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USE OF NEEDLES IN IRRADIATION OF GYNECOLOGICAL TUMORS

Introduction. *Methods of irradiation of cervical cancer and other localizations in gynecology are constantly being improved. This is especially true for brachytherapy.*

Methods. *New applicators are being created, new types of normalization are being introduced, irradiation zones are identified, to which it is recommended to apply different doses of irradiation, recommendations for irradiation of critical organs are changing, and priorities are being set in the irradiation process.*

Results. *If more modern applicators are unavailable, additional introduction of needles freehand solves the problem of better irradiation of the pathological area.*

Conclusions. *It is important to note that in some cases, such as vaginal scar recurrence, vulvar cancer, primary and secondary vaginal lesions, and rectal cancer with vaginal invasion, external beam radiotherapy is not effective. In such cases, intratissue brachytherapy using needles plays a key role in providing local control and improving treatment outcomes. Thus, the use of needles in brachytherapy is critical to achieving therapeutic goals and improving patients' quality of life.*

Keywords: *brachytherapy, intratissue irradiation, gynecological cancer.*

Introduction

From the very first day of the history of brachytherapy in irradiation of gynecological tumors, there has been a problem of high-quality irradiation of the tumor without damaging the bladder, urethra, rectum and sigmoid colon. In advanced stages, Fletcher applicators do not cope with the task at hand, and the parametrium and peripheral areas of the tumor suffer especially from insufficient irradiation.

Strict guidelines that place restrictions on irradiation of critical organs tie the hands of planning. This problem is usually solved by additional insertion of needles into the cervix or parametrium.

Methods

The procedure is performed manually free hand or with the help of special applicators such as Venice. This applicator is usually used at high stages of the disease, regardless

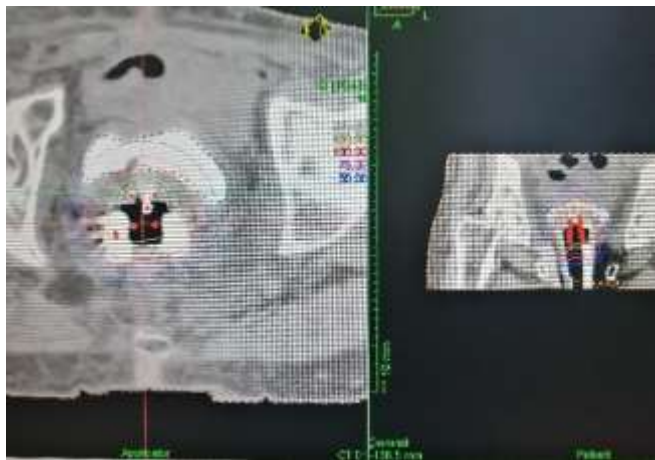
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of the size and shape of the tumor. Planning is based on MRI and is standardized not by the point, but by the volume of the lesion (Hiher-Meder et al., 2024). A high-risk zone and an average-risk zone are distinguished. In these cases, uneven distribution is effective and different doses are delivered to different areas of the lesion.

On average, the cervix is 4 cm long and needles are inserted through the guide holes in the ovoid's to the same length. We do not have such applicators in stock, we insert needles manually. Each needle changes the distribution and plays its own special role in the distribution of the dose. Usually the length to which the needle is inserted is 2–4 cm, depending on the anatomical features of the patient. Needles usually make it possible to cover the entire process with a standard is dose, adhering to the recommendations.

If, when introducing the Fletcher applicator, normalization is carried out on a fixed point, then the introduction of needles makes it possible to normalize on the tumor volume based on MRI after external radiation therapy. As far as other localizations is concerned, with rare exceptions, it is impossible to cope with recurrences using external radiotherapy. This applies to recurrences along the vaginal scar, vulvar cancer, primary and secondary lesions of the vagina, rectal cancer with invasion into the vagina (Schmid et al., 2020).

Some tumor locations cannot be stabilized at all without the use of brachytherapy, in which uneven distribution plays a key role. It is always necessary to use high isodoses in distribution. When used correctly, this helps in achieving the goal. Let us give some examples from our experience (Figs. 1–3).



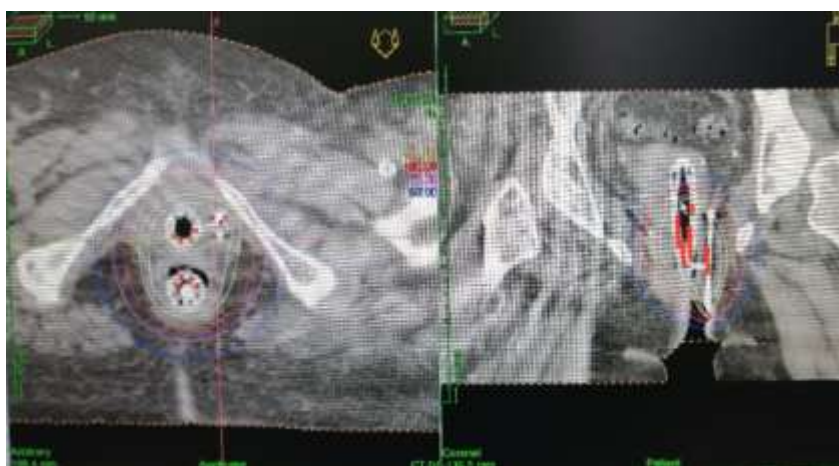
**Fig. 1. Patient F. Lesion of 1/3 of the vagina, initial tumor growth into the bladder and rectum.
After distant radiation therapy 46 Gy**

When introducing needles, only the area of residual tumor is taken into account in the dose distribution, either after external beam radiation therapy or independently in case of relapses. We actively use needles not only for gynecological tumors, but

also for squamous cell carcinoma of the lip, non-melanoma skin lesions, and for irradiation of pathological lymph nodes.



