# Myelosuppression/Radiation Protection Research

| Yeast Beta 1,3/1,6 Glucan | NOTE: Seminal papers highlighted in blue. |
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| **Citation** | **Abstract** |
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| Turnbull, J. L., M. L. Patchen, and D. T. Scadden.<br><br>**The polysaccharide, PGG-glucan, enhances human myelopoiesis by direct action independent of and additive to early-acting cytokines.**<br><br>*Acta Haematol.* 1999. 0102:66-71.<br><br>PMID: 10529508 [PubMed - indexed for MEDLINE] | ßeta-Glucans stimulate leukocyte anti-infective activity, enhance murine hematopoietic recovery following bone marrow injury and mobilize murine progenitor cells from bone marrow. This study evaluated the in vitro hematopoietic potential of the beta-glucan, PGG-glucan, on human bone marrow mononuclear cells (BMMC) and CD34+ BMMC compared with protein cytokines. In the presence of submaximal concentrations of recombinant human granulocyte-macrophage colony-stimulating factor (rhGM-CSF; 0.5 ng/ml), PGG-glucan significantly increased BMMC myeloid colony formation comparable to the increase observed with either interleukin-3 (rhIL-3) or stem cell factor (rhSCF). Moreover, the addition of PGG-glucan to cultures containing GM-CSF + IL-3 or GM-CSF + SCF significantly augmented granulocyte-macrophage colony production above baseline, demonstrating that PGG-glucan acts independently of those early-acting cytokines and can enhance their activity in an additive manner. Anti-PGG-glucan monoclonal antibody specifically abrogated the growth-enhancing effect of added PGG-glucan in a saturable manner and other control carbohydrate polymers failed to affect colony formation. Further, PGG-glucan was not associated with induction of IL-6, GM-CSF production and removal of accessory cells by CD34+ cell isolation did not alter the PGG-glucan effect. These data demonstrate that PGG-glucan acts on committed myeloid progenitors to enhance human hematopoietic activity by a mechanism of direct action independent of IL-3 or SCF and independent of secondary cytokine stimulation. |
| Patchen, M. L., T. Vaudrain, H. Correira, T. Martin, and D. Reese.<br><br>**In vitro and in vivo hematopoietic activities of Betafectin PGG-glucan.**<br><br>*Exp. Hematol.* 1998. 26:1247-1254.<br><br>PMID: 9845381 [PubMed - indexed for MEDLINE] | Betafectin PGG-glucan is a novel beta-(1,3)glucan that has broad-spectrum anti-infective activities without cytokine induction. Here we report that PGG-glucan also has both in vitro and in vivo hematopoietic activities. In vitro studies with bone marrow target cells from the C3H/HeN mouse revealed that although PGG-glucan alone had no direct effect on hematopoietic colony-forming cell (CFC) growth, when combined with granulocyte colony-stimulating factor (CSF) or granulocyte-macrophage CSF, it increased CFC numbers 1.5- to 2.0-fold over those obtained with CSFs alone. Bone marrow cells cultured for high-proliferative-potential CFCs in the presence of interleukin (IL)-1, IL-3, macrophage CSF, and stem cell factor (SCF), or cultured for erythroid burst-forming units in the presence of IL-3, SCF, and erythropoietin, also exhibited enhanced growth in the presence of PGG-glucan. The synergistic effect of PGG-glucan was specific and could be abrogated by anti-PGG-glucan antibody. The ability of PGG-glucan to modulate hematopoiesis in vivo was evaluated in myelosuppressed rodents and primates. C3H/HeN female mice were intravenously administered saline solution or PGG-glucan (0.5 mg/kg) 24 hours before the intraperitoneal administration of cyclophosphamide (200 mg/kg), and the recovery of bone marrow cellularity and granulocyte-macrophage progenitor cells was evaluated on days 4 and 8 after cyclophosphamide treatment. At both time points, enhanced hematopoietic recovery was observed in PGG-glucan-treated mice compared with saline-treated control mice. In a final series of in vivo experiments, we evaluated the ability of therapeutically administered PGG-glucan to enhance hematopoietic recovery in cyclophosphamide-treated cynomolgus monkeys. Monkeys received intravenous infusions of cyclophosphamide (55 mg/kg) on days 1 and 2, followed on days 3 and 10 by intravenous infusion of PGG-glucan (0.5, 1.0, or 2.0 mg/kg). Compared with those in saline-treated monkeys, accelerated white blood cell recovery and a reduction in the median duration of neutropenia were observed in PGG-glucan-treated monkeys. These studies illustrate that PGG-glucan has both in vitro and in vivo hematopoietic activities and that this agent may be useful in the prevention and/or treatment of chemotherapy-associated myelosuppression. |

