 0.10,0.21). (*There were 12 episodes where there was documentation of an MSU being sent to the laboratory but the result was not found during the audit. For this reason, they were excluded from this analysis).

Positive Urinalysis: There were 1949 episodes of dipstick urinalysis analysed. Six hundred and twenty (31.8%) episodes were positive according to the definition from the WBM.

Two hundred of the 268 women (75%) had at least one episode of abnormal urinalysis during pregnancy according to the protocol (Table 1). Samples were sent to pathology in 44% of cases where it was appropriate to do so. The number of positive MSU results per MSU sent was 88/263 (33.5%). This is the positive predictive value for dipstick urinalysis in this study.

The WBM recommends immediate treatment for those with positive urinalysis or those who are symptomatic. This occurred 31.9% of the time. Of women with positive urinalysis, 19.7% were both treated immediately with antibiotics and had their urine sent for MC&S; 56.6% had either MC&S or immediate treatment. There were 269 incidents where neither treatment was given nor an MSU sent for positive urinalysis, equating to 131 women (48.9%). Assuming 33.5% of these positive dipsticks tests were true positives, there were 89 episodes or 44 women (16.4%) who had unrecognised and untreated episodes of asymptomatic bacteriuria.

Where antibiotics had been given, the correct antibiotic according to the WBM was given in 162/198 (81.8%) episodes (Table 1).

Pyelonephritis

Pyelonephritis was defined as either a hospital discharge summary with a diagnosis of pyelonephritis or a presentation to the clinic with loin pain, a confirmed urine infection and a documented fever. There were four confirmed episodes of pyelonephritis and nine episodes of probable pyelonephritis (ie loin pain and urinary tract infection, but with no documented temperature in the clinic notes) (Table 2).

Discussion

In this study, the prevalence of urinary tract infections at first visit was 15.7%, which is higher than rates of 5-10% previously reported in the international literature[6,18]. This is expected, because the prevalence of asymptomatic bacteriuria rises with falling socioeconomic status[6]. Indigenous Australians have a low socioeconomic status compared with the rest of the Australian population[19]. Screening for asymptomatic bacteriuria has been shown to be cost-effective in the USA and is more cost-effective, the higher the prevalence of the disease[20]. Hence, in this rural and remote Indigenous population it is important to screen for and treat asymptomatic bacteriuria.

Table 1: Positive urinalysis results as found in quality assurance audit of 268 Indigenous pregnancies occurring in 2002 or 2003 in rural and remote communities of the Northern Territory.

Question	n	% or valid %	Range among communities %	95% confidence intervals
No. women with at least one episode of positive urinalysis during pregnancy	200/268	75.0	60–94	[0.70,0.80]
No. women with at least one positive mid-stream urine (MSU) during pregnancy.	62/268	23.1	15–50	[0.18,0.28]
No. women with at least one episode of positive urinalysis with no MSU sent during pregnancy.	17/200	8.5		[0.05,0.12]
No. MSU sent per episode of positive urinalysis	275/620	44.4	25–70	[0.40-0.48]
No. positive MSU results per MSU sent	88/263†	33.5	25–100	[0.28-0.39]
No. episodes where immediate treatment was given per episode of positive urinalysis.	198/620	31.9	19–65	[0.28-0.36]
No. episodes where the correct antibiotic was given per episode of immediate treatment given.	162/198	81.8	28.6–100	[0.76,0.87]

†The denominator for positive MSUs sent is smaller than the numerator for MSU sent. This is because there were 12 cases where there was documentation of an MSU being sent but the result was not found. For this reason, they were excluded from this analysis.

Table 2: Percentage of women with pyelonephritis

Variable	n (%)
Women in study with pyelonephritis	13/268 (4.9)
Women with positive urinalysis and pyelonephritis	13/200 (6.5)
Women with positive urine culture and pyelonephritis	13/62 (21.0)

Pyelonephritis will occur in 1.8%-30% of woman who have non-treated asymptomatic bacteriuria during pregnancy[6,18]. In this study, it is difficult to accurately determine the percentage of women with asymptomatic bacteriuria who were not treated, because 56% of positive urinalysis samples were not sent to the laboratory for microscopy and culture and 68% of the women were not given immediate antibiotic treatment. So accurate comparisons cannot be made.

To prevent pyelonephritis, asymptomatic bacteriuria must be detected and then treated with antibiotics. Appropriate diagnosis of urine specimens is more challenging in these communities than in large rural centres and capital cities.

