

# Hydrosalpinx: Functional Surgery or Salpingectomy

Nomonde D Gumata

Department of Obstetrics and Gynecology, Kalafong Hospital, University of Pretoria, South Africa

## Abstract

**Background:** Hydrosalpinx is a common cause of female infertility<sup>1</sup> and adversely affects the outcomes of *in vitro* fertilization (IVF). Although IVF is the main treatment, alternative treatments, such as salpingectomy and functional tubal surgery have been suggested.<sup>2</sup> Previously, hydrosalpinx was diagnosed using tubal patency tests (transvaginal ultrasound, TVUS; hysterosalpingography, HSG; and laparoscopy), which do not assess tubal function hydrosalpinx, and salpingectomy was the main surgical treatment for hydrosalpinx prior to IVF.<sup>3</sup> However, with modern tubal endoscopy (salpingoscopy and fertiloscopy)<sup>4-7</sup> and their ability to assess tubal functional mucosa, functional tubal surgery can be considered for thin-walled hydrosalpinx and a healthy mucosa and salpingectomy performed for thin-walled hydrosalpinx with mucosal adhesions and thick-walled hydrosalpinx with absent mucosal folds.<sup>8</sup>

**Aims and objectives:** The aim of the review is to highlight the use of appropriate tubal function tests to help in making a choice between either salpingectomy or functional tubal surgery as the treatment for hydrosalpinges.

**Materials and methods:** A literature search was performed using the search engine Google, HighWire press, PubMed and SpringerLink. Selected papers were taken for further references. All articles, including randomized controlled trial (RCT) were included for the review.

**Results:** Vasquez et al<sup>8</sup> suggested that mucosal adhesions are the most important factors in determining fertility outcomes especially in thin-walled hydrosalpinges. Several studies on hydrosalpinges have also shown that the absence of mucosal adhesions on salpingoscopy can identify patients who can benefit from advantages offered by reconstructive surgery.<sup>3-7</sup> Boer Meisel et al<sup>9</sup> showed that patients with thin-walled hydrosalpinges and well preserved mucosa had an intrauterine pregnancy rate of 77% and a tubal pregnancy rate of 4% following reconstructive surgery.<sup>9</sup> Vasquez et al<sup>8</sup> in their prospective study showed that thin-walled hydrosalpinges with a normal or flattened mucosa, but without mucosal adhesions were associated with a 58% pregnancy rate and low risk of tubal pregnancy.<sup>8</sup> Their study also found that thick-walled hydrosalpinges with mucosal adhesions have a statistically significant lower intrauterine pregnancy rate.<sup>8</sup> Dechaud et al<sup>10</sup> showed that salpingectomy for thick-walled hydrosalpinges improved the outcome of IVF.

**Conclusion:** An appropriate tubal mucosal assessment should be a routine prior to deciding upon further management of hydrosalpinx. Functional tubal surgery should be preferred in mild forms of hydrosalpinx and salpingectomy reserved for severe forms of hydrosalpinx.

**Keywords:** Hydrosalpinx, Salpingectomy, Functional tubal surgery, Fimbrioplasty, Salpingostomy, Uterine tubal anastomosis, Tubal function tests, Salpingoscopy and Fertiloscopy.

## INTRODUCTION

Hydrosalpinx, also known as fallopian tube obstruction, is defined as a fluid filled distension of the fallopian tube in the presence of distal tubal occlusion.<sup>11</sup> It is one form of tubal disease and may involve the proximal, distal or the entire fallopian tube.<sup>11</sup> The occlusion is almost secondary to pelvic inflammatory diseases (PID), endometriosis, fimbrial serosal obstruction following an adjacent appendicular inflammation and previous surgery (either tubal, pelvic or abdominal).<sup>12</sup> PID being the most common cause of hydrosalpinx results in a severe inflammatory process obstructing the distal end of the fallopian tube.<sup>12,13</sup> This inflammatory process combined with the natural transitional cell mucosa production produce a swollen nonfunctioning hydrosalpinx fluid.<sup>13</sup> Hydrosalpinx can be classified according to severity of tubal damage into: Mild/grade I, moderate/grade II and severe/grade III.<sup>14</sup>

Hydrosalpinx is a common cause of female infertility<sup>1</sup> and accounts for between 26 and 30% of patients with infertility treated with IVF.<sup>15</sup>