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| Hofer M, Pospisil M.<br><br>**Glucan as stimulator of hematopoiesis in normal and gamma-irradiated mice. A survey of the authors' results.**<br><br>*Int J Immunopharmacol.* 1997 Sep-Oct;19(9-10):607-9.<br><br>PMID: 9637361 [PubMed - indexed for MEDLINE] | Glucan, a beta-1,3-linked polyglucose derived from the yeast *Saccharomyces cerevisiae*, is a broad spectrum enhancer of host defense mechanisms stimulating humoral and cell-mediated immunity. On the basis of these features, glucan has been tested by the authors' research group in experiments on gamma-irradiated mice. Two glucan forms, particulate and soluble, have been studied. Attention has been focused on various application regimens in relation to the time of irradiation (pre- or postirradiation application), the possibilities of using glucan in various radiation regimens (single or repeated irradiation), combined pharmacological therapy (joint administration of glucan with cystamine or inhibitors of prostaglandin synthesis), and on the negative side effects of therapy with glucan. Some studies included also experiments on unirradiated mice. The results have demonstrated the ability of glucan to influence positively the course of the acute radiation disease. Stimulation of hematopoiesis has been found to be the most important mechanism of glucan's radioprotective effects. In this communication, the results of 11 full-length articles are summarized and discussed. |
| Patchen ML, Brook I, Elliott TB, Jackson WE.<br><br>**Adverse effects of pefloxacin in irradiated C3H/HeN mice: correction with glucan therapy.**<br><br>*Antimicrob Agents Chemother.* 1993 Sep;37(9):1882-9.<br><br>PMID: 8239601 [PubMed - indexed for MEDLINE] | Opportunistic bacterial infections are the predominant cause of death following myelosuppressive radiation exposure. When used alone, a variety of immunomodulators and antibiotics have been reported to reduce radiation-induced death. In these studies, the combined therapeutic effects of the immunomodulator glucan and the quinolone antibiotic pefloxacin were evaluated for survival-enhancing effects in myelosuppressed C3H/HeN mice. Mice were exposed to 7.9 Gy of whole-body 60Co radiation and treated with saline, glucan (250 mg/kg of body weight intravenously, 1 h after irradiation), pefloxacin (64 mg/kg/day orally, days 3 to 24 after irradiation), or glucan plus pefloxacin. Survival 30 days after irradiation in mice receiving these respective treatments was 25, 48, 7, and 85%. Evaluation of granulocyte-macrophage progenitor cell (GM-CFC) recovery in mice receiving these treatments revealed that, compared with recovery in saline-treated mice, glucan stimulated GM-CFC recovery, pefloxacin suppressed GM-CFC recovery, and glucan administered in combination with pefloxacin could override pefloxacin's hemopoietic suppressive effect. |
| Baker WH, Nold JB, Patchen ML, Jackson WE.<br><br>**Histopathologic effects of soluble glucan and WR-2721, independently and combined in C3H/HeN mice.**<br><br>*Proc Soc Exp Biol Med*. 1992 Nov;201(2):180-91.