Review

by Prof. Dr. Krasimir Dimitrov Ivanov, PhD, BSc
Head of the Department of General and Operative Surgery
Medical University "Prof. Dr. Paraskev Stoyanov" - Varna

of the dissertation
"Role of Virtual Colonoscopy in Minimally Invasive and Robotic Oncological Colorectal Surgery"

by: **Dr. Mehmed Behchet Hadzhiveli**

for the acquisition of a scientific and educational degree "PhD" in the scientific specialty "General Surgery"

Scientific supervisor: Prof. Dr. Nikola Yordanov Kolev, PhD, BSc

The dissertation thesis has been discussed and approved for public official defense by the Departmental Council of the Department of General and Operative Surgery, Medical University - Varna with a departmental council report with entry. №102-55/11.01.2023. By order P-109-100/02.02.2023 of the Rector of the Medical University - Varna, I have been appointed as a member of the scientific jury for the defense of the dissertation work.

The presented set of materials on paper and electronic media is in accordance with the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (LDASRB) and the Regulations for the Development of the Academic Staff at the Medical University "Prof. Dr. Paraskev Stoyanov"- Varna.

Biography

Dr. Mehmed Behchet Hadzhiveli was born in 1982 in Kubrat. He graduated in Medicine in 2007 at MU-Sofia. He specialized in Surgery from 2008 to 2013 at the N.I. Pirogov Hospital and acquired a specialty in 2014. From 2016 to 2019, he specialized in Thoracic Surgery at "St. Marina" Hospital - Varna and acquired his second specialty in 2019. He currently works as a surgeon in the First Clinic of Surgery, "St. Marina" Hospital - Varna and as an assistant at the

Department of General and Operative Surgery, MU "Prof. Dr. Paraskev Stoyanov" - Varna.

The topic of the dissertation is current and dissertationable. Colorectal carcinoma is a socially significant malignancy with a high incidence. Timely diagnosis and treatment is a leading goal. The set of diagnostic methods is supplemented by virtual colonoscopy. The simultaneous combination of computed tomography of the abdomen with colonoscopy opens new horizons that need in-depth study. Such studies are relatively rare in the Bulgarian scientific literature, which emphasizes the merit of the present dissertation work.

The dissertation is presented in a volume of 164 pages and contains 29 tables and 59 figures. It complies with the accepted requirements for the structure of a dissertation work. It includes the following chapters: Introduction (1 p.), Literature review (52 p.), Aim and objectives (1 p.), Material and methods (12 p.), Results of own research (38 p.), Analysis and discussion of own results (24 pages). Conclusion and conclusions (2 pages), Bibliography (18 pages). Bibliography includes 233 titles in Latin and two articles by Bulgarian authors.

The literature review is well structured with the following sections: Social epidemiology of oncological colorectal patients; Modern minimally invasive surgical methods of treatment of oncological colorectal diseases; Novelties in imaging diagnostics of oncological colorectal diseases; Satisfaction and quality of life of patients with oncological colorectal diseases undergoing endoscopic examinations; Economic analyzes of imaging in colorectal cancer screening; A critical evaluation of the literature on the problem circle. Articles from 1996 to 2022 are included, with articles from the last five years predominating. It is noteworthy that the role of virtual colonoscopy has not been fully clarified and is used in the diagnosis, screening and follow-up of patients with colorectal lesions. The basis of comparison is always the conventional colonoscopy. The advantages of virtual colonoscopy are non-invasiveness of the method, lack of need for sedation, the possibility of simultaneous evaluation of the colon pathology and the anatomical area, examination of the colon and in the case of stenosis of malignant origin, a negligibly low frequency of complications, including perforation.

The dissertation sets a clearly formulated **Objective**, namely: To study the role of virtual colonoscopy in minimally invasive and robotic oncological colorectal surgery. In order to fulfill this goal, the following tasks are set:

1. To investigate the diagnostic role of virtual colonoscopy in patients with colorectal cancer.

2. To investigate the diagnostic role of virtual colonoscopy in patients with colorectal polyps.
3. To analyze the additional diagnostic role of virtual colonoscopy in colonic and extracolic diseases.
4. To analyze the application of virtual colonoscopy in the staging of patients with colorectal cancer.
5. To analyze the role of virtual colonoscopy in the choice of surgical method.

Dr. Hadzhiveli's study was retrospective, monocentric. **It was implemented in** the structures of "St. Marina" Hospital - Varna and covers the period from 01.01.2012 to 31.12.2021. The patient population includes **1695 patients** who underwent virtual colonoscopy.

The material is well described and illustrated with figures and tables. For the period covered in the study, 1,695 virtual colonoscopies were performed, with 812 of them also having a conventional colonoscopy performed. 715 of the patients underwent surgical treatment, of which 112 were minimally invasive interventions, including robot-assisted resections. Patients were divided into homogeneous groups, which allowed for a statistically reliable analysis.
The research methodology is clear and corresponds to the set tasks. The applied protocol for virtual colonoscopy and endoscopy is described, as well as the set of statistical tools.