## HYDROSALPINX EFFECTS ON PREGNANCY OUTCOMES

Women with hydrosalpinges have lower implantation rates of 2.9% and lower pregnancy rates of 9.2%,<sup>1</sup> as well as higher ectopic pregnancy rate and early pregnancy losses of 70%.<sup>16,17</sup>

The exact mechanism of such low pregnancy outcomes is unclear with many postulated hypotheses.<sup>16</sup> Mechanical and chemical factors as well as endometrial receptivity dysfunction have been implicated and shown to adversely impair IVF outcomes. Andersen et al<sup>16</sup> postulated that the low pregnancy outcomes might be due to leakage of fluid into the uterine cavity which disturbs the receptivity of the

endometrium and/or the developing embryo.<sup>16</sup> The toxic substances contained in hydrosalpinx fluid drain into the uterine cavity and dilute the endometrial secretion, and thus generate an unfavorable uterine milieu.<sup>18-20</sup> Mukherjee et al<sup>21</sup> showed that the hydrosalpinx fluid enters into the uterine cavity.<sup>21</sup> Sonography done during the luteal phase in patients with hydrosalpinx showed uterine cavity fluid distension and none of these patients obtained an ongoing intrauterine pregnancy after IVF treatment.<sup>22</sup>

## DIAGNOSIS OF HYDOSALPINX USING IMAGING TECHNIQUES

Hydrosalpinx can be diagnosed using various imaging techniques.<sup>2</sup> Most of these investigations can only assess the tubal patency with few assessing the tubal function (functional status of tubal mucosa).<sup>2,3</sup>

Tubal patency tests, such as HSG, hysterosalpingo-contrast ultrasonography (HyCoSy), TVUS and laparoscopy are not good at assessing tubal function.<sup>2,3</sup>

Tubal function tests, such as falloscopy, salpingoscopy and fertiloscopy are the main tests that should be utilized to assess the functional status of the tubal mucosa. These tests are new interventions utilizing tubal endoscopy.<sup>4,5</sup> Salpingoscopy can be used to classify hydrosalpinx into four types (Table 1).

**Table 1:** Classification of hydrosalpinges based on salpingoscopy<sup>2,6</sup>

- Thin-walled hydrosalpinx with a healthy mucosa
- Thin-walled hydrosalpinx with flattened mucosal folds without mucosal adhesions (hydrosalpinx simplex)
- Thin-walled with mucosal adhesions (hydrosalpinx follicularis)
- Thick-walled hydrosalpinx with absent mucosal folds.

Thin-walled hydrosalpinx and a healthy mucosa have good results postsurgery.<sup>8</sup>

Tubal function tests play an important role in choosing patients suitable for tubal surgery (functional tubal surgery or salpingectomy).<sup>2</sup>

## HYDOSALPINX TUBAL SURGERY

Although IVF is the main treatment for tubal factor infertility related to hydrosalpinx, surgical treatment plays a crucial role prior to IVF, and scientific evidence has shown it to improve pregnancy outcomes by removing the toxic effects of hydrosalpinx that impair IVF outcomes.<sup>23</sup> The performance of surgical interventions, such as salpingectomy and functional or reconstruction surgery (fimbrioplasty, salpingostomy and microsurgical tubocornual anastomosis),

prior to the IVF procedure in women with hydrosalpinges has been shown to improve the likelihood of successful outcome.<sup>23-26</sup> These procedures can be performed via laparoscopy as well as laparotomy since, both routes are equally effective although laparoscopy is the preferred route.<sup>15,27</sup>

## SALPINGECTOMY

Laparoscopic salpingectomy prior to IVF is usually performed in women who have unilateral hydrosalpinx with normal contralateral tube as well as those with bilateral hydrosalpinges, and results in significant improvement in pregnancy and implantation after surgery.<sup>27</sup> Evidence suggests that laparoscopic salpingectomy should be performed only when hydrosalpinges are beyond repair or in cases of IVF failure.<sup>30-32</sup> Thin-walled hydrosalpinges with mucosal adhesions and thick-walled hydrosalpinges with absent mucosal folds diagnosed using salpingoscopy are indications for salpingectomy.<sup>33</sup>

