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Investigation into the Clinical Efficacy of Scolopendin for Gastric Cancer Treatment

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Abstract. Centipedes belong to the phylum Annelida, but they are actually arthropods. Their bodies can produce antimicrobial peptides to deal with pathogens, which is an important part of their innate immune response. Recent studies have found that a new antimicrobial peptide, Scolopendin, has been successfully isolated and identified from Scolopendra subspinipes mutilans. Furthermore, it is worth noting that a variety of antifungal drugs can cause cell death through different mechanisms. In this paper, the author emphasizes a new medicine extracted from the venom of someparticular centipede species called scolopendin and one of them is AMPsco which has. Additionally, this article also shows an experiment which proved the effectiveness of AMPsco in treating gastric cancer cells.

Keywords: AMP Scolopendin, gastric cancer, EGFR receptor

1. Introduction

It is estimated that in 2020, there were over one million new cases of gastric cancer worldwide (1,089,103 cases), causing 768,793 deaths. Owing to population aging and the expansion of high-risk groups, it is projected that these burdens will persist in increasing. On a global scale, it is estimated that there were 136,038 new cases and 96,997 deaths in Europe [1]. The incidence rate of gastric cancer varies conspicuously worldwide. The regions with the highest incidence are Eastern Asia, Central and Eastern Europe, and South America. Over the past 60 years, the incidence of gastric cancer has gradually declined in Western Europe and North America, and the recent downward trend in high-risk countries is also quite evident (GBD 2017 Gastric Cancer Collaborators) [1]. Scolopendin, a protein found in the venom of centipedes, is one of the traditional Chinese medicines. For many years, the Chinese have believed that this substance has a certain effect on the treatment of gastric cancer [2]. Gastric cancer is a malignant tumor originating from the epithelial cells of the gastric mucosa, and its occurrence is regulated by factors such as phosphatidylinositol 3-kinase/protein kinase B, the MARK pathway, HER1/EGFR epidermal growth factor, vascular endothelial growth factor A (VEGF-A), and HER1/EGFR [3, 4]. Vascular endothelial growth factor A (VEGF-A) and other vascular growth factors, mesenchymal-epithelial transition factor and other pathways inhibit cell apoptosis, promote tumor angiogenesis, and facilitate the proliferation, invasion and metastasis of gastric cancer cells [5]. Nevertheless, the paratestosterone of centipedes is a basic polypeptide substance with antibacterial activity. One of them is AMP-scolopin 2, which can kill tumor cells by inducing apoptosis [6]. The epidermal

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growth factor receptor (EGFR) is an epithelial growth factor receptor for cell proliferation and signal transduction [7, 8]. The extract of centipedes can effectively inhibit the expression of EGFR or DNA synthesis, thereby suppressing the proliferation of tumor cells.

2. Hypothesis

Predict that increasing concentrations and treatment durations with AMP-scolopin 2 of MKN45 cells leads to cell death and reduction in EGFR levels and reduced activation of AKT and Erk.

3. Material& method

The assessment of cellular demise was conducted through the MTT assay, while the quantification of EGFR levels was achieved via Western blot analysis. The activation states of AKT and Erk were elucidated by employing pAKT and pERK Western blot techniques. Ganetespib served as the positive control for EGFR detection, whereas Herceptin fulfilled this role in the MTT, AKT, and Erk experiments. PBS acted as the negative control throughout these investigations [9]. The MTT colorimetric assay represents a sophisticated approach to evaluating cellular vitality and proliferation. Its underlying principle hinges on the enzymatic activity of succinate dehydrogenase within the mitochondria of living cells, which catalyzes the reduction of exogenous MTT into insoluble, blue-violet Formazan crystals that accumulate intracellularly [10]. In stark contrast, nonviable cells lack this metabolic capacity. Dimethyl sulfoxide (DMSO) facilitates the dissolution of these crystalline deposits, enabling their optical density to be quantified at a wavelength of 490nm through enzyme-linked immunosorbent assays. This measurement serves as an indirect yet reliable indicator of viable cell count, with the formation of MTT crystals exhibiting a proportional relationship to the number of living cells within a defined range. Western blotting stands as a cornerstone technique in proteomic research, adept at separating and identifying proteins with remarkable precision [11]. It employs SDS-PAGE technology to fractionate proteins from the sample of interest, subsequently transferring them onto nitrocellulose or polyvinylidene fluoride membranes. These immobilized proteins are then incubated with specific antibodies tailored to recognize target proteins. Through meticulous membrane washing procedures, unbound antibodies are meticulously removed, leaving only those antibodies securely tethered to their respective targets. Ultimately, the presence of bound antibodies is revealed through film development or fluorescence scanning, providing a vivid and accurate depiction of protein expression profiles. Ganetespib is a heat shock protein 90 (HSP90) inhibitor that has demonstrated potent cytotoxicity in a variety of blood and solid tumor cell lines, acting as a positive control can test if the effectiveness of the AMPsco is greater than current treatment.

