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Original Article

Cancer Epidemiology in Radiation Oncology: An Institutional Experience From North India During 2016-2022

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Abstract

Background and aims: Cancer is emerging as a serious health issue in developing countries mainly as a consequence of metamorphosis in the demography and epidemiology of various cancers. This study aimed to describe our institutional experience in terms of demographic, clinical, and radiation treatment characteristics in cancer patients.

Methods: A descriptive cross-sectional study was conducted on histopathologically proven carcinoma cases treated with radiation therapy (RT) from January 1, 2016 to May 31, 2022 at Capitol Hospital, Jalandhar. All enrolled 3753 patients' data were retrieved from medical records on January 1, 2022. Baseline demographic, clinical information, and radiation treatment details were compiled, and chi-square test was performed to compare categorical data of age versus histology. The Jonkheere-Terpstra and Cuzick method was used to test the trend across different time periods for categorical variables ($P<0.05$).

Results: The trend analysis of the year-wise distribution and age demonstrated that the majority of diagnosed patients were in the age group of 51-70 years (mean age ± standard deviation, 58 ± 13.12). Most oncological patients represented good compliance (93.2%). The intention of radiation treatment was curative in 84.4% of patients, while the remaining patients (15.6%) were treated with palliative intent. It was found that RT plays a major role in the breast (21.1%), head and neck (20.4%), and female genitourinary (GU) (16.2%) malignancies as compared to male GU, gastrointestinal (GI), and other malignancies.

Conclusion: The findings revealed carcinoma breast, cervix uteri, head and neck, prostate, and esophagus as established cancers being treated with RT. Our analysis showed good compliance to the RT of 93.8% owing to modern techniques. The most common histologies were adenocarcinoma and squamous cell carcinoma observed in the age group of 51-70 years. The findings represented that RT is utilized in various settings in the multidisciplinary management of cancer. This epidemiological distribution might contribute to planning cancer control strategies in the near future.

Keywords: Cervix, Esophagus, Radiation oncology

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Introduction

Non-communicable diseases (NCDs) result in substantial morbidity and mortality globally. The burden of NCDs in India is rising at an alarming rate.[1] NCDs are responsible for 38 million (68%) of all deaths globally and about 5.87 million (60%) of all deaths in India, mainly from cardiovascular diseases, chronic respiratory disease, cancers, and diabetes (82% of all NCD deaths).[2] GLOBOCAN has predicted that India's cancer burden is expected to nearly double in the next 2 decades, from one million cases in 2012 to more than 1.7 million by 2035, indicating an expected rise in the absolute number of cancer deaths from 680 000 to 1.2 million.[3] Recent data suggested that carcinoma lung, colorectal, breast, and prostate are following an increasing trend.[4] In India, the projected national cancer incidence burden for the year 2020 is 98.7 per 100 000 people. This incidence is higher for females (712 758) than males (679 421) with the most common five leading sites being breast, lung, mouth, cervix uteri, and tongue.[5]

Radiation treatment, either alone or in combination with other therapies such as chemotherapy or surgery, has become an effective tool in the armamentarium of cancer treatment. It has been estimated that more than 50% of all cancer patients will receive radiation therapy (RT) at some point in the course of the disease.[6] The indications of RT range from definitive treatment for early-stage and advanced-stage tumors to the palliation of symptoms from widespread metastatic disease. There have been innovations in RT delivery techniques, as well as improvements in the existing technology, resulting in improving the accuracy and quality of radiation delivery and enhanced survival rate for many oncological patients.[7] As has been reported in head and neck malignancies, the overall survival rates with RT have escalated from about 30% two decades ago to 80% at present.[8,9]

The present study sought to evaluate the pattern of various cancers in terms of demographic, clinical, and

radiation treatment characteristics at a tertiary care hospital. This study highlights the need for designing a roadmap for addressing and prioritizing the healthcare infrastructure according to the cancer burden in this region.

Materials and Methods

Study Design

This descriptive cross-sectional study is a review of all histopathologically proven cases of carcinoma that were treated with RT from January 1, 2016 to May 31, 2022. This study was conducted in a multidisciplinary, tertiary care hospital covering a large number of patients from Punjab and surrounding areas.

