Abstract
High incidence of missed abortion induces to search for its causes. Apart from genetic and anatomic uterine factors, the state of the decidual endometrium and implantation zone of chorionic structures of the gestational sac are of particular interest. Direct visualization of the intact decidual endometrium is possible with embryoscopy, however, there is lack of presented data of normal and pathological signs of the endometrium during pregnancy. This paper describes the changes of the endometrium in missed abortion obtained by hysteroscopy in 160 women with nonprogressive pregnancy after ART protocols. High incidence of vascular disorders is determined, namely perivascular hemorrhage (70%), thrombosis of small-caliber endometrial vessels (36.9%), necrosis of the decidual endometrium and areas of the endometrium ejection beyond the implantation zone as a source of vaginal bleeding (10%). In addition, a high incidence of capsular decidual membrane defects are detected, namely, dystrophy, thinning and necrosis (60.6%).

Introduction
Missed abortion occurs in approximately one-third of pregnant women [1]. It affects greatly the quality of life of a woman who got pregnant after long-term expectation and especially as a result of IVF program. The state of endometrium and implantation of the embryo during the IVF cycle cannot be adequately evaluated with noninvasive methods, while endometrial biopsy followed by histological assessment is a risk.

At present, we can obtain some information about causes of pregnancy loss using an ultrasound examination, histology of aspirated intrauterine tissue and chorionic villi sampling and karyotyping. However, all these methods have some limitations. So, for example, the ultrasound scan does not provide a sufficiently high resolution in comparison with the histological examination. The accuracy of diagnostic quality of the endometrium is impaired after surgical damage during the curettage of the uterine cavity because of significant fragmentation and mixing of tissue samples. Hysteroscopy is an abundantly used approach to the uterine cavity assessment and gives us the most precise state of the uterine cavity in vivo. We are aware of the majority of normal and pathological signs of endometrial structure that can be found by hysteroscopy during follicular and luteal phase of a menstrual cycle. However, the information about normal and pathological hysteroscopic signs of the endometrium in pregnancy is underexplored.

The purpose of this study is an evaluation of the hysteroscopic signs of normal and pathological implantation using an example of non-viable pregnancy after IVF protocol.

Materials and methods
From January 2014 to April 2016, 160 embryoscopic examinations in missed abortion after ART program were performed at the Centre of Family Medicine. All patients were divided in two groups. The first group of 82 women underwent IVF protocols after diagnostic hysteroscopy and manual vacuum aspiration (Ipas, NC) at the follicular phase in previous 1–2 menstrual cycles and the second group of 78 women had no previous intrauterine surgery. Both groups had no differences in mean age, infertility duration and factors, number of previous IVF attempts, p > 0.05. The survey covered all types of IVF programs – long GnRH agonist, GnRH antagonist protocols and frozen-thawed embryo transfer. The embryoscopy in missed abortion was performed in accordance with the protocol described in detail by Philipp, 2001 [2]. The equipment for performing surgery and operative technique were described in our previous publication [3].

An initial hysteroscopic examination of the uterine cavity prior to endometrial damage with dilators provides information about its form, color and structure of the endometrium, structure and distribution of endometrial glands and vessels, state of decidua capsularis, the integrity of the implantation zone. The following features are included into the descriptive protocol of the embryoscopy: distribution of blood vessels and endometrial glands, presence of hemorrhage, thrombosis in the small-caliber vessels, areas of necrosis and ejection of the endometrium, thinning and dystrophy of the decidua, subchorionic hematoma and detachment of the ovum.
Discussion of results

While examining the uterine cavity no deformations as well as synechia, polyps or intrauterine septum were found. The results are summarized in Table 1. Examination of the endometrium beyond the implantation zone with the maximum approximation of hysteroscope revealed normal structure and distribution of the glands in most cases in both groups – in 80 (97.6%) and 74 (94.9%) women, respectively. In two cases, in the first group and four cases in the second group uneven distribution and different form of glands were noted together with low thickness of the endometrium with insufficiently even distribution of the vessels. Five women (6.1%) in the first group and 11 women (14.1%) in the second group had areas of endometrium necrosis and ejection beyond the implantation zone, which were probably the source of vaginal bleeding in the absence of any other damage of integrity of the decidua capsularis.

Substantial number of cases in both groups featured hemorrhage (68.3% and 71.8%, respectively) and thrombosis of the endometrial vessels (37.8% and 35.9%, respectively). Dystrophy of the capsular decidual membrane was also found in a large number of observations (58.5% and 62.8%, respectively). The diagnostics is difficult due to the absence of the identified strict criteria of normal structure of the endometrium in progressive pregnancy depending on the gestational age. The revealed changes may be the cause or consequence of the missed abortion being congruent with the histological signs of commencement of the endometrium ejection. Following the results of the examination no differences are found between the groups with and without hysteroscopy before the ART protocol. Nevertheless, hysteroscopy preceding the protocol was performed solely subjected to indications, namely abnormal ultrasound structure of the endometrium, suspected polyp or myoma in the uterine cavity, assessment of the uterine cavity form and exclusion of synechia or congenital anomalies.

Conclusion

Therefore, while examining the uterine cavity in missed abortion some structural imperfections of the endometrium and decidua capsularis were found in most cases. Such changes can be classified as pathological, however, it is impossible to determine the age thereof. One should consider the time interval after embryo loss and till the surgery performance, which can vary from several days to several weeks. An ultrasound follow-up facilitates more precise determination of the period of the miscarriage which could be of help for early embryoscopy, identification and determination of sequence of the emerging abnormalities of the endometrium.

Declaration of interest

The authors declare no conflicts of interests. The authors alone are responsible for the content and writing of this paper.

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