INTRODUCTION

Tubal blockage is a common cause of infertility among women [1]. Basic understanding of the factors associated with female infertility is very important in clinical practice as well as in successful management. Pelvic inflammatory disease (PID) and upper genital tract infection causing endometritis, salpingitis, tubo-ovarian abscess and peritonitis in the small pelvis may contribute in tubal infertility [2]. In most cases the infection is ascending, Chlamydia trachomatis and Neisseria gonorrhoea are common with increasing incidence [3]. Chlamydia trachomatis infection is also associated with a high risk of PID [4]. Pelvic sequelae with permanent tubal alterations due to immuno-allergic reactions can also happen, that lead to chronic pelvic pain and infertility [5]. In addition, there are many other causes of tubal infertility which include surgery, previous ectopic pregnancy, congenital abnormality, endometriosis and hydrosalpinx [6].

In these patients, conception is only possible through expensive and complex treatments such as in vitro fertilization or surgery. Further, the success rate cannot be guaranteed, even after repeated treatments. Major drawbacks of in vitro fertilization are low pregnancy rate (28.4%), birth rates (<20%) and the significant number of multiple pregnancies (21%) [2]. The main outcome measures are the pregnancy and birth rates following the microsurgical procedure. The pregnancy (43.4%) and birth (29.2%) rates after microsurgery for tubal damage (abortion: 6.4%; ectopic pregnancy: 7.9%) were higher than after single in vitro fertilization [7].

Continuous short wave diathermy (SWD) is the technique of choice when uniform marked elevation of temperature is required in the deep tissues. Continuous SWD can help to relieve pain and muscle spasm, resolve inflammatory states reduce swelling, promote vasodilatation, increase the compliance of connective tissue, increase joint range and decrease joint stiffness [8]. Although, diathermia is relatively safe, but regarded as a contraindication compared to metal implant in general field of treatment, because of the risk of thermo damage to surrounding tissues [9]. However, in this study, we assessed the possibility of tubal infertility treatment following ultrasound and SWD.

OBJECTIVE: To evaluate for the first time the role of short wave diathermy (SWD) in the treatment of blocked fallopian tubes of tubal infertility.

METHODOLOGY: This is a case control study that investigated women with primary and secondary tubal infertility. The study was comprised of 50 patients as cases and 15 patents as controls. Cases were exposed to SWD while the controls were not subjected to the SWD. The main outcome measure was fallopian tubes patency.

RESULTS: After one month of treatment, fertile fallopian tubes were nonspecifically indicated by HSG in 84% (42/50) of the cases but none of the controls (0/15) showed any significant improvement in their condition. This difference was found to be statistically significant (P <0.001). After 6 months of follow-up, clinical pregnancy occurred in 12/50 (24%) of the cases but none of the control subjects who did not have SWD intervention got pregnant (P =0.002). The miscarriage rate among these 12 cases was 16.6%.

CONCLUSION: The use of SWD is highly successful in the treatment of fallopian tube patency.

Keywords: Tubal infertility, Fallopian tubes, Short wave diathermy.

MATERIALS AND METHODS

This study included 65 (50 were ascertained as cases and 15 were controls) patients with primary or secondary infertility with evidence of blocked fallopian tubes at Al Molem Center for Specialists, Khartoum, Sudan. The patients were identified prospectively through Obstetrics and Gynecology clinic diagnosis and infertility treatment registers. All cases underwent an exposure to SWD (accepted exposure). None of the controls was exposed to SWD (declined exposure).

Ethical consent: Each participant was asked to sign a written ethical consent form during the interview, before the inclusion in the study. The study was further approved by Al Molem Center for Specialists ethics committee for health research.

Patients with ovarian cyst, malignancy, open wounds, ischemia or atherosclerosis, active bleeding, metal implants, pacemakers, acute infection or fever and pregnancy were excluded. Pelvic-abdominal ultrasound scanning was used to exclude some of these conditions.

Pelvic inflammatory disease was diagnosed depending on:
1- clinical examination to check for source of pain, fever, discharge and for evidence of an STD.
2- Pelvic ultrasound to see if the fallopian tubes are enlarged or to see if there is an abscess.
3- Laboratory investigations including, discharge culture.

Hyterosalpingography (HSG) in day 8 or day 9 of the cycle was involved. Each patient was given...
intravenous antispasmodic to decrease the possibility of tubal spasm, half an hour before the HSG. The patients had HSG with a radio-contrast solution. Vaginal wash and introduction of the Methylene blue dye were done to know whether the tubes were patent or blocked. The X-ray was interpreted by the consultant radiologist. The consultant radiologist was unaware of the treatments received by the patients. All patients were prospectively followed for six months.