Study Population

We retrospectively analysed the data of 3926 patients treated by RT as part of multimodality treatment. The inclusion criteria were histopathologically proven carcinoma prior to initiating RT irrespective of the primary tumor site and all patients registered for RT. On the other hand, the patients with incomplete data were excluded from this study.

Sampling Method and Sample Size Determination

Non-probability sampling (i.e., the convenient sampling method) was used to include all the patients diagnosed with cancer fulfilling the inclusion and exclusion criteria of the study.

Data Collection Method

All data from 3753 patients enrolled in this study were retrieved from medical records on July 12, 2022. These medical records were examined for information on the demographic, clinical characteristics, and radiation treatment details of various cancer patients enrolled in this study. An extensive data collection Excel sheet was prepared using Microsoft. The extracted demographic information was the year of diagnosis, age, gender, and geographical distribution. Clinical and radiation treatment information included the stage, and site of disease, tumor histology, presence, site of metastatic disease, the applied radiation technique, and the intent of RT treatment. For ease of presentation, various malignancies were broadly categorized into breast, head and neck, lung, female genitourinary (GU), gastrointestinal (GI) and hepatobiliary, male GU, central nervous system, carcinoma of unknown primary, hematological malignancies, and miscellaneous categories.

The enrolled patients' diagnoses were confirmed based on the pathologic data. All patients were clinically staged according to American Joint Committee on Cancer Staging and were discussed in the multidisciplinary tumor board. The intent of RT treatment was mainly curative or palliative based on the patient's age, disease stage, and performance status. The patients were referred for either definitive, adjuvant, neo-adjuvant, consolidative, prophylactic, or palliative RT. All patients underwent treatment planning contrast-enhanced CT scan with a 3 mm slice thickness. Patients were positioned as per the primary tumor site and immobilized accordingly. Contouring guidelines for target volume delineation as per the radiation therapy oncology group were followed, wherever available. All treatment plans were developed using the Varian Eclipse planning system, version 13.5. All these patients were treated with a megavoltage linear accelerator (Truebeam) with 6 and 10 MV photons or 6-12 MeV electrons depending on the tumor depth. Depending on the primary tumor site, the applied RT technique was the 3-dimensional conformal RT (3-DCRT)/intensity-modulated RT (IMRT)/rapid arc technique. Image guidance was performed for all patients treated with curative intent. Target volumes and fractionation were individualized, and the RT regimens varied according to the primary site. Weekly clinical examination was performed for all patients during radiation treatment. The indication of combining chemotherapy with RT relied on the medical oncologist, performance status, and primary tumor site.

Analysis Method

Data were described in terms of range, mean ± SD, frequencies (number of cases), and relative frequencies (percentages) as appropriate. A chi-square test was performed for comparing categorical data of age vs. histology. Jonkheere-Terpstra and Cuzick method was utilized for trend analysis. All statistical calculations were conducted using SSPS (Statistical Package for Social Science) (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows, version 21.

Results

Characteristics of the Study Population

Totally, the data of 3926 patients with histopathologically proven carcinoma and subjected to radiation treatment were retrieved. However, only 3753 (92.3%) patients had all the necessary and relevant details. Nonetheless, 173 (4.6%) patients could not be included due to incomplete data.

Demographic Characteristics

The mean (± SD) age of the study population was 58 (± 13.12) years (range 5-97 years). The trend analysis of the year-wise distribution and age demonstrated that the majority of diagnosed patients were in the age group of 51-70 years (Figure 1, $P < 0.05$). Among the total of 3926 patients, 3753 (92.3%) cases completed the planned RT treatment, while 288 (7.7%) did not complete the planned treatment schedule.

Clinical Characteristics

Among these patients, the most frequent sites of cancer were breast (21.1%), head and neck (20.4%), and female GU (16.2%), the details of which are displayed in Figure 2. In the breast cancer group, all patients were females, except for 5 (0.5%) males, and 151 (14.6%) of patients

were younger than 40 years of age. Further, stage-wise distribution was I/II/III/IV as 11.2%/32.4%/40%/16.4%, respectively. The mean age in the head and neck group was 55 (± 10.22) years. Among this cohort, 62% of patients were females, and the stage-wise distribution was I/II/III/IV as 14.6%/22.1%/56.4%/6.9%, respectively. The third most common malignancy was the female GU group, including carcinoma cervix, endometrium, ovary, vagina, vulva, renal cell carcinoma, and bladder carcinoma. Among these, carcinoma cervix constituted 23.5% of patients, and the stage-wise distribution was II/III/IVA as 28%/41%/31%, respectively.