The results are presented in an appropriate analytical form. The role in the diagnosis of colorectal cancer has been evaluated. Through the performed 1695 virtual colonoscopies, a total of 154 patients with colorectal carcinoma were diagnosed by VCS, of which 48 were found to have a synchronous colorectal tumor. A total of 88 cases of CRC, promptly diagnosed with the help of VCS, were missed during the examination of the patients with the help of FCS. All missed CRCs were proximally located. Evaluation of virtual colonoscopy in colorectal polyps indicates that virtual colonoscopy has a high specificity and sensitivity of 82% and 96%, respectively. Three groups of patients were studied - those with polyps $\leq$ 5 mm (n=46; 2.71%), polyps of 6-9 mm (n=153; 5.54%), polyps $\geq$ 10 mm (n=109; 6 .43%). 66 polyps were missed during FCS. On the other hand, virtual colonoscopy has its disadvantages in detecting polyps smaller than 5 mm.
Diagnostic role of virtual colonoscopy in other colonic and extracolic diseases is another section of the Results chapter. It is striking that a number of diseases have been identified with the potential to change the surgical strategy.
A diagnostic role of virtual colonoscopy in the staging of patients with colorectal cancer concerns TNM-stage determination. Of the established 154 patients with colorectal carcinoma, 138 of them were operated on and examined

histologically. The obtained pathoanatomic results for T-stage were compared with the preliminary images for T-stage from VCS. A statistically significant difference was obtained only at T1 stage. For the rest T2, T3, T4 there is no significant difference when comparing the two studies.

The diagnostic role of virtual colonoscopy in choosing a surgical method is a chapter with important results for practice. Intraoperative results were analyzed in terms of tumor localization and the need for intraoperative optical endoscopy to mark the localization of CRC in minimally invasive surgeries, due to the lack of tactile sensation. Two groups of patients were distinguished - GROUP-1 with VCS and GROUP-2 without VCS, each considered in the context of open and minimally invasive surgery. We divided each group into conventional. A coincidence of tumor localization and implemented operative plan was established in Group-1 with VCS, with a statistically significant difference when compared with Group-2 without VCS. In 26 patients, the performance of VCS led to a change in the operative strategy in the direction of expanding the volume of resection.

The discussion follows the structure of the Results chapter and this allows the reader to gain a clear impression of the place of the author's results among the world literature data.
In the **Conclusion** chapter, it is rightly noted that imaging methods for detection, localization, staging, preoperative plan, presence or absence of accompanying pathology and follow-up play a key role in preoperative diagnostics. Virtual colonoscopy is the method of choice, meeting the requirements of preoperative preparation.

The conclusions are 7 in number and are a logical continuation of the set tasks:
1. Virtual colonoscopy is characterized by high specificity and sensitivity in T1-T3 carcinomas.
2. Virtual colonoscopy has a significant role in the detection of synchronous neoplasms and is the method of choice for incomplete optical colonoscopy.
3. Virtual colonoscopy is characterized by high specificity and sensitivity for polyps over 6mm.
4. Colonic and extracolic diseases established by VKS directly affect the choice of surgical method.
5. Staging with VCS allows reliable determination of T-stage, localization, loco-regional status and vascular anatomy.
6. Virtual colonoscopy reliably reduces the probability of changing the operative plan, reduces the frequency of conversions and perioperative complications.

7. Statistically significant benefits for the accurate staging of the oncological disease and selection of the optimal radical surgical method were reported in patients with a preoperative VCS.

As **contributions** of the dissertation I can recognize:

• For the first time in Bulgaria, the role of virtual colonoscopy in minimally invasive colorectal surgeries has been analysed.
• A ten-year period with a large number of diagnosed, operated and followed-up patients was analyzed.
• Literature and clinical data on the advantage of virtual colonoscopy in the preoperative diagnosis of colorectal neoplasms are presented.
• A retrospective clinical-epidemiological single-center study was performed and contemporary data on the incidence and clinical characteristics of patients with colorectal carcinoma were presented.
• A detailed imaging and clinical study was performed on the impact of virtual colonoscopy on operative methods.
• A comparative analysis was made between a non-invasive imaging method and optical endoscopy, which is the gold standard in colorectal diseases.
• An increase in minimally invasive and robotic surgery in the treatment of colorectal diseases is confirmed.

Dr. Mehmed Hadzhiveli is an assistant professor with potential in the scientific field, respected by students and fellow teachers, a surgeon with deep theoretical knowledge and excellent practical skills. This allows him to prepare a dissertation work of high scientific and practical value, which will specify the role of virtual colonoscopy in surgery and in particular in minimally invasive and robotic interventions. This gives me the right to propose to the highly respected Scientific Jury for acquisition by Dr. Mehmed Hadzhiveli of the educational and scientific degree "Philosophiae Doctor".

Varna
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Prof. Dr. Krasimir Dimitrov Ivanov, PhD, BSc
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