## FUNCTIONAL OR RECONSTRUCTIVE TUBAL SURGERY

Functional or reconstructive tubal surgery remains another important tubal surgical treatment, complement to assisted reproductive techniques (ARTs).<sup>33,34</sup> This surgery should be considered as first-line treatment when the correction of infertility pathology is achievable and good results are expected.<sup>33</sup> It should be preferred to salpingectomy in mild forms of hydrosalpinges, especially those with preserved tubal mucosa without adhesions (diagnosed using salpingoscopy) as these hydrosalpinges are amenable to surgical repair and have good prognosis.<sup>8</sup>

### Fimbrioplasty

Fimbrioplasty is the incision of any fibrous or scar tissue covering the terminal end of the tube, thus freeing the agglutinated fimbriae and lysis of peritubal adhesions.<sup>34</sup> Fimbrioplasty is, thus, indicated in patients with fimbrial occlusion usually with concurrent periaxonal adhesions.<sup>35,36</sup>

### Salpingostomy or Neosalpingostomy

Salpingostomy is the procedure whereby a stoma is fashioned in the distal fallopian tube using scissors, electrosurgery or laser.<sup>35</sup> The procedure can be performed using laparoscopy or laparotomy with microsurgical technique.<sup>36,37</sup> When the procedure is performed for mild hydrosalpinges, it is associated with better pregnancy rates.<sup>34</sup>

## Microsurgical Tubocornual Anastomosis

Microsurgical tubocornual anastomosis is a procedure where the patent portion of the distal tube is joined to the uterine cavity under magnification. This procedure has been regarded as the standard treatment for proximal tubal occlusion.<sup>35</sup> However, some spontaneous intrauterine pregnancies have been seen in women with proximal tubal obstruction. This type of surgery is more effective for women with mild hydrosalpinges and should be considered especially in centers where appropriate expertise is available.<sup>35</sup>

The aim of the review was to highlight the use of appropriate tubal function tests to help in making a choice between either salpingectomy or functional tubal surgery as treatment for hydrosalpinges.

A literature search was performed using the search engine Google, HighWire press, PubMed and SpringerLink. Selected papers were taken for further references. All articles, including randomized controlled trial (RCT) were included for the review.

## RESULTS

### Salpingoscopy

Puttemans et al<sup>2</sup> utilized translaparoscopic salpingoscopy to evaluate the ampullary segment of the fallopian tube in patients suffering from infertility. Their study compared this technique with HSG in a series of 32 patients with hydrosalpinges and demonstrated the superiority of salpingoscopy in the evaluation of tubal mucosa. This diagnostic approach allows a more accurate selection of patients for microsurgical repair.<sup>7</sup>

Valentini et al<sup>5</sup> performed a prospective study to identify radiographic signs of mucosal damage by comparing HSG with salpingoscopy. Forty-one candidates for laparoscopy underwent HSG and preoperative salpingoscopy; at both, tubal patency was noted. Radiographic criteria for mucosal abnormality were rounded filling defects (i.e. the cobblestone pattern) and the absence of longitudinal radiolucent bands in the ampullary tract. At salpingoscopy, tubal mucosa was categorized by means of inspection into five classes of fold pattern: Classes I and II, normal; classes III-V, abnormal. Seventy-four tubes were evaluated. At HSG, 31 tubes were distally non-patent. Of these, 26 showed a distal obstruction at salpingoscopy. None of the patent tubes at HSG showed obstruction at salpingoscopy. The agreement between HSG and salpingoscopy in detecting abnormal mucosal pattern was 89.2% ( $\kappa$ , 0.73;  $P < 0.001$ ). The cobblestone pattern always corresponded to intraluminal adhesions at salpingo-

scopy. The absence of radiolucent bands corresponded to abnormal mucosa at salpingoscopy in four of six cases. The cobblestone pattern was found only in hydrosalpinges and never in patent tubes. Six normal patent tubes at HSG showed intraluminal adhesions at salpingoscopy.<sup>5</sup>

### Salpingectomy

Strandell et al<sup>31</sup> performed a randomized control trial that analyzed the effect of salpingectomy on birth rates and IVF cycles. A total of 186 women underwent 452 IVF cycles. Among these, 77 women had no surgical intervention and 24 had salpingectomy after 1 or 2 failed IVF cycles. Salpingectomy group had a significantly increased birth rate (HR 2.1, 95% CI 1.6-3.6,  $P = 0.014$ ) and higher implantation rates (27.2% versus 20.2%,  $P = 0.0331$ ).