Head and neck cancer (34.5%), male GU (21%), and GI (17.4%) were noted to be the most common sites of malignancies among males, constituting 70% of the total patients. However, carcinoma breast (39.1%), female GU (30.5%), and GI (10%) were recognized as the common malignancies among females, accounting for 79.6% of all patients (Figure 3). Moreover, 60% of GI malignancies were carcinoma esophagus in both genders.

Among the male GU malignancies, carcinoma prostate accounted for 72.6%, followed by urinary bladder (18.7%) and renal cell carcinoma (4.6%). Among the female GU malignancies, carcinoma cervix was found in 23.5% of patients. Endometrial malignancy and other sites were responsible for 3.8% and 10.4% of patients, respectively.

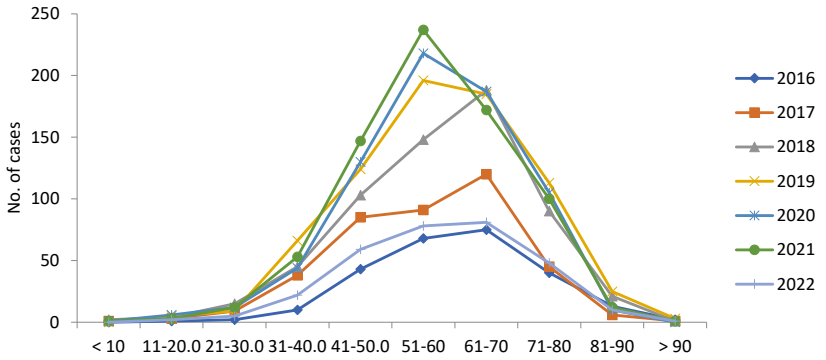

Figure 1. Trend Analysis of the Year-wise Distribution and Age.

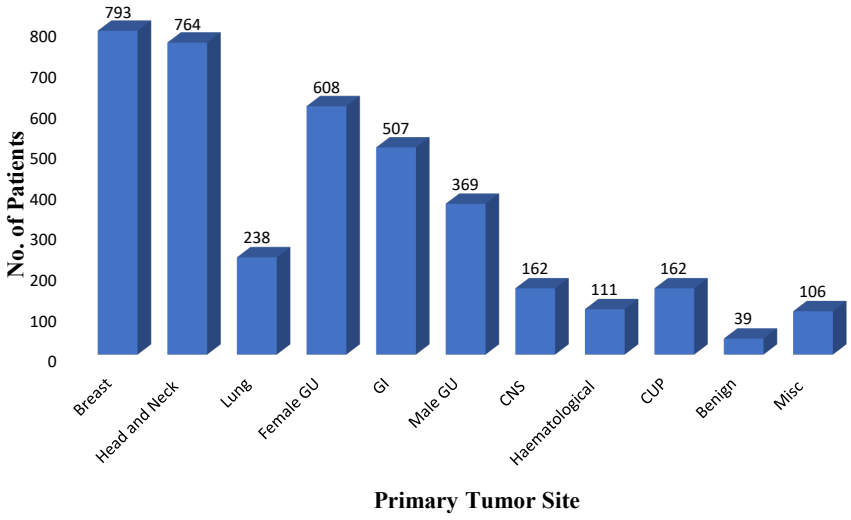

Figure 2. Spectrum of Various Primary Tumor Sites Being Treated With RT. *Note*. RT: Radiation therapy .

