Inhibition and Anti Proliferation Human Tongue Cancer Cells Sup’ri’s Clone-1 Invasion with Cyclooxygenase-2 Inhibitor

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Abstract: The aim of this study was to examine inhibition and proliferation of tongue cancer cells by using the SP - C1 chemopreventive drug, Celecoxib. In the method of invasion, tongue cancer cells treated with SP - C1 Celecoxib at concentrations of 5 μm, 10 μm, 25 μm, 50 μm, 75 μm, 100 μm and 125 μm, and 0 as the control group. Tests were carried out for 24 and 48 hours with the calculation of the mean tongue cancer cell invasion SP-C1. Invasion tests used Boyden Chamber Assay and polycarbonate membrane. In proliferation test, Tongue cancer cells SP-C1 were treated with various concentrations of Celecoxib and time. 192 cancer cells were grouped in 4 different groups of observation time, each group have 8 cancer cells, one without Celecoxib treatment (control), 5 μm, 10 μm, 25 μm, 50 μm, 75 μm, 100 μm and 125 μm. Mean growth inhibition of cancer cells SP-C1 was calculated using Biorad/Microplate Reader 540 nm. The results of the study showed the average number of tongue cancer cell invasion SP-C1 after the administration Celecoxib based on the concentration and time with ANOVA gives F = 60.46, which statistically significant. In zero concentration of Celecoxib (control) was 24.4 with Celecoxib concentrations ranging from 5 to 125 had decreased from an average of 11 to 2.3. In a proliferation test, results were statistically significant. Time factor (calculated F = 45.78), concentration factor (F count = 17.77), and time and concentration interaction (F count = 46.64) had showed the effect of different views of the average cell growth inhibition. The conclusion of this research Celecoxib delivery on tongue cancer cells showed SP - C1 barriers invasion and proliferation. Greater concentration of Celecoxib administered will provide a greater effect on the barrier invasion and proliferation of tongue cancer cells SP-C1.

Keywords: Invasion, Proliferation, Cancer Cells tongue SP-C1, Celecoxib

1. Introduction

Squamous cell carcinoma is a malignant tumor derived from epithelial tissue with a cell structure in groups. Squamous cell carcinoma is able to infiltrate through the bloodstream and lymphatic spread throughout the body.¹ Squamous cell carcinoma is the most common type of cancer that occurs in the oral cavity which is about 90-95% of the total malignancy in the oral cavity. Location squamous cell carcinoma of the oral cavity is usually located on the tongue (ventral, and lateral), lips, floor of the mouth, buccal mucosa, and retromolar area.² ³

Squamous cell carcinoma of the tongue is a malignant tumor derived from epithelial mucosa of the oral cavity and is largely a type of carcinoma of the tongue squamous cell carcinoma epidermoid.⁴ Ranged from 25 to 50 % of all malignant cancers in the mouth, squamous cell carcinoma of the tongue has a poor prognosis, so early diagnosis is necessary especially if there has been a metastasis to other areas (neck and cervical). Carcinoma of the tongue is often found together with syphilis and premalignant diseases such as leukoplakia. According to research oerythroplasia by Frazell and Lucas, tongue cancer cases occurred at dorsal of the tongue was only 4%, but were more malignant (Undifferentiated epidermoid carcinoma).⁵

Cell proliferation is an increase in the number of cells with a process involved cell cycle. Cell cycle in normal cells is strictly controlled. Cyclins, CDK, and CKI’s work is mutually sustainable. Cyclins, CDK, and CKI together are responsible for controlling various phases of cell cycle control mechanism through the check point. Basicsetings of cancer cell’s damage mechanisms, which control the regulation of growth of normal cells disruption, are resulted in uncontrolled cell proliferation. Celecoxib’s effect as an anticancer intervention contained in the cell cycleause a decreased in the expression of cyclin A, B and D, increased expression of p21⁶ and cell cycle inhibitors p27⁷ and loss of CDK activity. This condition led to inhibiting proliferation in cancer cells.⁸

Squamous cell carcinoma of the tongue is occured due to loss of control of the cell cycle, which control cell survival (loss of apoptosis), and the control of cell motility (increased activity of invasion and metastasis).⁹ ¹⁰ The process of formation of squamous cell carcinoma is a gradual process, which is due to the growth regulators malfunction (protooncogene and tumor inhibitor gene) resulting in increased production of growth factors and the number of cell surface receptors, stimulate intercellular signal transduction, and increasing production of transcription factors. ¹¹ ¹² Lethal traits of cancer is the ability to invade the tissues around, spread throughout the body, and metastasize to other region in the body.¹³ ¹⁴