<br><br>PMID: 1329111 [PubMed - indexed for MEDLINE] | Soluble glucan, an immunomodulator, and Walter Reed (WR)-2721, a radioprotectant, increase postirradiation survival when administered before and after exposure, respectively. Combined, these agents act synergistically through WR-2721's ability to spare hematopoietic stem/progenitor cells from radiation injury and glucan's ability to subsequently stimulate spared cells to proliferate. In this study, the histopathologic effects of WR-2721 (200 mg/kg, ip) and glucan (250 mg/kg, iv), at doses capable of increasing survival in lethally irradiated mice, were evaluated in unirradiated and irradiated female C3H/HeN mice. After treatment, whole body weights and wet organ weights of liver, spleen, and kidney, as well as gross and histologic changes in these and other tissues, were monitored on Days 1, 4, 7, 11, 15, 21, and 28. Morphometric studies of splenic white and red pulps were also performed. Soluble glucan, with or without WR-2721, in unirradiated groups, was associated with splenomegaly, transient morphometrically determined perturbations of white and red pulp areas, and histologic alterations of white pulp. In irradiated mice, splenic weight loss was initially dampened in glucan groups and accompanied by morphologic and histologic changes similar to those seen in unirradiated counterparts. The subsequent rebound of splenic parameters in irradiated mice was limited to WR-2721-treated mice and was associated with hematopoietic reconstitution. Glucan, with or without WR-2721, in unirradiated groups was associated with transient hepatomegaly and associated histologic changes. Similar changes in irradiated animals were seen only in the combined treatment group. |

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| Patchen ML, MacVittie TJ, Solberg BD, D'Alesandro MM, Brook I.<br><br>**Radioprotection by polysaccharides alone and in combination with aminothiols.**<br><br>*Adv Space Res.* 1992;12(2-3):233-48.<br><br>PMID: 11537014 [PubMed - indexed for MEDLINE] | We demonstrated that glucan, a beta-1,3 polysaccharide immunomodulator, enhances survival of mice when administered before radiation exposure. Glucan's prophylactic survival-enhancing effects are mediated by several mechanisms including (1) increasing macrophage-mediated resistance to potentially lethal postirradiation opportunistic infections, (2) increasing the D(o) of hematopoietic progenitor cells, and (3) accelerating hematopoietic reconstitution. In addition, even when administered shortly after some otherwise lethal doses of radiation, glucan increases survival. Glucan's therapeutic survival-enhancing effects are also mediated through its ability to enhance macrophage function and to accelerate hematopoietic reconstitution; glucan's therapeutic potential, however, is ultimately dependent on the survival of a critical number of hematopoietic stem cells capable of responding to glucan's stimulatory effects. Preirradiation administration of the traditional aminothiol radioprotectants WR-2721 and WR-3689 has been previously demonstrated to be an extremely effective means to increase hematopoietic stem cell survival. Therapeutic glucan treatment administered in combination with preirradiation WR-2721 or WR-3689 treatment synergistically increases both hematopoietic reconstitution and survival. Such combined modality treatments offer new promise in treating acute radiation injury. |
| Patchen ML, MacVittie TJ, Solberg BD, Souza LM.<br><br>**Survival enhancement and hemopoietic regeneration following radiation exposure: therapeutic approach using glucan and granulocyte colony-stimulating factor.**<br><br>*Exp Hematol*. 1990 Oct;18(9):1042-8.<br><br>PMID: 1697806 [PubMed - indexed for MEDLINE] | C3H/HeN female mice were exposed to wholebody cobalt-60 radiation and administered soluble glucan (5 mg i.v. at 1 h following exposure), recombinant human granulocyte colony-stimulating factor (G-CSF; 2.5 micrograms/day s.c., days 3-12 following exposure), or both agents. Treatments were evaluated for their ability to enhance hemopoietic regeneration, and to increase survival after radiation-induced myelosuppression. Both glucan and G-CSF enhanced hemopoietic regeneration alone; however, greater effects were observed in mice receiving both agents. For example, on day 17 following a sublethal 6.5-Gy radiation exposure, mice treated with saline, G-CSF, glucan, or both agents, respectively, exhibited 36%, 65%, 50%, and 78% of normal bone marrow cellularity, and 84%, 175%, 152%, and 212% of normal splenic cellularity. At this same time, granulocyte-macrophage colony-forming cell (GM-CFC) values in saline, G-CSF, glucan, or combination-treated mice, respectively, were 9%, 46%, 26%, and 57% of normal bone marrow values, and 57%, 937%, 364%, and 1477% of normal splenic values. Endogenous spleen colony formation was also increased in all treatment groups, with combination-treated mice exhibiting the greatest effects. Likewise, although both glucan and G-CSF alone enhanced survival following an 8-Gy radiation exposure, greatest survival was observed in mice treated with both agents. These studies suggest that glucan, a macrophage activator, can synergize with G-CSF to further accelerate hemopoietic regeneration and increase survival following radiation-induced myelosuppression. |
