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Original research

Endorectal ultrasound in the diagnosis of rectal cancer: Accuracy and criticies

Alessandra Surace [a, *], Alessia Ferrarese [a], Silvia Marola [a], Alessandro Borello [a], Jacopo Cumbo [a], Matteo Rivelli [a], Mario Solej [a], Valter Martino [a], Marco Ferronato [a], Herbert Dal Corso [b], Mario Nano [a]

[a] University of Turin, Department of Oncology, School of Medicine, Teaching Hospital "San Luigi Gonzaga", Section of General Surgery, Orbassano, Turin, Italy
[b] Santa Croce e Carle Hospital, Cuneo, Department of General Surgery, Italy

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ABSTRACT

Introduction: Endorectal ultrasound (ERU) is used for locoregional staging of rectal cancer. Our work compares the data in the literature regarding diagnostic accuracy of the technique and results of routine use of the technique in two centers in Piedmont. **Material and methods**: 77 reports ultrasound with the final diagnosis of rectal cancer from the period 2008–2012 were examined. The echographies were performed by two experienced operators, using two ultrasound device with the same technical characteristics. **Results**: Sensitivity levels are high, with the exception of stage T3. Specificity is always high. The relationships of verisimilitude, both negative and positive, showing that the accuracy of the test is still high. The risk of overstaging is higher for pT1, while most important the risk of understaging concerns the stage T3 (23.5%); on the contrary the ERU is able to exclude infiltration of perirectal organs with a good accuracy (NPV of 99.3%). **Conclusion**: Although our study was a retrospective study, likewise some literature's reports, the interpretation of our analysis results shows a significant risk of downstaging T3 and N+ tumors. ERU represents in our experience a very important radiological staging methods to evaluate T1 and T2 rectal cancer.

1. Introduction

Subperitoneal rectal cancer is about 35% of cases of colorectal cancer (CRC) in Europe. Incidence and mortality are of 15–25/100.000/year and 4–10/100.000/year; the highest rates are recorded in males [1].

Preoperative staging relies on clinical evaluation and on endoscopic and imaging techniques. Endorectal ultrasound (ERU) is a diagnostic technique used to study the wall of the rectum and subperitoneal adjacent structures; together with the MRI is the investigation of choice for preoperative local staging of rectal cancer.

ERU was introduced in 1956 by Wild and Reid for the study of prostate cancer [2]; ten years after the technique was also applied to the study of the rectum [3,4]. Since then, ERU became more and more widespread, now becoming the gold standard for rectal cancer locoregional staging because of its feasibility and minimal disturbance to the patient [5].

Review of literature shows conflicting results on ERU accuracy, since this is an operator-dependent technique; however, in most of the studies is stressed the high diagnostic accuracy of the technique [6]. The two major studies published on ERU are the meta-analysis of Puli (2009), which shows a high diagnostic accuracy, and a multicenter study (Marusch, 2011) [7]), which differs from the results of Puli.

The aim of our study is to compare our results with literature data, to highlight agreements and discrepancies, and highlight the

Abbreviations: ERU, Endorectal ultrasound; CRC, colorectal cancer; TEM, Transanal Endoscopic Microsurgery; TME, total mesorectal excision.

* Corresponding author. Department of Oncology, University of Turin, Section of General Surgery, San Luigi Gonzaga Teaching Hospital, Regione Gonzole 10, 10043 Orbassano, Turin, Italy.
E-mail addresses: alessandra.sur@gmail.com (A. Surace), alessiaferrarese.md@gmail.com (A. Ferrarese), silvia.marola@gmail.com (S. Marola), alexbori@libero.it (A. Borello), jacopo.cumbo@gmail.com (J. Cumbo), mariosolej@gmail.com (M. Solej), valtermartino.md@gmail.com (V. Martino), marcoferronato@libero.it (M. Ferronato), herbertdalcorso@libero.it (H. Dal Corso), mario.nano@unito.it (M. Nano).

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Table 1
Qualitative analysis dell'ERU for the parameter T, with the calculation of the risk of over-and underestimation. SENS = sensitivity; SPEC = specificity; I.C. = confidence interval; PPV = positive predictive value; NPV = negative predictive value; LR = likelihood ratio.

Stage	SENS % [I.C.]	SPEC % [I.C.]	PPV% [I.C.]	NPV% [I.C.]	LR + [I.C.]	LR − [I.C.]	Overstaging risk	Understaging risk
pT0	0.958 [0.699 −0.996]	0.869 [0.766 −0.931]	0.575 [0.364 −0.762]	0.991 [0.921 −0.999]	7.328 [3.873−13.867]	0.048 [0.03 −0.724]	0 [0.51−52.18]	0 [0.51−52.18]
PTis	0.9 [0.463−0.989]	0.993 [0.937 −0.999]	0.9 [0.463−0.989	0.993 [0.937 −0.999]	129.6 [8.06−2083.968]	0.101 [0.007 −1.397]	42.11 [23.06 −63.95]	0 [0.51−52.18]
pT1	0.778 [0.453 −0.937]	0.882 [0.785 −0.939]	0.467 [0.248 −0.699]	0.968 [0.89 −0.991]	6.611 [3.158−13.838]	0.252 [0.074 −0.858]	47.06 [26.02 −69.24]	11.76 [3.58 −34.71]
pT2	0.833 [0.552 −0.953]	0.908 [0.813 −0.957]	0.625 [0.386 −0.815]	0.967 [0.888 −0.991]	9.028 [4.403−20.157]	0.184 [0.052 −0.652]	33.03 [16.29 −56.55]	11.11 [3.38 −33.14]
pT3	0.714 [0.454 −0.883]	0.952 [0.869 −0.984]	0.769 [0.497 −0.918]	0.938 [0.85 −0.975]	15 [4.736−47.512]	0.3 [0.131−0.688]	17.65 [16.29 −41.42]	23.53 [9.69 −47.64]
pT4	0.833 [0.31 −0.982]	0.993 [0.939 −0.999]	0.833 [0.31 −0.982]	0.993 [0.939 −0.999]	123.333 [7.437 −2045.279]	0.168 [0.013 −2.107]	0 [0.51−52.18]	0 [0.51−52.18]