**SWD procedure**: Using SWD Machine 250 watts (GPC medical Ltd, model PT 20), heat was introduced, while the patient supine. Two electrodes were put on anterior and posterior aspects of the pelvic region. The electrodes were placed in the suprapubic region, exactly in the center, directly in the opposite side in the lower part of the vertebral column. An average of 24 exposures for 15 minutes on daily basis (Frequency: 200 HZ, 80% Intensity), was performed. All cases were exposed to HSG after the completion of the 24 sessions. The HSG was done in the following month after each session.

**Statistical analysis**: SPSS version 12 statistical software was used for statistical analysis. The chi square test with a 95% confidence interval was used. Relationships between variables were analyzed using Pearson’s correlation analysis. A p<0.05 was considered statistically significant.

**RESULTS:**

This study included a total of 65 patients their ages ranging from 20 to 45 years with a mean age of 30 years, as shown in Figure 1. The age distribution, duration of infertility, body mass index (BMI), and hormonal status were relatively similar among the cases and the controls. Of the 50 cases, 17 (34%) were patients with primary infertility and the remaining 33 (66%) were with secondary infertility. History of miscarriage was identified among 30 (60%) of the cases and 5 (33%) of the controls. Pelvic inflammatory disease (PID) was proved in 28 (56%) of the cases and 10 (67%) of the controls, as indicated in Table 1.

Of the two cases of miscarriages, one was from the primary infertility and the other was from secondary infertility. Of the 42 (84%) treated patients, 15 (35.7%) and 27 (64.28%) of the primary and secondary infertility respectively. Of 17 (34%) cases and 10 (66.7) cases of primary and secondary infertility categories, respectively. Out of the 12 pregnant women, 3 (75%) were with primary infertility and 9 (75%) were with secondary infertility. Of the 12 cases of miscarriages, one was from the primary infertility and the other was from secondary infertility group, as shown in Table 3. With respect to the relationship between pregnancy and the age, of the 12 pregnant women, 4 (33.3%) were less than 30 years of age, 5 (41.7%) were between the ages of 31-40 and 3 (25%) above 41 years (as shown in Figure 2).

**DISCUSSION**

Tubal surgery is a widely accepted treatment for tubal infertility. Estimated live birth rates after surgery range from 9% for women with severe tubal disease to 69% for those with mild disease [10]. Due to multiple complications and the costs associated with tubal surgery, it is important to determine the effectiveness of surgery against other treatment options in women with tubal infertility. In vitro fertilization (IVF) is now a widely accepted treatment for unexplained infertility with estimated live-birth rates per cycle varying between 13% and

---

**Table 1. Distribution of the study population by different infertility parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Cases N (%)</th>
<th>Controls N (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patent Tube</td>
<td>42 (84)</td>
<td>0 (0)</td>
<td>0.001</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>12 (24)</td>
<td>0 (0)</td>
<td>0.001</td>
</tr>
<tr>
<td>Miscarriage</td>
<td>2 (4)</td>
<td>0 (0)</td>
<td>0</td>
</tr>
<tr>
<td>History of miscarriage</td>
<td>30 (60)</td>
<td>5 (33)</td>
<td>0.5</td>
</tr>
<tr>
<td>PID</td>
<td>28 (56)</td>
<td>10</td>
<td>1.9</td>
</tr>
<tr>
<td>Primary infertility</td>
<td>17 (34)</td>
<td>5 (33.3)</td>
<td>0.9</td>
</tr>
<tr>
<td>Secondary infertility</td>
<td>33 (66)</td>
<td>10 (66.7)</td>
<td>0.8</td>
</tr>
</tbody>
</table>

**Table 2. Showing the site of tubal blockage by tubal patency**

<table>
<thead>
<tr>
<th>Tubal block- age</th>
<th>Total number</th>
<th>Tubal Patency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distal</td>
<td>26</td>
<td>52</td>
</tr>
<tr>
<td>Mid region</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>Proximal</td>
<td>11</td>
<td>22</td>
</tr>
</tbody>
</table>

**Table 3. Distribution of the study population by the type infertility**

<table>
<thead>
<tr>
<th>Duration</th>
<th>Infertility</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Primary</td>
<td>Secondary</td>
</tr>
<tr>
<td>intensity</td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td></td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td>1-2 years</td>
<td>7 (14)</td>
<td></td>
</tr>
<tr>
<td>3-5 years</td>
<td>24 (48)</td>
<td></td>
</tr>
<tr>
<td>5+ years</td>
<td>19 (38)</td>
<td>0.64</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>64</td>
</tr>
<tr>
<td>Patent Tube</td>
<td>42 (100)</td>
<td>0.44</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>12 (100)</td>
<td>0.64</td>
</tr>
<tr>
<td>Miscarriage</td>
<td>2 (100)</td>
<td>0</td>
</tr>
</tbody>
</table>

---

**Figure 1**: Distribution of the study population by different infertility parameters.

**Figure 2**: Distribution of the study population by the type infertility.
Although, 22% of the patients had proximal tubal disease of which 72.7% were subsequently shown to be patent after diathermy. This rate is comparable to the patency rate with a follow-up HSG or diagnostic laparoscopy with no treatment. However, most of patients in this study were with distal tubal blockage, which favors the role of SWD in tubal patency.