There were two important facts on the use of a combination of Non-Steroid Anti-Inflammatory Drugs (NSAID) with radiotherapy in the treatment of cancer. First aspect is prevention (preventive cancer) which then affects the long-term effects. The second aspect is to be used in cancer treatment (curative). Celecoxib (one class of NSAIDs) can inhibit the proliferation and invasion of cancer cells and kill...
cancer cells (in some percentage). Celecoxib as an anti-
cancer play role on intervention in the cell cycle.\textsuperscript{[11,12]}

Celecoxib has anti-cancer effects by altering protein expression that stopping the cell cycle and lead to cell death. Cells move through three phases before they divide, the G1 phase, the cell grows and makes the proteins, the S phase, cells make DNA and chromosomes copies, and G2 phase, in which cells is prepared to divide. The cell cycle also has several checking points that function in deciding that the cell is ready to move to the next phase. Celecoxib is able to alter the expression of the protein at the G1 check point and significantly decreases the activity of a protein called E2F1. These activities are necessary for the cells to move through the cell cycle and are also important for the activity of S phase in DNA repair. Inhibition of E2F1 activity by Celecoxib is a mechanism of S phase -specific toxicity to
cancer cells.\textsuperscript{[13]}

COX-2 is involved in the change of procarcinogens into
carcinogens, and has an important role in initiating tumor formation. COX-2 is a key regulatory enzyme in the
synthesis of prostaglandin E2 (PGE2), which is important to
increase tumorigenesis. Increased expression of COX-2
inhibits apoptosis and is involved in angiogenesis. COX-2
inhibitors inhibit intestinal polyps and colorectal tumours.\textsuperscript{[13,14]}

2. Materials and Methods

The whole study was conducted by experimental laboratory
using cultured human tongue cancer cells Supri’s-Clone (SP-
C1). The study was conducted at the Laboratory of Integrated
Research and Testing (LPPT) GadjahMada University in Yogyakarta from July to October 2014. The study of cancer
cell invasion test SP-C1 commenced using \textit{boyden chamber assay} and membrane polykarbonat preceded by dilution of the drug Celecoxib (Celebrex) to adjust the number of
research samples of tongue cancer cell SP-C1 then with the
activation and propagation of cancer cells SP - C1 in culture
media (DMEM, FBS and Fungizone).

Using a Boyden chamber invasion assay, polycarbonate
membrane layer discs were placed in cell disc culture (petri dish), given the mill-Q solution and incubated at 37°C.
Boyden chamber was opened and the lower chamber (holes)
was inserted media experiment/control (Celecoxib) with each
collection of 5, 10, 25, 50, 75, 100, and 125. Cancer cells
inserted into the upper wells Boyden chamber as much as 50
µL, respectively. Both \textit{Boyden chamber} for 24 and 48
hours was being put back into the incubator with a wet paper
towel to get the moisture at a temperature of 37°C. Cell count
was commenced at polycarbonate membranes (24 and 48
hours). Membranes were mounted on a glass object to do the
calculation.

Cellproliferationbarriertest with MTT Assay was performed by
preparing 4 plates containing 96 hole. MTT assay testing
hours to 0, 24, 48, 72 hours. In each plate, tongue cancer
cells SP-C1 were inserted as much as 5 X 10\textsuperscript{5} cells/holes in
100 µL DMEM (Dulbecco’s Modified Eagle Medium) in accordance with the concentration of Celecoxib. Based on
the calculation, total numbers of cells required were 12.8 X
10\textsuperscript{5} cells for all of the holes and the amount of DMEM
solution was as much as 25.6 ml. Cancer cells’ calculation
was determined using a hemocytometer. 96 holes plates were
measured with a \textit{Bio-radMicroplate Reader} at 540 nm
wavelength. The same test was done at 24, 48 and 72 hours.