causes of staging errors that have had greater significance in our clinical experience.

2. Materials and method

We retrospectively reviewed the cases operated for rectal cancer in San Luigi Gonzaga Teaching Hospital in Orbassano and Santa Croce e Carle Hospital in Cuneo, from January 2008 to June 2012. Data were aggregated and the header of origin of individual patients has been cleared to avoid that this was a confounding factor for subsequent statistical analysis; reports were divided by stage.

3. Sample selection

On 130 patients operated, 117 are staged with the ERU. Only exclusion criteria was the treatment with neoadjuvant therapy; applying this limit, the patients included in the study were 77.

The echographies were performed by two experienced operators as defined in the literature coming from the same school and with identity setting and reporting: they collaborated for five years and for one year compared to blind their reports. The ultrasound used in the two centers are identical and use a radial probe at a frequency of 10–13 MHz.

4. Variables

Characteristics of ERU accuracy were estimated by comparing ultrasound report with the pathological findings, considered the gold standard; for staging TNM classification was used [8].

N and T parameters were analyzed separately. For T staging, patients were stratified by stage. In each stage was conducted statistical analysis: true positives (in which ultrasound diagnosis agrees with the anatomo-pathologic examination), false negatives (classified by ultrasound at a stage lower than anatomopatology), false positives (classified by ultrasonography at a stage higher than anatomopatology) and true negatives (patients correctly staged by ultrasonography as belonging to a different stage than that taken considered) were identified.

5. Statistical analysis

Sensitivity, specificity, positive and negative predictive value, positive and negative likelihood ratio, with confidence intervals at 95% were estimated [9]. The significance of the results was estimated by chi-square test.

Probability to overestimate of ultrasound stage was estimated, using a logistic regression model where the dependent variable is the probability of overestimation and the explanatory variables are sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio (LR+) and negative likelihood ratio (LR−) [10].

Overestimation Odds ratio, relative confidence intervals of 95% and significance tests was calculated.

All analyzes were conducted with SAS 8.1 program.

6. Results

77 ERUs reports were divided as follows: 14 UT0, 6 UTIs, 16 UT1, UT2 17, 19 UT3, 5 UT4 (total uT = 77); UN0 52, 16 + uN (uN total = 68). The number of patients studied for the parameter N is lower than in patients studied for parameter T because 9 patients staged as UT0 have not been evaluated by the parameter N.

Table 1 presents the characteristics of accuracy compared ERU pathological examination in the T staging of the tumor, stratified by stage.

Results show levels of sensitivity in accord with literature, with the exception of pT3 in which the sensitivity does not reach 80%. The specificity is still high: the highest value is found for stage pT4 (99.3%), while the specificity for the stadium PT0 is only 88.2%. The highest risk of overstaging concerns the pT1. The positive predictive values are always moderately low, except for pTis, while negative values are high. The likelihood ratio both negative and positive show that the accuracy of the test is high. Due to the low sample size, confidence intervals at 95% are very large.

Specificity, PPV and LR+ for stage Tis are high (99.3%, 0.9 and 129.6 respectively).

LR-of pT0 stadium is 0.048: the risk that a tumor of the major stage is identified as UT0 is therefore very low. However, the risk of overstaging for pTo is 42%.

Specificity and LR+ for T1 stadium are respectively 88.2% and 6.611. The PPV is low (0.467), with high risk of overstaging (47%), but low risk of understaging for T2 (11%).

Sensitivity and specificity for pT2 stage are respectively 83% and 91%. In this case, the main risk is the overstadiation (33%). The risk of understadiation is 11%.

T3 stage has low sensitivity (71.4%), high specificity (95%) and high NPV (94%). The understaging risk is high (23.5%), conversely the risk of overstaging (17.65%).

For stage T4 there is a high ability of the test to define the true positives (specificity = 99%; PPV = 83.3%); Furthermore the ERU is able to exclude the infiltration of perirectal organs (NPV = 99.3%).

Evaluation of these variables has also been applied to the parameter N. Sensitivity and specificity for pN0 stage are 84%, and 99%. Sensitivity and specificity for pN+ stage are 95.5%, and 91.4%. The PPV for N0 and N1 is elevated (98% and 62% respectively). LR- for N+ is 0.05, furthermore LR+ is high for both N0 and N+ (82%