| Patchen ML, MacVittie TJ, Weiss JF.<br><br>**Combined modality radioprotection: the use of glucan and selenium with WR-2721.**<br><br>*Int J Radiat Oncol Biol Phys*. 1990 May;18(5):1069-75.<br><br>PMID: 2161407 [PubMed - indexed for MEDLINE] | Glucan, WR-2721, and selenium, three agents with distinct radioprotective mechanisms, were evaluated in C3H/HeN mice for survival-enhancing and hemopoietic-regenerating effects when administered alone or in combinations before exposure to 60Co radiation. At LD50/30 radiation doses (radiation doses lethal for 50% of mice within 30 days postexposure), dose reduction factors of 1.21, 1.02, 1.37, 1.51, and 1.66 were obtained following glucan (75 mg/kg i.v., -20 hr), selenium (0.8 mg/kg, i.p., -20 hr), WR-2721 (200 mg/kg, i.p., -30 min), glucan + WR-2721, and glucan + selenium + WR-2721 treatments, respectively. All treatments increased numbers of hemopoietic stem cells as measured by the day 12 endogenous spleen colony-forming unit (E-CFU) assay; the most significant E-CFU effects, however, were observed following glucan + WR-2721 and glucan + selenium + WR-2721 treatments. Combined modality treatments were also more effective than single-agent treatments at accelerating bone marrow and splenic granulocyte-macrophage colony-forming cell (GM-CFC) regeneration. These results demonstrate the value of multiple-agent radioprotectants. PMID: 2161407 [PubMed - indexed for MEDLINE] |

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| Patchen ML, MacVittie TJ, Jackson WE.<br><br>**Postirradiation glucan administration enhances the radioprotective effects of WR-2721.**<br><br>*Radiat Res.* 1989 Jan;117(1):59-69.<br><br>PMID: 2536480 [PubMed - indexed for MEDLINE] | Based on murine survival studies, endogenous hemopoietic spleen colony formation (E-CFU), and recovery of bone marrow and splenic granulocyte-macrophage colony-forming cells (GM-CFC), it was demonstrated that the postirradiation administration of glucan, an immunomodulator and hemopoietic stimulant, enhances the radioprotective effects of WR-2721. LD50/30 dose reduction factors for mice treated with WR-2721 (200 mg/kg approximately 30 min before irradiation), glucan (250 mg/kg approximately 1 h after irradiation), or both agents were 1.37, 1.08, and 1.52, respectively. Enhanced survival in mice treated with both agents appeared to be due in part to glucan's ability to accelerate hemopoietic regeneration from stem cells initially protected from radiation-induced lethality by WR-2721. Following a 10-Gy radiation exposure, E-CFU numbers in mice treated with saline, WR-2721, glucan, or both WR-2721 and glucan were 0.05 +/- 0.03, 6.70 +/- 1.05, 0.95 +/- 0.24, and 33.90 +/- 2.96, respectively. Similarly, bone marrow and splenic GM-CFC numbers were greater in mice treated with both WR-2721 and glucan than in mice treated with either agent alone. These results demonstrated at least additive radioprotective effects when mice were given WR-2721 prior to irradiation and glucan following irradiation. These effects appeared to depend on the sequential cell protection mediated by WR-2721 and hemopoietic repopulation mediated by glucan. |
| Patchen ML, Chirigos MA, Brook I.<br><br>**Use of glucan and other immunopharmacological agents in the prevention and treatment of acute radiation injuries.**<br><br>*Fundam Appl Toxicol.* 1988 Nov;11(4):573-4. No abstract available.<br><br>PMID: 3229582 [PubMed - indexed for MEDLINE] | N/A |
| Patchen ML, D'Alesandro MM, Chirigos MA, Weiss JF.<br><br>**Radioprotection by biological response modifiers alone and in combination with WR-2721.**<br><br>*Pharmacol Ther.* 1988;39(1-3):247-54. Review. No abstract available.<br><br>PMID: 2849129 [PubMed - indexed for MEDLINE] | N/A |