3. Results and Discussion

The calculation results of tongue cancer cells SP-
C1 commenced in 24houronpolycarbonatemembranesunder a
light microscope appeared to have changed significantly
tocarcinobarrriersSP-C1, rangingfromconcentrations5
test concentrations125. In addition, when compared the control
group at24hours and48hours, the number of tonguecancer cells SP-C1 was still experience an increased
number of reinvasion after the calculations done on the
research data span of48hours.

<p>| Table 1. Invasion analysis of Cancer Cell SP-C1 |</p>
<table>
<thead>
<tr>
<th>Time</th>
<th>Concentrations (B)</th>
<th>Total</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hours</td>
<td>control</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>95</td>
<td>65</td>
<td>40</td>
<td>24</td>
</tr>
<tr>
<td>96</td>
<td>52</td>
<td>39</td>
<td>25</td>
</tr>
<tr>
<td>94</td>
<td>54</td>
<td>40</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>285</td>
<td>171</td>
<td>119</td>
</tr>
<tr>
<td>Mean</td>
<td>95,0</td>
<td>57,0</td>
<td>39,7</td>
</tr>
<tr>
<td>48 hours</td>
<td>control</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>98</td>
<td>30</td>
<td>27</td>
<td>22</td>
</tr>
<tr>
<td>99</td>
<td>32</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>103</td>
<td>32</td>
<td>26</td>
<td>21</td>
</tr>
<tr>
<td>Total</td>
<td>300</td>
<td>94</td>
<td>77</td>
</tr>
<tr>
<td>Mean</td>
<td>100,0</td>
<td>31,3</td>
<td>25,7</td>
</tr>
</tbody>
</table>

When the amount of tonguecancer cells SP-C1 in control group
was calculated, the control group was also compared after
24hours. The results of the 48hours’ group calculation
showed an increased percentage of 5%. The result indicated

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cancer cells without Celecoxib will yield an increased in the number of SP-C1 tongue cancer cells.

### Table 2. Comparison of the number of cell invasion by time and drug concentration

<table>
<thead>
<tr>
<th>Time</th>
<th>Concentration</th>
<th>F count</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hours</td>
<td>Mean (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>95.0 (1.0)</td>
<td>94.96</td>
<td>311,920</td>
</tr>
<tr>
<td></td>
<td>Range 57.0 (7.0)</td>
<td>52.65</td>
<td></td>
</tr>
<tr>
<td>48 hours</td>
<td>Mean (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100 (2,646)</td>
<td>98.103</td>
<td>1209,220</td>
</tr>
<tr>
<td></td>
<td>Range 31.33 (1,155)</td>
<td>30.32</td>
<td></td>
</tr>
</tbody>
</table>

From the results of this study, we found the resistance of cancer cell invasion by a given concentration of 5µm to 125µm showed significant changes, seen in the decrease in the number of cancer cells in the Boyden chamber based on the test barrier invasion of cancer cells’ calculations, either in the span of 24 hours and 48 hours. Based on the results of research on barriers tongue cancer cell invasion on the SP-C1 treated with Celecoxib concentrations, respectively 5, 10, 25, 50, 75, 100, 125, and without celecoxib (control) were conducted during the next 24 hours and 48 hours, we concluded that time, concentration, and the interaction between time and concentrations showed different effects.

The results of time factor using ANOVA showed F = 80.504count which was statistically significant. The result showed time factor’s influenced the activity of Celecoxib. The longer time passed, the decreased cell invasion could be seen from the average of cancer cell invasion (35.042 at 24 hours showed a difference from the average of 48 hours’ value = 29.250). The result of concentration factor with using ANOVA gives Fcount = 984.880 was statistically significant meaning the average occurrence of induction was seen due to Celecoxib usage compared with certain concentrations of Celecoxib showed there were no difference. The result from group without Celecoxib (control) was 97.50 with Celecoxib’s concentration from 5 to 125 had undergone a change with average values of 44 to 9.00. The interaction between time and concentration showed calculated F = 27.790 which was also significant.

The results of this study were supported by the research of Lucille et al (2007) which stated 10 µm Celecoxib inhibited cell invasion or migration through collagen type 1 matrix approximately 40% within 24 hours. Zymography results stated the presence of 10 µm Celecoxib showed enzyme activity of MMP-2 and MMP-8 decreased about 30-40%.