Although, the biological mechanism that regulates the relationship between the thermal exposure and the retrieval of fallopian tubes is unknown, but it might be attributed to high blood perfusion and alterations in other physiological mechanisms.

In this study pregnancy occurred in 12/50 (24%) with only 2/12 (16.7%) cases of miscarriage. The mechanism of action could be the same as the opening of the blocked fallopian tubes. Increase in the blood supply due to the vasodilatation leads to improve the cell function. The improvement in the endometrial blood supply might improve the endometrial receptivity which could be the cause of the high pregnancy rate. Furthermore, the ovarian function itself could be positively affected by the enhanced blood supply to the ovary, leading to the availability of more mature follicles and ova.

SWD is a safe technique with high tubal patency rates, high pregnancy rates, reduced risks, costs and morbidity compared with IVF and surgical procedures. Although, the sample size was relatively small in this study, pregnancy and abortion rates reported here were within reasonable values reported in similar studies [15, 16, 2]. Although, younger women achieve higher rates of pregnancy and live births than their older counterparts [17], this study found that, the highest success rate of pregnancy in women aged between 31 and 40 years. Similar results were also reported earlier [18, 19].

Couples with primary infertility have never been able to conceive, while, on the other hand, secondary infertility is difficulty conceiving later after the first pregnancy. In this study the majority of cases (66%) were with secondary infertility. The prevalence of primary and secondary infertility was 37.1% and 62.9%, respectively; similar findings were reported from Nigeria [20]. The relation between the type of infertility and the pregnancy rate was found to be statistically significant P value <0.054. It was noticed that 75% of those patients who got pregnant were having secondary infertility, while 25% of those patients who got pregnant were having primary infertility. This could be explained by the fact that, 40% of the cases were having a history of miscarriage before tubal blockage which could be associated with post abortive infection and the resultant tubal patency due to the anti inflammatory effect of diathermia.

History of miscarriage was identified in 53.8% of the studied subjects in the current study. Though, miscarriage significantly reduces the initial success and efficacy of assisted reproduction treatment, as well as, increasing the psychological burden on patients, it is associated with a variety of factors [21].

---

Figure 1. Description of the study population by age

Figure 2. Description of the pregnant women by age
PID is demonstrated in 58.5% of our study population. PID is an infection-caused inflammatory condition from the cervix to the peritoneal cavity. Most importantly, it is associated with fallopian tube inflammation, which can lead to infertility. The microbial etiology is linked to sexually transmitted microorganisms, including Chlamydia trachomatis, Neisseria gonorrhoeae, Mycoplasma genitalium, and bacterial vaginosis-associated microorganisms, predominantly anaerobes [22]. Incidence of clinical PID, greatly differ in different countries, and a major cause of infertility worldwide [23].

There is no any an adverse outcome or harm to patients noted during the study. The possible sources of limitations in this study would be the small sample size, short period of follow-up and the method of diagnosis which may yield false positive results (blocked tubes) in about 7-15 % of cases [9]

Although, HSG is still a useful screening test for the evaluation of the uterine cavity in the study of primary or secondary infertility. In addition, HSG provides information concerning the assessment of tubal morphology and patency. We believe that one of the major limitations of this study is use of HSG only in identifying tubal morphology without hysteroscopy and that why we have reported nonspecific indication of tubal patency. HSG is associated with false-positive and false-negative rates, and hysteroscopy is more accurate than HSG, although the magnitude of the discrepancy is controversial [24]. However, these two procedures are complementary in the evaluation of infertile women [25]. Moreover, of the limitation of this study are short period of follow up and the small sample size.

References:
3. HOOF, K. - Pelvic inflammatory disease. Thor Umsch: 64(7):365-8., 2007,
5. JUDLIN, P.G., THIEBAUGEORGES, O. - Pelvic inflammatory diseases. Gynecol Obstet Fertil 37(2):172-82., 2009,
12. GIOMFIBIA, A. - http://bmb.oxfordjournals.org/content/83/1/379.full-aff-1,
16. MORALOGLOU, O., TONGUC, E., YAR, T., ZEYREK, T., BATILOCAL, S. - Treatment with oxytocin antagonists before embryo transfer may increase implantation rates after IVF. Reprod Biomed Online; 21(3):338-43., 2010,
23. DAKESHOTI, P., KERRY, S., AGHAZU, A. - Randomised controlled trial of screening for Chlamydia trachomatis to prevent pelvic inflammatory disease: the POPI (prevention of pelvic infection) trial. BMJ; 340:e1642., 2010,