There is no ideal screening test for asymptomatic bacteriuria. Dipstick urinalysis, which is recommended by the local guidelines, has a high negative predictive value and, hence, is useful for excluding disease, but has a low positive predictive value and is poor for diagnosis[21]. The high false positive rate is exacerbated in the Northern Territory because dipsticks should be stored in low humidity and at less than 30°C, a challenge given the weather conditions[22].

Inappropriate storage leads to false positive results on the nitrites test[23].

Reasons for the high false positive rate on dipstick urinalysis include the presence of Candida, Chlamydia, Gonorrhoea or Trichamonas[1]. Indigenous Australians and the Northern Territory population have well-documented high rates of Chlamydia and Gonorrhoea[24,25]. Prevalence rates for *Candida albicans* are not available for the Northern Territory or for Indigenous women. The prevalence is higher in pregnant, compared with non-pregnant women[26]. Fungal infections are thought to be more common in hot, humid climates. Given these are the climatic conditions of the Northern Territory of Australia, it is likely that Candida infection is common. Treating any of these infections with the antibiotics recommended for a urine infection is inappropriate and, in the case of Candida, could exacerbate the infection.

Because of the high false positive rate of dipstick urinalysis, the WBM recommends sending all positive urinalysis specimens to the pathology laboratory for MC&S to confirm diagnosis. There are challenges in transporting specimens to the laboratory. Microbiologists will not culture a specimen that is more than 72 h old and would prefer to culture a specimen that is less than 24 h old. Some communities are serviced by mail planes weekly and so transporting a specimen within 72 h can be impossible. The best-serviced communities have daily bus services for transport. While health services can advocate for increased frequency of transport, they do not control this directly.

Another option is to train clinic staff to perform Gram stains and culture. These techniques are not difficult. The problem is that many remote communities have high staff turnover and failure to keep up with the training with new staff would leave frequent gaps in the service[27,28]. Reducing staff turnover is challenging, given the working and living conditions of community life.

An alternative is to treat all women with a positive dipstick with antibiotics without a microscopy and culture result, as

recommended in the WBM. It solves the problem of transporting specimens to the laboratory or teaching clinic staff laboratory techniques. This option leads to over-prescribing of antibiotics. In this study the positive predictive value of dipstick urinalysis was 33.5%. If the guidelines were followed, two-thirds of women would be treated for a urine infection that they did not have, risking adverse effects and increased resistance to antibiotics.

Staff issues are the other aspect to guideline compliance. Retaining staff in isolated remote communities can be difficult[27,28]. Many of these communities have high staff turnover and there is little time to fully orient staff to the differences in the guidelines compared with other jurisdictions before the staff have left and the process needs to begin again. Attempts to improve compliance must begin with reduced staff turnover. Some communities with low turnovers also have low level of guideline compliance. In these places the audit and feedback loop should help improve compliance.

In some instances the guidelines are inappropriate. The guidelines state that any specimen with abnormal urinalysis should be both sent to the laboratory and immediate treatment given. If a community has access to pathology services and a functioning recall system to recall clients with positive MSU results, then following the guidelines may be inappropriate. There were two communities that did not follow the guidelines, but had logical reasons for their actions. One community sent most of their abnormal specimens to the laboratory (70%) but rarely gave immediate treatment (19%) because they were able to follow-up clients with positive results. Another community that had a weekly mail plane service rarely sent specimens to the laboratory (34%), but treated many patients immediately with antibiotics (66%). Again, this is appropriate given the lack of available transport.

The process of guideline implementation is an important part of improving staff compliance. The Australian NHMRC has produced guidelines that discuss steps that may improve compliance[29]. However, given the urban orientation of the

NHMRC document and the rural and remote setting where the guidelines discussed will be used, not all steps identified by the NHMRC will be applicable. A search by the authors was not able to locate rural-specific advice on implementation, so this may be a subject for future research. However, from the NHMRC document, steps that may be useful include: use of opinion leaders and 'champions'; practice visits from influential experts; reminder systems incorporated into clinicians' daily work; continuing quality assurance and data feedback; and local adaptation of the guidelines.

Conclusion

Aboriginal women have worse pregnancy outcomes than the non-Indigenous population of Australia. Pyelonephritis is a preventable condition in pregnancy. In these rural and remote communities, pyelonephritis has not been prevented due, in part, to a failure to follow the local guidelines. Structural problems were identified and need to be addressed in order to both improve compliance with guidelines and improve pregnancy outcomes for rural and remote Indigenous women.

Acknowledgements

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