PBS stands for Phosphate Buffered Saline, which is mainly composed of phosphate, chloride and sodium ions. The pH value is stable, usually 7.2-7.6, which is suitable for maintaining the stability of biomolecules. It contains a moderate amount of salt and has a similar ion concentration to biological tissue and cell fluid, which can simulate the biological environment. Using PBS as the negative control can test if this new medicine works.

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4. Results

Table 1: The performance of the test MTT and Western blot on each combination

Combination of possible results (CR)	AMPsc decreases viability by MTT	AMPsc reduces EGFR by Western	AMPsc reduces p-Erk by western	AMPsc reduces p-Akt by western	Support hypothesis
CR1	+	+	+	+	Full
CR2	+	+	+	-	Partial
CR3	+	+	-	+	Partial
CR4	+	-	+	+	Partial
CR5	-	+	+	+	Partial
CR6	+	+	-	-	Partial
CR7	+	-	+	-	Partial
CR8	+	-	-	+	Partial
CR9	-	+	+	-	Partial
CR10	-	+	-	+	Partial
CR11	-	-	+	+	Partial
CR12	+	-	-	-	Partial
CR13	-	+	-	-	Partial
CR14	-	-	+	-	Partial
CR15	-	-	-	+	Partial
CR16	-	-	-	-	Fully contradicts

+ indicates the measurement changes in the direction indicated in the column header similar to the positive control (Ganetespib for EGFR and herceptin for MTT, pAKT, pErk) and the opposite to the negative control in PBS. - indicates the measurement changes in the opposite of the direction indicated in the column header similar to the negative control (PBS) and the opposite to the positive control (Ganetespib fir EGFR and herceptin for MTT, pAKT, pErk)).

As the combination of possible results 1 shows, the viability result of MTT decreases due to the addition of AMPsc which proved this medicine does affect the growth of tumor cells. Besides, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of EGFR p-Erk and p-Akt which fully support the hypothesis.

As the combination of possible results 2 shows, the viability result of MTT decreases due to the addition of AMPsc which proved this medicine does affect the growth of tumor cells. Besides, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of EGFR p-Erk but not p-Akt which partially support the hypothesis.

As the combination of possible results 3 shows, the viability result of MTT decreases due to the addition of AMPsc which proved this medicine does affect the growth of tumor cells. Besides, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of EGFR p-Akt but not p-Erk which partially support the hypothesis.

As the combination of possible results 4 shows, the viability result of MTT decreases due to the addition of AMPsc which proved this medicine does affect the growth of tumor cells. Besides, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of p-Akt p-Erk but not EGFR which partially support the hypothesis.

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As the combination of possible results 5 shows, the viability result of MTT has no decrease due to the addition of AMPsc which cannot prove this medicine does affect the growth of tumor cells. However, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of EGFR p-Erk and p-Akt which partially support the hypothesis.

As the combination of possible results 6 shows, the viability result of MTT decreases due to the addition of AMPsc which proved this medicine does affect the growth of tumor cells. Besides, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of EGFR but not p-Akt and p-Erk which partially support the hypothesis.

As the combination of possible results 7 shows, the viability result of MTT decreases due to the addition of AMPsc which proved this medicine does affect the growth of tumor cells. Besides, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of p-Akt but not EGFR and p-Erk which partially support the hypothesis.

As the combination of possible results 8 shows, the viability result of MTT decreases due to the addition of AMPsc which proved this medicine does affect the growth of tumor cells. Besides, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of p-Erk but not EGFR and p-Akt which partially support the hypothesis.

As the combination of possible results 9 shows, the viability result of MTT has no decrease due to the addition of AMPsc which cannot prove this medicine does affect the growth of tumor cells. However, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of EGFR p-Erk but not p-Akt which partially support the hypothesis.

As the combination of possible results 10 shows, the viability result of MTT has no decrease due to the addition of AMPsc which cannot prove this medicine does affect the growth of tumor cells. However, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of EGFR p-Akt but not p-Erk which partially support the hypothesis.

As the combination of possible results 11 shows, the viability result of MTT has no decrease due to the addition of AMPsc which cannot prove this medicine does affect the growth of tumor cells. However, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of p-Erk p-Akt but not EGFR which partially support the hypothesis.

