



A risk nomogram of COVID-19 infection in cancer patients

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The pandemic of COVID-19 is of international concern and poses great challenges for management of oncology services.¹ Recent studies showed that patients with cancer histories² and cancer patients being treated³ had higher infection rates than individuals. Oncology societies have promptly issued guidelines on cancer care during the pandemic.^{1,4,5} These guidelines provide general recommendations to management of cancer patients, but offer no specific personal evaluations based on risk factors, which remain largely unstudied.

Here, we have collected 27 confirmed cases from 1720 cancer patients in Renmin Hospital of Wuhan University, Wuhan, China during December 23, 2019 to January 23, 2020. Clinicopathologic and laboratory characteristics on routine admission were collected and analyzed to uncover the potential risk factors of COVID-19 infection. Univariate logistic analysis revealed that 17 factors were significantly associated with COVID-19 infection (Fig). Generally, older age, smoking history and primary site of liver were associated with increased risk. Besides, hypertension, radiation pneumonia and lung infection history were also significant risk factors (Fig). Notably, chemotherapy, radiotherapy, targeted therapy, and immunotherapy within 1 month were not risk factors in our analysis, while anemia and hypoproteinemia were statistically significant. In blood routine and chemistry test, low lymphocyte, rather than white blood cell, and platelet predicted increased risk. Meanwhile, nutritional status factors including hemoglobin, albumin, sodium, and potassium were also significant risk factors (Fig). In multivariate logistic analysis, hypertension (odds ratio [OR] = 5.18, 95% confidence interval [CI]: 1.10–24.98, $P=0.034$), radiation pneumonia (OR = 17.71, 95% CI: 2.50–109.58, $P=0.002$), lymphocyte count (OR = 0.07, 95% CI: 0.01–0.50, $P=0.018$), and albumin (OR = 0.86, 95% CI: 0.76–0.96, $P=0.007$) were independent risk factors

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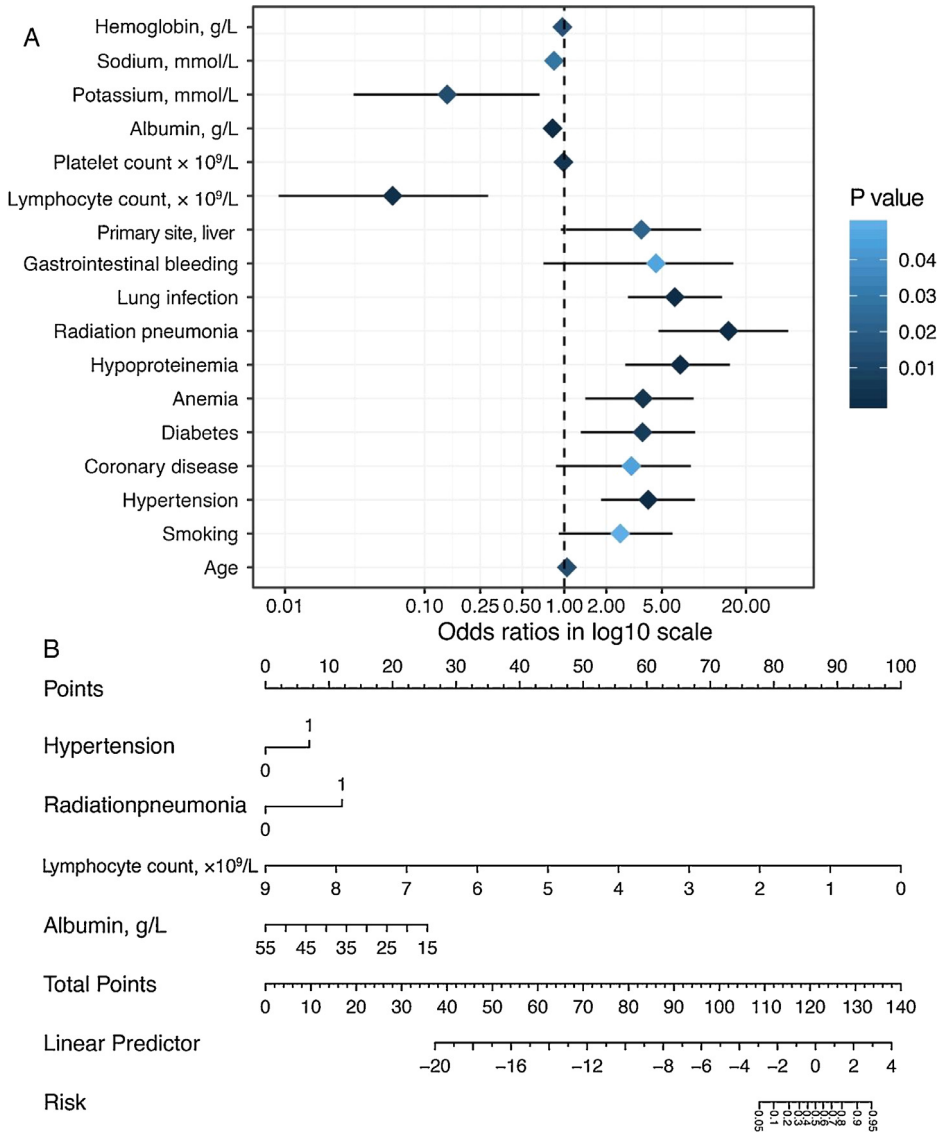


Fig. Risk factors and a risk nomogram for COVID-19 infection in cancer patients. (A) odds ratios (OR) of clinicopathologic and laboratory characteristics from univariate logistic analysis. Diamond indicates OR and line represents 95% confidence interval (CI). P value is shown with scaled blue color in the diamond. (B) A risk nomogram for COVID-19 infection in cancer patients.

for COVID-19 infection. Based on these 4 factors, a risk nomogram was built, and a total score over 120 indicated increased risk of COVID-19 infection. Notably, lymphocyte represented driven factor in the nomogram (Fig).

The results were largely consistent with current consensus. Older age and smoking history had been reported as risk factors.^{2,3} Moreover, the blunted immune status caused by cancer or antitumor treatment was the most concern in cancer patients. Our analysis highlighted that lymphocyte rather than white blood cell might be the driven risk factor and antitumor

treatment within 1 month was not statistically significant. Therefore, colony-stimulating factors might lower the risk by propping up the white blood cell including lymphocyte. Besides, the nutritional status-related factors including anemia and hypoproteinemia were also risk factors.

As recommended by the ASCO guideline, the risk-benefit calculus is tricky and individual patient decisions have to be made by multidisciplinary teams [1]. How to minimize cancer patients' exposure and maximize the benefit of active treatment is still challenging. Our analysis provided systematic analysis of risk factors and a risk nomogram for cancer patients. Although COVID-19 is highly contagious and is driven by exposure to the virus, our preliminary report provided auxiliary model for personal evaluation, which also need validation in larger cohort. It is worth noting that the results might be biased toward symptomatic cases, since some cases of COVID-19 were fully asymptomatic and did not receive testing.

COVID-19 could overwhelm healthcare systems worldwide and may last for months, decisions on whether or not to postpone cancer treatment based on specific and statistical evaluation may offer better protection to cancer patients.

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