**Fig. 2. Patient D. Vulvar carcinoma.
After external beam radiation therapy 46 Gy (left)**



**Fig. 3. Patient H. Recurrence of rectal cancer (left) after surgery
and external beam radiation therapy.
Invasion into the lower wall of the vagina**

Results

The use of needles in interstitial brachytherapy, both independently and in conjunction with standard applicators, represents a critically important method for optimizing dose distribution in the treatment of gynecological tumors. This approach enables more precise targeting of radiation to the residual tumor zone, which is particularly crucial following external beam radiation therapy or in cases of recurrence.

The future of brachytherapy bases in intra-tissue techniques. More and more localizations, the tumors of which are insensitive to standard fractionation of 2-3 Gy, are successfully treated with the help of flexible applicators or needles (plastic or iron). This is especially true for relapses and metastatic lesions. In case of gynecological tumors, it is impossible to stabilize the disease without internal tissue procedures. Again, vaginal lesions, scar recurrences, primary and recurrent vulvar tumors, etc., can be eradicated only with the use of needle insertion.

Due to restrictions on critical organs in their dose distribution, Fletcher applicators cannot fully cover the lesion area, which causes relapses. It should be mentioned that, in addition to gynecological organs, brachytherapy is extremely effective for tumors of the lower ampullary region of the rectum, recurrences of the rectosigmoid region, head and neck tumors.

Dose distribution and selection of total dose and dose per fraction. This is a very difficult problem because the total dose and doses per fraction are very different when using iron needles and flexible applicators. The introduction of needles makes it possible to increase the dose per fraction.

Recalculation of EQD2 can provide guidance, but in case of relapses, in fact, both the dose distribution and dose value are based on experience, teaching and past errors. In brachytherapy, the choice of normalization points or PTV is crucial. A large role is played by the volume of irradiation, which is not included in the modern radiobiological model, but it appears in the limiting criteria of the load on critical organs. With experience, a certain and it could be said peculiar concept is created. It develops over time and keeps improving.

I would like to say a few words about the effect of dose rate on the outcome of brachytherapy treatment of non-gynecological tumors. Often in our practice we use boluses to be able to regulate the dose at a greater depth without damaging the skin. We noticed that even a small change in power affects the time of the radiation reaction and the speed of healing of the irradiated lesion.

Healing occurs significantly faster and it is possible to treat deeper tumors of both endophytic and exophytic plans, despite the fact that most exophytic tumors require the introduction of applicators. It is difficult to say what affects to a greater extent, the exposure time or the imperceptible for measurements quality of exposure.

Discussion and conclusions

Employing needles allows for comprehensive coverage of the entire process with a standard dose, thereby enhancing control over the tumor process and minimizing impact on surrounding healthy tissues. This is significantly beneficial for improving treatment effectiveness and enhancing patients' quality of life.

Further research and refinement of needle insertion techniques in brachytherapy will contribute to the development of standardized protocols, thereby enhancing the precision and effectiveness of treatment. This, in turn, will improve therapy outcomes and facilitate more successful management of tumor processes in oncological practice.

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ВИКОРИСТАННЯ ГОЛОК ДЛЯ ОПРОМІНЕННЯ ГІНЕКОЛОГІЧНИХ ПУХЛИН

Вступ. Використання голок у внутрішньотканинній брахітерапії є важливим методом для лікування гінекологічних пухлин, особливо на пізніх стадіях захворювання.

Методи. Процедура може виконуватися вручну або за допомогою спеціальних аплікаторів, таких як Venice, що дозволяє враховувати індивідуальні анатомічні особливості пацієнтів і забезпечує високу точність введення радіаційної дози. Планування лікування базується на МРТ і стандартизується за об'ємом ураження, що дозволяє ефективно розподіляти різні дози до різних ділянок пухлини.

Результати. Відсутність спеціальних аплікаторів компенсується ручним введенням голок, яке, хоча і вимагає високої кваліфікації медичного персоналу, залишається ефективним методом. Голки зазвичай вставляються на глибину 2–4 см і дозволяють охопити весь процес стандартною ізодозою, дотримуючись рекомендацій. Це забезпечує можливість нормалізації об'єму пухлини після зовнішньої променевої терапії.

Висновки. Важливо зазначити, що в деяких випадках, таких як рецидиви по рубцю вагіни, рак вульви, первинні та вторинні ураження вагіни, і рак прямої кишки з інвазією у вагіну, зовнішня променева терапія не ефективна. У таких випадках внутрішньотканинна брахітерапія з використанням голок відіграє ключову роль у забезпеченні локального контролю та покращенні результатів лікування.

Таким чином, використання голок у брахітерапії є критично важливим для досягнення терапевтичних цілей і підвищення якості життя пацієнтів.

Ключові слова: брахітерапія, внутрішньотканинне опромінення, пухлини жіночих статевих органів.

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