**Supplementary table S9 Biological functions of the hub genes in HCC.**

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| --- | --- | --- |
| **Genes** | **Biological functions in HCC** | **Reference** |
| CCNB1 | A key gene for identifying early HCC | Wu, et al.,2019 |
| TOP2A | Be regarded as a biomarker in HBV-related HCC | Liao, et al.,2019 |
| RFC4 | Promotes cell proliferation of HepG2 | Arai, et al.,2009 |
| MAD2L1 | Promotes HepG2 cell proliferation, migration and invasion | Arai, et al., 2009 |
| BUB1B | Related to poor prognosis | Li, et al., 2017 |
| CDC20 | Promotes cell proliferation in G2/M-phase | Yang, et al.,2019 |
| CCNB2 | Promotes cell proliferation and migration; inhibits cell apoptosis, and caused S phase arrest in HCC cells | Li, et al.,2014 |
| BIRC5 | Mediates cancer cell survival and tumor maintenance | Li, et al.,2019 |
| RRM2 | Associated with the anticancer activity of sorafenib | Cao, et al.,2013 |
| TTK | Activates Akt and promotes proliferation and migration of HCC cells. | Yang, et al.,2020 |
| NCAPG | Promotes the proliferation of HCC through PI3K/AKT Signaling. | Liu, et al.,2015 |
| MCM2 | Promotes of the HepG2 cell cycle and proliferation  through the cyclin D-dependent kinases 2/7 pathway | Gong, et al.,2019 |
| MELK | An oncogenic kinase essential for early HCC recurrence. | Yang, et al.,2018 |
| PRC1 | Promotes early recurrence of HCC throught the Wnt/β-catenin signalling pathway. | Xia, et al.,2016 |
| ZWINT | Promotes the proliferation of HCC by regulating cell-cycle-related proteins. | Chen, et al.,2016 |
| SMC4 | Associated with tumor de-differentiation,advanced stage and vascular invasion of HCC. | Ying, et al.,2018 |
| KIF20A | Contributes to HCC aggressiveness in patients | Zhou, et al.,2012 |
| DTL | Promotes liver cancer cell growth, decreased senescence, and increase tumorigenesis | Gasnereau, et al.,2012 |
| TPX2 | Correlates with HCC cell proliferation, apoptosis, and EMT. | Chen, et al.,2018 |
| CAT | A Potential biomarker for HCC | Liang, et al.,2015 |
| EHHADH | A biomarker in the occurrence of HCC. | Yang, et al.,2005 |
| SERPINC1 | Serum markers for AFP-negative patients with HCC | Arai, et al., 2009 |
| GYS2 | Negative feedback regulates p53 to limit tumor growth in HBV-related hepatocellular carcinoma. | Li, et al., 2017 |

**Note:** References of Supplementary table S9

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