A systematic review that included six studies, comparing pregnancy outcomes after laparoscopic surgery with that of open or conventional microsurgical technique was done by Ahmad et al.<sup>15</sup> In this review, there was no significant difference observed in the intrauterine pregnancy rate between the two groups, combined OR (odds ratio) 1.32 (95% confidence interval [CI], 0.58-3.02). For patients with mild tubal disease, there was no significant difference in the intrauterine pregnancy rate between treatment and control group, OR 1.06 (95% CI, 0.42-2.70). For patients with severe tubal disease, there was a significantly increased intrauterine pregnancy rate in the laparotomy group, OR 0.34 (95% CI, 0.14-0.86).<sup>15</sup>

Sagoskin et al<sup>29</sup> reported on their retrospective observational study of 25 infertility patients with known unilateral hydrosalpinges and a patent contralateral fallopian tube. Eighteen of these women subsequently had spontaneous pregnancies after laparoscopic salpingectomy without IVF treatment. Pregnancies occurred in an average of 5.6 months with a range of 1 to 21 months. There were no ectopic pregnancies in the study population.<sup>29</sup>

Another study performed by Kontoravdis et al<sup>28</sup> that evaluated and compared the clinical impact salpingectomy, when performed before IVF in patients with hydrosalpinges, found that patients who underwent proximal tubal occlusion before IVF demonstrated significantly increased implantation, clinical pregnancy, and ongoing pregnancy rates compared to those with no surgical intervention and demonstrated implantation, clinical pregnancy, and ongoing pregnancy rates comparable to those who underwent salpingectomy.<sup>28</sup>

A Cochrane systematic review was performed by Johnson et al<sup>27</sup> to highlight evidence that laparoscopic salpingectomy for women with hydrosalpinges enhances

the success of IVF. Three randomized controlled trials were included in the review. The results showed that the odds of pregnancy [odds ratio (OR) = 1.75, 95% confidence interval (CI) 1.07-2.86] and of ongoing pregnancy and live birth (OR = 2.13, 95% CI 1.24-3.65) were increased with laparoscopic salpingectomy for hydrosalpinges prior to IVF. There were no significant differences in the odds of embryo implantation (OR = 1.34, 95% CI 0.87-2.05), ectopic pregnancy (OR = 0.42, 95% CI 0.08-2.14), miscarriage (OR = 0.49, 95% CI 0.16-1.52) or treatment complications (OR = 5.80, 95% CI 0.35-96.79).<sup>27</sup>

The latest Cochrane review, performed by Johnson et al<sup>25</sup> on surgical treatment for tubal disease in women due to *in vitro* fertilization is also available. In this review, five randomized controlled trials involving 646 women were included. Four studies assessed salpingectomy versus no treatment. The odds of ongoing pregnancy (Peto OR 2.14, 95% CI 1.23 to 3.73) and of clinical pregnancy (Peto OR 2.31, 95% CI 1.48 to 3.62) however, were increased with laparoscopic salpingectomy for hydrosalpinges prior to IVF.<sup>25</sup>

### Fimbrioplasty

Donnez and Casanas Roux<sup>34</sup> studied the prognostic factors of fimbrial microsurgery. They operated upon 257 women and found that after fimbrioplasty for occlusion of degree I the term pregnancy rate was > 50%.<sup>34</sup> On systematic review of eight RCTs and 14 observational studies, found no difference in pregnancy rates between the different techniques used such as CO<sub>2</sub> laser adhesiolysis versus diathermy adhesiolysis (53% with laser versus 52% with diathermy; OR = 1.04; 95% CI 0.65 to 1.67).<sup>15</sup> The review of 14 observational studies did not detect a difference between laparoscopic adhesiolysis and microsurgical adhesiolysis in improving outcome.<sup>38</sup> Audebert et al<sup>39</sup> in a prospective study reported 51% clinical pregnancy rate and 23% ectopic pregnancy rate in 35 patients with severe fimbrial occlusion treated by laparoscopic fimbrioplasty.