As the combination of possible results 12 shows, the viability result of MTT decreases due to the addition of AMPsc which proved this medicine does affect the growth of tumor cells. Besides, the width of the band in western blot reveals the effect of AMPsc does not reduce the abundance of p-Akt t EGFR and p-Erk which make the test group partially support the hypothesis.

As the combination of possible results 13 shows, the viability result of MTT has no decrease due to the addition of AMPsc which cannot prove this medicine does affect the growth of tumor cells. However, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of EGFR but not p-Erk p-Akt which partially support the hypothesis.

As the combination of possible results 14 shows, the viability result of MTT has no decrease due to the addition of AMPsc which cannot prove this medicine does affect the growth of tumor cells. However, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of p-Erk but not EGFR p-Akt which partially support the hypothesis.

As the combination of possible results 15 shows, the viability result of MTT has no decrease due to the addition of AMPsc which cannot prove this medicine does affect the growth of tumor cells. However, the width of the band in western blot reveals the effect of AMPsc does reduce the abundance of p-Erk but not EGFR p-Akt which partially support the hypothesis.

As the combination of possible results 16 shows, the viability result of MTT has no decrease due to the addition of AMPsc which cannot prove this medicine does affect the growth of tumor cells.

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Also, the width of the band in western blot reveals the effect of AMPsc does not reduce the abundance of EGFR p-Erk and p-Akt which completely contradicts the hypothesis.

5. Discussion

CR1 fully endorses this hypothesis. The MTT assay, or the MTT colorimetric assay, serves as a sophisticated method for assessing cellular viability and proliferation. Its underlying principle lies in the enzymatic activity of succinate dehydrogenase within the mitochondria of living cells, which catalyzes the reduction of exogenous MTT into water-insoluble blue-violet crystalline Formazan deposits that accumulate intracellularly. In contrast, dead cells lack this metabolic capacity. Dimethyl sulfoxide (DMSO) facilitates the dissolution of these crystalline deposits, enabling their optical density to be quantified at 490nm via enzyme-linked immunosorbent assays (ELISA). This measurement provides an indirect yet reliable indicator of viable cell count, with the formation of MTT crystals exhibiting a proportional relationship to the number of living cells within a defined range. Employing the MTT assay can illuminate the efficacy of the novel drug AMPsc in gastric cancer treatment. For any failed tests, potential causes may include concentration inaccuracies or contamination of experimental equipment.

Western blotting stands as a cornerstone technique in proteomic research, renowned for its ability to separate and identify proteins with remarkable precision. It employs sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) to fractionate proteins from the sample of interest, subsequently transferring them onto nitrocellulose or polyvinylidene fluoride membranes. These immobilized proteins are then incubated with specific antibodies tailored to recognize target proteins. Through meticulous membrane washing procedures, unbound antibodies are meticulously removed, leaving only those antibodies securely tethered to their respective targets. Ultimately, the presence of bound antibodies is revealed through film development or fluorescence scanning, yielding clear bands whose thickness corresponds to protein abundance. By analyzing the position and intensity of specific reactions, valuable insights into the expression levels of target proteins within given cell or tissue homogenates can be gleaned. Owing to the exceptional resolution of gel electrophoresis and the unparalleled specificity and sensitivity of immunological detection, Western blot analysis can detect as little as 1ng of the target protein. Utilizing this method elucidates the mechanistic underpinnings of AMPsc in treating gastric cancer. Through this investigation, EGFR, p-Erk, and p-Akt were validated as pivotal contributors to the therapeutic efficacy.

6. Conclusion

Advanced gastric cancer, with its high invasiveness and rapid metastatic characteristics, poses a significant challenge in clinical treatment. Modern treatment strategies for advanced gastric cancer includes chemotherapy, radiotherapy, targeted therapy, and immunotherapy. In chemotherapy, the development of new drug combinations and individualized treatment plans has improved treatment outcomes. Innovations in radiotherapy, such as in tensity-modulated radiation therapy, have enhanced the precision of treatment. Targeted therapy, focusing on specific molecular markers, has shown potential for specific treatment approaches, while immunotherapy opens new therapeutic avenues by activating the patient's immune system to attack cancer cells. Individualized treatment strategies, based on molecular profiling and bio markers, provide more precise treatment options for patients. Additionally, the customization and optimization of treatment plans, including adjustments in drug dosages and the use of combination therapies, further enhance the effectiveness and safety of treatments. The result of the experiment shows the scolopendin is truly effective in treating the

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Gastric Cancer. Thus, this substance can be really used to produce medicine for adjuvant therapy with chemotherapy. It is important to broaden the method of treating dangerous disease like the Gastric Cancer. And it is significant for Chinese traditional medicine to play a role in saving lives around the globe and push forward the investigation of designing effective medicine.

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