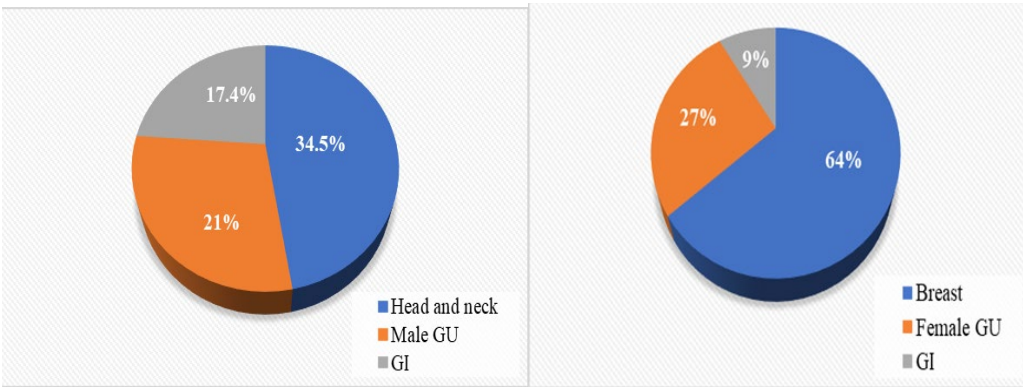

Figure 3. Gender-wise Distribution of Malignancies Among Male and Female Groups. *Note*. GU: Genitourinary; GI: Gastrointestinal and hepatobiliary .

Based on the results, the most common histopathology treated with RT was squamous cell carcinoma (SCC, 43.8%), followed by adenocarcinoma (41.9%) and others (14.3%), respectively ($P<0.05$). On subgroup analysis as per age, SCC and adenocarcinoma were the most prevalent histopathologies in the age group of 51-70 years (Figure 4).

It was observed that among those treated with curative intent, 48.4% of patients had SCC, while for those treated with palliative intent, 62.2% had adenocarcinoma. The majority (81.8%) of patients were treated with IMRT/RapidArc technique, and 685 (18.2%) patients received RT with the 3-DCRT technique. Those receiving the 3-DCRT technique were mainly palliative patients or those who had financial issues. RT is the preferred treatment of choice as definitive therapy, as well as adjuvant therapy, despite other indications (Figure 5).

RT was used as an effective tool for palliation in 15.6% of patients. The findings revealed that carcinoma prostate, breast, lung, and multiple myeloma were the common primary malignancies, forming 72% of the indications for palliative RT (Figure 6). RT was employed for palliation for wide indications such as bone pain and brain metastasis to control bleeding, spinal cord compression, severe dysphagia, superior vena cava syndrome, liver metastasis, and lung metastasis.

Discussion

The loco-regional treatment of tumors using ionizing radiation is one of the most important pillars of cancer treatment, along with surgery, systemic therapy, and targeted therapy. Based on our results, 81.8% of our patients were treated with the advanced IMRT/RapidArc technique. Completing the full course of RT is challenging for many patients. Our extensive data revealed that as high as 92.3% of patients could complete the planned RT treatment. This has happened perhaps due to the better toxicity profile of the IMRT technique, compared to conventional RT, in reducing RT-induced side effects. Several studies reported that IMRT allows for better sparing of organs at risk, resulting in a decrease in acute and late side effects.[10,11]

It was found that 7.7% of our patients discontinued planned RT treatment due to various causes such as the deterioration of performance status, radiation-induced reactions, economic constraints, and distance from the radiation center. Lazarev et al[12] examined the causes of premature termination of curative RT in head and neck cancer patients. The researchers reported the most common causes for RT discontinuation were RT toxicity (17%), medical comorbidity (24%), and medical advice (33%).

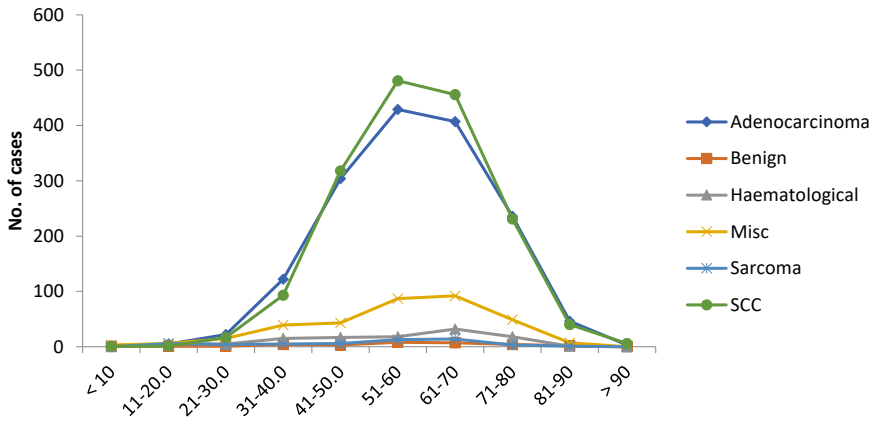

Figure 4. Distribution of Histopathological Types as per the Age.

