

Use of neutral argon plasma in the treatment of endometriosis initial findings

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Summary

Purpose of Investigation: Endometriosis is a condition in which the endometrial tissue grows outside its physiological location (outside the uterus). The main symptoms are chronic pain, dysmenorrhea, and infertility. Treatment of endometriosis is challenging, as this condition may reoccur. **Materials and Methods:** The authors present their first initial findings of treating endometriosis with the neutral argon plasma device. This study was conducted in the Center of Woman's and Child's Health, Zabrze Poland. During this period, 34 patients with diagnosed endometriosis were surgically treated with the use of neutral argon plasma. **Results:** Mean time of the operation was 86 (range, 30 to 250) minutes. Mean time of the hospitalization was five (range, 3 to 22) days. Re-operation was not needed in any case. **Discussion:** The present findings are consistent with available literature, that plasma argon is an effective and safe method of surgical treatment of endometriosis. **Conclusion:** Plasma argon may be hope for women suffering from chronic pain, infertility or re-occurring endometriotic lesions.

Key words: Endometriosis; Neutral plasma argon; Infertility.

Introduction

Endometriosis is defined as a gynaecological condition characterized by the occurrence of endometrial tissue outside the uterus [1, 2]. This can include the ovaries, ureters, and extrapelvic locations such as bowel and lungs. There are several theories that attempt to explain the development of endometriosis [3]. These are: the implantation theory, the theory of endometrial origin, the embryonic theory, and the metaplastic theory. Endometriosis can give many various symptoms such as chronic pain, dysmenorrhea, discomfort during sexual intercourse, and infertility [2]. It is reported that about 25% to 50% of infertile women have endometriosis, and 30% to 50% of women with endometriosis are infertile [4]. The treatment of endometriosis is an undeniable challenge in gynaecological practice. It involves pharmacological (analgesic and hormonal therapy) and surgical ways of treatment. It is also possible to combine operative techniques with pharmacological therapy [2]. One of the most innovative ways of surgical treatment of endometriosis is the one that uses neutral argon plasma. In Europe this treatment has been firstly used in 2004. Its first use in Poland in surgery of endometriotic lesions took place on November 19th, 2015 in Woman's and Child's Health in Zabrze, Poland. The healthcare professionals had been pre-

viously trained in Rouen, France [5]. Plasma is an ionized gas. It is formed when a gas is heated enough to cause the atoms collide with each other and knock their electrons off. Typically, in the laboratory environment, it is made either by driving an electric current through the small amount of gas, or by shining radio waves into it. Because of that plasma is often called the "fourth state of matter". In macroscopic scale, plasma is electrically neutral [6]. The plasma jet device uses a high energy neutral argon plasma to either dissect, coagulate or vaporise tissues. In surgery, the effect of ionization of the gas takes place in the device used by the surgeon. A 2-cm stream of plasma is obtained and it is characterized by high kinetic energy, high temperature, and it provides the effect of luminescence.

Materials and Methods

A study was conducted between November 2015 and April 2017 in the Center of Woman's and Child's Health, Zabrze Poland. In this period 34 patients with diagnosed endometriosis were surgically treated with the use of neutral argon plasma. All patients underwent general anesthesia. The plasma jet device was used to either vaporise or cut the endometriotic lesions, and in addition to coagulate the bleeding. The authors present their initial experience using this system in the surgical treatment of endometriosis by analyzing the cases of 34 patients.

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Results

The plasma jet device was used to surgically treat endometriosis in 34 patients. All participants were women with the mean age of 37 (range 22 to 73) years. In each case the diagnostic process consisted of: MRI of the lesser pelvis, transvaginal USG, USG of the abdomen, and laboratory examination of the Ca-125 antigen level. Some of the 34 patients had an endometriotic lesion in more than one anatomical location, so the total of 37 cases of endometriotic lesions were treated. All patients were classified according to the 1996 revised American Fertility Society (rAFS) classification: superficial endometriosis of peritoneum (n=7), deep endometriosis of peritoneum (n=4), superficial endometriosis of ovary (n=6), deep endometriosis of ovary (n=9), and partial obliteration of Douglas pouch (n=4). In addition, in seven cases the endometriosis in the scar after caesarian section was detected (it did not belong to the rAFS classification). Mean time of the operation was 86 (range, 30 to 250) minutes. Mean time of the hospitalization was five (range, 3 to 22) days. It is important to note that re-operation was not needed in any case.

Discussion

Plasma gives up its energy also in the form of heat, which enables the surgeon to coagulate the bleeding [7]. This advantage facilitates the surgeon rapid coagulation of bleeding. Because of this feature, the surgeries in this Center were almost bloodless, the surgeons were able to maintain good haemostasis.

Reducing postoperative complications connected with high amount of thermal energy spread to the surrounding and deep tissues is crucial. A conventional electrosurgery often causes deep tissue thermal effects. Undeniable advantage of the neutral argon plasma is that the injury of the surrounding tissues is minimal and it is contained in the range from 0.1 to 2 mm. [8-11]. In addition, Sonoda *et al.* discovered an unique property of thermal plasma: the additional thermal spread is relatively insensitive to vaporization depth [10].

One form of the energy that is given up by the plasma when it contacts the tissues is the light energy. It enables to illuminate the surgical field in laparoscopic procedures, which gives the surgeon excellent visibility of the operating area [7].

In all of the 34 patients there were no postoperative complications, including problems with healing of the wound, long-lasting postoperative pain, or recurrence of the endometriosis. In addition, the authors observed smoother and quicker cicatrization of the wound. This state is consistent with the observation of Parhomenko *et al.*, who established that although all tissues present healing regardless the method used, those treated with plasma are followed by

smaller scar and less negative effects of lateral tissues [7].

Endometriosis is fraught with high risk of reactivation, despite non-pharmacological and pharmacological treatment [2]. A fact that there has not been any recurrence of the disease in patients treated with the plasma jet device in this Center so far, makes it an effective tool in the fight against endometriosis. This Center will continue a long-term research in this field.

Although the plasma jet device is expensive and the costs of healthcare professionals training seem to be high, it is cheaper than the CO₂ laser [9].

Conclusion

Although this is just an initial study, the results are satisfying. The plasma jet device appears to be an effective, safe, and sufficient method of treatment. Although standard surgical management of endometriosis is routinely performed in many gynaecological centers, a reactivation of this disease after the operation is still frequent. Neutral argon plasma may be a solution to this problem. The present Center is the only place in Poland where women can be treated for endometriosis with the use of plasma argon jet system. In addition, the authors would like to broaden their study in establishing the impact of plasma jet surgery on fertility of their patients. Long-term and multicenter studies are required to provide better assessment of advantages of the plasma jet device in the surgery of endometriotic lesions.

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