### Salpingostomy or Neosalpingostomy

Donnez and Casanas Roux<sup>34</sup> operated upon 257 women and found that after salpingostomy for degree II, III and IV fimbrial tube occlusion, the term pregnancy rate was > 50%, 25% and 22%, respectively. On systematic review of eight RCTs and 14 observational studies evaluating various surgical techniques for treating tubal infertility, found no difference in pregnancy rates between laser salpingostomy versus diathermy salpingostomy (35% with laser versus

27% with diathermy; OR = 1.30; 95% CI 0.77 to 2.19).<sup>15</sup> A review of 10 case series in women who underwent neosalpingostomy for distal tubal occlusion (n = 1128) reported a cumulative ectopic pregnancy rate per pregnancy of 23%.<sup>6</sup>

### Microsurgical Tubocornual Anastomosis

A review of nine other case series studies reported that about 50% of women with proximal tubal blockage who had microsurgical tubocornual anastomosis achieved a term pregnancy.<sup>40</sup> Case series and cohort studies have demonstrated high pregnancy rates in women who underwent this type of surgery.<sup>35</sup> A case series study reported live birth rates of 27%, 47% and 53% within one, two and 3.5 years of surgery respectively.<sup>41</sup>

## DISCUSSION

Data available in the literature strongly suggest that surgical treatment of hydrosalpinges improves the pregnancy rate in IVF.<sup>11</sup> However, surgery is not without risks and the need to avoid the practice of indiscriminant salpingectomy in all women with hydrosalpinges who are undergoing IVF, makes the ability to identify women at risk for suboptimal IVF success increasingly important.<sup>11</sup> Hence, preoperative patient selection is an essential step in surgical treatment for hydrosalpinx.<sup>11</sup> Tubal patency test utilizing tubal endoscopy plays an important role in selection of hydrosalpinges for different surgical treatments.<sup>4-7</sup> Valentini et al<sup>5</sup> in their study showed intraluminal disease in patent tubes might not always be excluded on normal HSG.<sup>5</sup> Their study together with several other studies have shown that tubal patency tests are not appropriate for assessing tubal function.<sup>4-8</sup> Hence, this emphasizes the importance of utilization of tubal function tests. However, tubal function tests are still unpopular and not performed routinely in many countries.

The main advantages of laparoscopic surgery over microsurgery in the treatment of hydrosalpinx are that the laparotomy incision is avoided leading to less postoperative discomfort and pain, shorter hospitalization, and quicker resumption of normal activities.<sup>11,36,37</sup> However, the reproductive outcomes after laparoscopic surgery are similar to that of open microsurgery.<sup>11</sup>

Several studies have shown that laparoscopic salpingectomy improves IVF outcomes.<sup>2-4,31</sup> However, this procedure is not ideal for every woman with hydrosalpinx.<sup>11</sup> Laparoscopic salpingectomy should be performed only when hydrosalpinges are beyond repair or in cases of IVF failure.<sup>8</sup>

There had been reports about adverse effects associated with salpingectomy, especially if performed close to the uterus as it might disrupt the normal blood flow to the ovary resulting in fewer oocytes being retrieved from the side of the operation during IVF cycles in comparison with intact adnexa.<sup>18</sup> NICE guidelines suggested that the evidence of impairment of ovarian response in subsequent IVF was inadequate but emphasize that laparoscopic salpingectomy should be done with care not to compromise ovarian blood supply.<sup>35</sup>

Reconstructive tubal surgery should be preferred to salpingectomy in mild forms of tubal disease.<sup>34,36,40,41</sup> Preserved tubal mucosa indicates a good prognostic for tubal surgery.<sup>34,36</sup> The distinction of hydrosalpinges that can be treated with functional surgery can be achieved by utilization of tubal endoscopy tests.<sup>4,5</sup> Therefore, an appropriate mucosal assessment should be routine prior to deciding upon further management of hydrosalpinges.<sup>11</sup> Fimbrioplasty should be performed in patients with mild periadnexal adhesions and patent hydrosalpinx mucosa as this improves pregnancy outcomes.<sup>35,36</sup> Salpingostomy is an ideal procedure for mild hydrosalpinges with normal mucosa as it is associated with better pregnancy rates.<sup>34</sup> Microsurgical tubocornual anastomosis is the standard treatment for proximal tubal occlusion.<sup>35</sup> This type of surgery is more effective than no treatment for women with mild hydrosalpinges and should be considered especially in centers where appropriate expertise is available.<sup>35</sup>

## CONCLUSION

Proper assessment of hydrosalpinges tubal mucosa utilizing tubal endoscopy tests should be routine prior to decision about the choice of surgical treatment as this will prevent mis-management of patients.

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