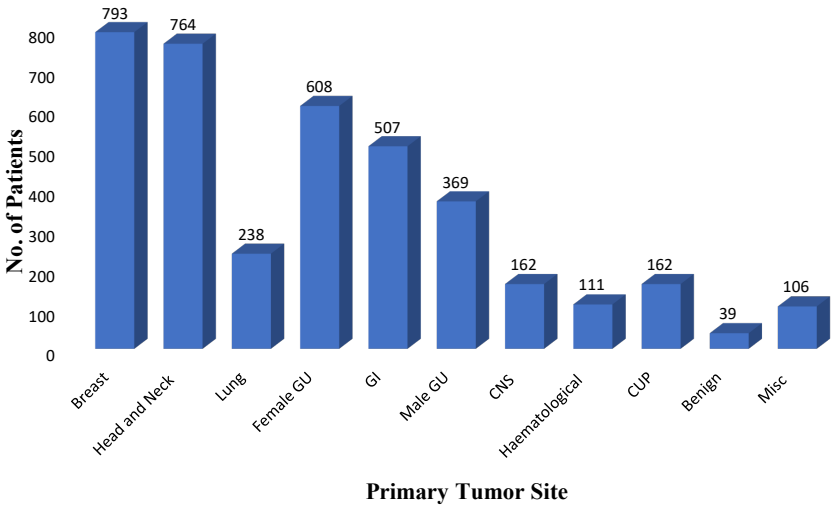

Figure 5. Indications of RT in Various Malignancies. *Note*. RT: Radiation therapy

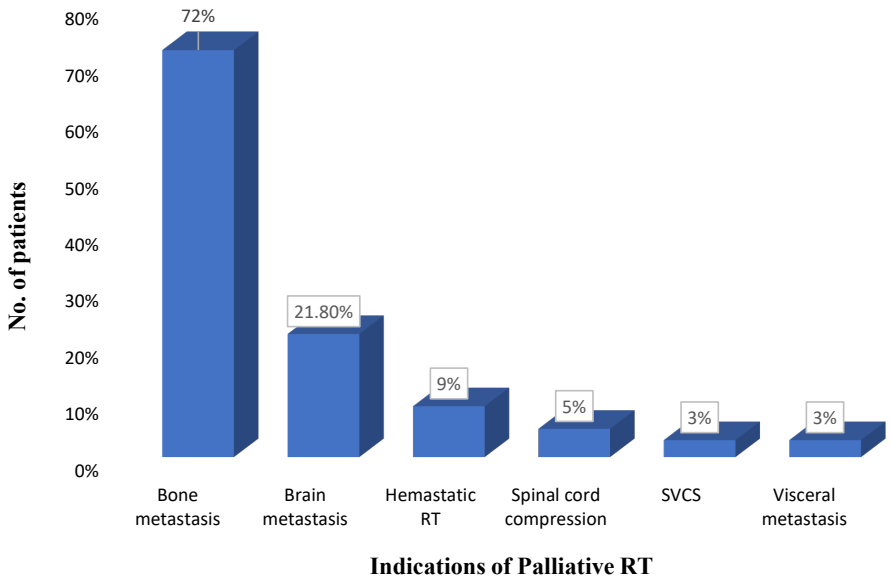

Figure 6. Indications of Palliative RT. *Note*. RT: Radiation therapy

The majority of the diagnosed patients were in the age group of 51-70 years. Research indicated that males have more susceptibility to cancers than women.[13] However, there were no gender disparities in cancer incidence in this study.

Concerning age, 90% of our patients had > 40 years of age. Advancing age is considered an important risk factor for all cancers and site-wise cancers. White et al[14] concluded that midlife is the period when there is a high prevalence of multiple cancer risk factors that translates to a higher incidence of certain cancers.