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| Patchen ML, D'Alesandro MM, Brook I, Blakely WF, MacVittie TJ.<br><br>**Glucan: mechanisms involved in its "radioprotective" effect.**<br><br>*J Leukoc Biol.* 1987 Aug;42(2):95-105.<br><br>PMID: 3036990 [PubMed - indexed for MEDLINE] | It has generally been accepted that most biologically derived agents that are radioprotective in the hemopoietic-syndrome dose range (eg, endotoxin, Bacillus Calmette Guerin, Corynebacterium parvum, etc) exert their beneficial properties by enhancing hemopoietic recovery and hence, by regenerating the host's ability to resist life-threatening opportunistic infections. However, using glucan as a hemopoietic stimulant/radioprotectant, we have demonstrated that host resistance to opportunistic infection is enhanced in these mice even prior to the detection of significant hemopoietic regeneration. This early enhanced resistance to microbial invasion in glucan-treated irradiated mice could be correlated with enhanced and/or prolonged macrophage (but not granulocyte) function. These results suggest that early after irradiation glucan may mediate its radioprotection by enhancing resistance to microbial invasion via mechanisms not necessarily predicated on hemopoietic recovery. In addition, preliminary evidence suggests that glucan can also function as an effective free-radical scavenger. Because macrophages have been shown to selectively phagocytize and sequester glucan, the possibility that these specific cells may be protected by virtue of glucan's scavenging ability is also suggested. |
| Patchen ML, MacVittie TJ.<br><br>**Hemopoietic effects of intravenous soluble glucan administration.**<br><br>*J Immunopharmacol.* 1986;8(3):407-25.<br><br>PMID: 3760593 [PubMed - indexed for MEDLINE] | A soluble form of the reticuloendothelial- and immune modulating agent glucan (glucan-F) has been evaluated for its effects on hemopoiesis. A single 5.0 mg intravenous injection of glucan-F into C3H/HeN mice increased peripheral white blood cellularity, bone marrow and splenic cellularity, bone marrow and splenic granulocyte-macrophage progenitor cell numbers (GM-CFC), and splenic pluripotent stem cell (CFU-s) and erythroid progenitor cell (CFU-e) numbers. Serum levels of granulocyte-macrophage colony stimulating activity (CSA) were also elevated following glucan-F administration. These hemopoietic responses correlate well with those previously shown to be induced by intravenous administration of particulate glucan (glucan-P). In contrast to glucan-P, however, intravenous glucan-F administration has been shown not to induce granuloma formation and severe hepatosplenomegaly, thus the potential clinical use of glucan-F as a hemopoietic stimulant is more likely than that of glucan-P. |
| Patchen ML, MacVittie TJ, Brook I.<br><br>**Glucan-induced hemopoietic and immune stimulation: therapeutic effects in sublethally and lethally irradiated mice.**<br><br>*Methods Find Exp Clin Pharmacol*. 1986 Mar;8(3):151-5.<br><br>PMID: 3713378 [PubMed - indexed for MEDLINE] | The hemopoietic effects of glucan, a beta 1,3 polyglycan biological response modifier, were assayed in normal and irradiated mice. In normal mice, glucan administration increased the content of bone marrow and splenic transplantable pluripotent hemopoietic stem cells (CFU-s), committed granulocyte-macrophage progenitor cells (GM-CFC), and pure macrophage progenitor cells (M-CFC). In mice partially hemopoietic depleted by exposure to 6.5 Gy of 60Co irradiation glucan increased the number of endogenous pluripotent hemopoietic stem cells (E-CFU). The most pronounced effects were observed when glucan was administered 1 day before irradiation. In addition, the administration of glucan 1 day before lethal (9.0 Gy) irradiation-enhanced survival. The enhanced survival in glucan-treated mice in part appeared to be mediated by an enhanced resistance to the surgence of enteric opportunistic pathogens that occurs following radiation-induced hemopoietic and immune depression. |