This vitro study also showed that there were barriers’ proliferation and invasion of squamous cell carcinoma by specific COX-2 inhibitor. Celecoxib produced anti-cancer effects through variation in cellular and molecular mechanisms.\[15\]

![Inhibition Cell Invasion based Concentration and Time Diagram](Image)

**Figure 1. Mean tongue cancer cell SP-C1’s invasion.**
The inhibition of SP-C1 cancer cell invasion based on the concentration and time showed Celecoxib would slow the proliferation and invasion of cancer cells and killed cancer cells. Celecoxib has an anti-cancer role in intervention on cell.[16] Cycle enzyme cyclooxygenase (COX) which is the target of action of non-steroid anti-inflammatory drugs (NSAIDs) has two isoforms, namely COX-1 and COX-2. Both of these enzymes catalyze the reaction and produce the same product, namely prostaglandins, but with different biological functions. [16, 17]

In proliferation barriers’ test, the effective cell growth inhibition concentrations of Celecoxib began at 25 μM and 100 μM. It was the most effective concentration. This study was similar with Wang et al showed the decreased expression of pancreatic cancer cells was decreased to 50% at concentrations of 25 μM and reached maximal inhibition at concentration of 100 μM.[19] At the concentration of 125 μM, growth inhibition at concentrations was lower than 100 μM. This condition was happened because of the saturation from cancer cell’s receptor. Cancer cell’s receptors showed no response of Celecoxib with concentration of 125 μM. The saturation point where the cell is the cell can no longer receive the higher concentrations. Higher doses are no more effective in inhibiting the growth of cancer cells.

The mean values of cancer cells’ growth inhibition by the time showed time factor affected the occurrence of inhibition. The longer the time, the lower the cell growth rate showed diminished number of cancer cells. In the hour - 0 cells were almost the same growth rate. The barriers occurred in the 24 to 72 hours. The most significant decline was seen in 72 hours. This condition occurred due to longer contact time between Celecoxib and the cancer cells, so that the drug action became more effective.

Molecular mechanisms that lead to the cessation of the cell cycle by Celecoxib are still not known for sure. Based on several studies, there are molecular targets that could lead to anti-proliferative Celecoxib, namely the inhibition of AKT signaling and NF-κB. Akt plays an important role in the regulation of cell cycles and proliferation defenses to cancer cells by affecting the phosphorylation status of Akt excessively. Akt signaling blockade lead to the cessation of growth inhibition and induction of cancer cells cycles’
apoptosis.\textsuperscript{[18,19,20]} NF-κB is a transcription factor involved in broad cellular functions, including apoptosis and cell cycle control. NF-κB regulates the excretion of several gene products associated with carcinogenesis. Among the genes, anti-apoptosis gene, COX-2, and cell cycle regulatory genes NF-κB is maintained in the cytoplasm by the inhibitor protein IκB. Mediators in the transduction pathway can activate Akt through phosphorylation of NF-κB from IκB. NF-κB is activated by translocation to the nucleus, leading to transcription of several genes (eg,COX-2). As a result, the production of prostaglandins will further activate NF-κB. NF-κB activation can lead to excessive and permanent effects, through activation of COX-2 pathway. In addition to inhibiting the production of prostaglandins Celecoxib inhibits Akt by the inhibition of the Akt cannot activate NF-κB resulting in cancer cell proliferation resistance.\textsuperscript{[18,19,20]} The results of this study indicated Celecoxib could inhibit SP-C1 cancer cell proliferation and the most effective concentration was 100 μM at 72 hours.

4. Conclusion

The results of this study showed the greater concentration of Celecoxib administered will provide a greater effect on cancer cell invasion barriers from tongue cancer cell SP-C1. On proliferation barriers, Celecoxib may inhibit tongue cancer cell SP-C1’s proliferation. The interaction between time and concentration factor obtained a linear relationship, with the increasing time and concentration showed the more effective inhibition of Celecoxib. The most effective concentration and maximum inhibition the concentration of 100 μM at 72 hours.

References


Author Profile

Harun Achmad received the D.D.S degree from Faculty of Dentistry, Hasanuddin University in 2000. He completed the study in Pediatric Dentistry Specialization and Master of Public Health from Faculty Of Dentistry, Padjajaran University in 2009 and 2010, respectively. In 2013, he finished his Doctoral Program in Faculty of Medicine, Hasanuddin University. He now work as researcher and lecturer in Department of Pediatric Dentistry, Faculty Of Dentistry, Hasanuddin University.