Our results represented that SCC is the most common histology being treated with curative intent RT as compared to palliative intent. In a retrospective study by Hu et al,[15] it was demonstrated that carcinoma cervix patients with adenocarcinoma had poorer survival than SCC patients irrespective of treatment with RT alone or concurrent chemo-radiotherapy. This has been attributed to the poor radiosensitivity of cervical adenocarcinoma compared to SCC.

RT forms an important and indispensable component of multimodality cancer management. Several studies have highlighted that RT is utilized as a curative option in approximately 40% of cases, and around 50% of oncological patients will need RT at some point during the disease, especially in low- and middle-income countries.[16,17] Radiation remains one of the most important pillars of comprehensive cancer care for various cancers both in curative and palliative settings.[18] Our findings revealed that the goal of RT was curative and palliative in 84.4% and 15.6% of patients, respectively.

Radiation treatment is a well-established, curative treatment option for four common cancer sites, including breast, lung, urological, and lower GI cancer.[19] As per Indian data, 40% of patients are disease-free following treatment by RT alone (or combined with surgery/chemotherapy).[20] Based on our results, 70% of females subjected to RT had breast cancer (39.1%), followed by female GU (30.5%) in which carcinoma cervix was responsible for 23.5% of cases and GI cancers (10%) as the most common cancers. Among males, the most common cancers constituting 70% included head and neck cancer (34.5%), male GU (21%) where carcinoma prostate was the most common (72.6%), and GI (17.4%) cancers. A recent report from 28 population-based cancer registries (PBCRs) and 58 hospital-based cancer registries in India under the National Cancer Registry Programme was published in 2020. This study reported that the most common sites of cancer among females across the PBCRs were breast, cervix, and ovarian cancers. Among males, lungs, head and neck, esophagus and stomach were the most common sites.[5]

The foundation of palliative RT is to effectively alleviate symptoms with the least resource utilization in advanced malignancies. Based on our findings, bone metastasis (72%) was the most common indication for palliative RT, followed by brain metastasis (22%). RT provides effective palliation by shrinking the tumor size or modulating pain signalling pathways even if the tumor shows a minimal response.[21]

This study has several strengths. To our knowledge, this study is the first one with the largest number of patients reporting various characteristics of oncological patients treated with RT from the North India region, especially Punjab. However, there are potential limitations representing that our data are cross-sectional, and it is a single-departmental, single-hospital-based study, which may not be representative of the entire region.

Conclusion

Based on our single-institution experience, it was found that carcinoma breast, cervix uteri, head and neck, prostate, and esophagus are well-established cancers being treated with RT. Most of our oncological patients have

shown good compliance (93.2%) for radiation treatment, mainly attributed to advanced radiation technology. The most common histologies were adenocarcinoma and SCC observed in the age group of 51-70 years old. Based on the findings, RT is utilized in various settings in the multidisciplinary management of cancer. However, further prospective studies are warranted on radiotherapy utilization rates for various malignancies from various regions.

Authors' Contribution

Conceptualization: Preety Negi, Harnoor Singh Pruthi, Himanshu Srivastava.
Data curation: Preety Negi, Harnoor Singh Pruthi, Himanshu Srivastava.
Formal analysis: Preety Negi, Harnoor Singh Pruthi, Himanshu Srivastava.
Funding acquisition: Preety Negi, Harnoor Singh Pruthi, Himanshu Srivastava.
Investigation: Preety Negi, Harnoor Singh Pruthi, Himanshu Srivastava.
Methodology: Preety Negi, Harnoor Singh Pruthi, Himanshu Srivastava.
Project administration: Preety Negi, Harnoor Singh Pruthi, Himanshu Srivastava.
Resources: Preety Negi, Harnoor Singh Pruthi, Himanshu Srivastava.
Supervision: Preety Negi, Harnoor Singh Pruthi, Himanshu Srivastava.
Validation: Preety Negi, Harnoor Singh Pruthi, Himanshu Srivastava.
Visualization: Preety Negi, Harnoor Singh Pruthi, Himanshu Srivastava.
Writing–original draft: Preety Negi, Harnoor Singh Pruthi, Himanshu Srivastava.
Writing–review & editing: Preety Negi, Harnoor Singh Pruthi, Himanshu Srivastava.

Competing Interests

None.

Ethical Approval

This study was undertaken after the approval of the Institutional Research Committee with scientific research committee No. CAP/SRC/2022-02.

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