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| Patchen ML, MacVittie TJ.<br><br>**Comparative effects of soluble and particulate glucans on survival in irradiated mice.**<br><br>*J Biol Response Mod.* 1986 Feb;5(1):45-60.<br><br>PMID: 3958754 [PubMed - indexed for MEDLINE] | The survival-enhancing capabilities of particulate (P) and soluble (F) glucan, a B-1,3 polyglycan biological response modifier, were assayed in 60Co irradiated mice. Although glucan-P was slightly more effective than glucan-F, both glucans significantly enhanced survival in otherwise lethally irradiated (9.0-11.0 Gy) C3H/HeN mice. Following 9.0 Gy, 60% of the glucan-P treated and 53% of the glucan-F treated mice exhibited long-term survival as opposed to 0% of the radiation control mice. The survival-enhancing effects of glucan-P and glucan-F decreased as the radiation dose increased to 11.0 Gy. At higher radiation doses (e.g., 12.0 Gy) neither glucan preparation was capable of enhancing survival. Both glucan-P and glucan-F enhanced the recovery of peripheral blood white cell numbers, platelet numbers, and hematocrit values. In addition, both agents increased endogenous pluripotent hemopoietic stem cell numbers in sublethally irradiated mice. Taken together, these results demonstrate that both glucan-P and glucan-F can significantly enhance survival in lethally irradiated mice. However, these agents appear to function specifically by enhancing hemopoietic recovery and are not effective at radiation does also known to induce gastrointestinal damage. |
| Patchen ML, MacVittie TJ.<br><br>**Stimulated hemopoiesis and enhanced survival following glucan treatment in sublethally and lethally irradiated mice.**<br><br>*Int J Immunopharmacol.* 1985;7(6): 923-32.<br><br>PMID: 4077349 [PubMed - indexed for MEDLINE] | Hemopoietic effects of the reticuloendothelial agent glucan were assayed in normal mice and in mice hemopoietically depleted by exposure to 60Co radiation. In normal mice, glucan administration increased the content of bone marrow and splenic transplantable pluripotent hemopoietic stem cells (CFU-s), committed granulocyte-macrophage progenitor cells (GM-CFC), and pure macrophage progenitor cells (M-CFC). Erythroid progenitor cells (CFU-e) were increased only in the spleen. In sublethally irradiated mice (650 rads), glucan increased the number of endogenous pluripotent hemopoietic stem cells (E-CFU) when administered either before or after irradiation. The most pronounced effects were observed when glucan was administered 1 day before, 1 h before, or 1 h after irradiation. In addition, the administration of glucan before lethal irradiation (900 rads) enhanced survival. The most significant results were seen when glucan was aministered 1 day prior to irradiation. The possibility of using agents such as glucan to enhance hemopoietic reconstitution and prevent septicemia following chemotherapy and/or radiotherapy is discussed. |
| Patchen ML, DiLuzio NR, Jacques P, MacVittie TJ.<br><br>**Soluble polyglycans enhance recovery from cobalt-60--induced hemopoietic injury.**<br><br>*J Biol Response Mod.* 1984 Dec;3(6):627-33.<br><br>PMID: 6512563 [PubMed - indexed for MEDLINE] | Six soluble polyglycans (glucan-C, glucan-F, glucan-S, krestin, lentinan, and schizophyllan), two soluble polymannans (mannan-A and mannan-R), and one soluble polyfructan (levan) were assayed for their ability to enhance hemopoietic recovery in C3H/HeN mice when administered either 1 h before or 1 h after a 6.5-Gy dose of cobalt-60 radiation. Hemopoietic recovery was measured by the endogenous spleen colony assay and was compared with recovery in both radiation control mice and irradiated mice treated with glucan-P (a particulate polyglycan previously shown to enhance recovery from radiation-induced hemopoietic injury). Compared with radiation controls, when administered before irradiation, mannan-A, glucan-F, and glucan-S enhanced endogenous colony formation 4.2-5.1-fold (equivalent to glucan-P), and levan and schizophyllan approximately 2.7-fold. Lentinan, krestin, mannan-R, and glucan-C did not enhance hemopoietic recovery above radiation controls under these conditions. When polyglycan administration was delayed until after irradiation, endogenous colony formation was enhanced 3.0-3.9-fold by mannan-A, schizophyllan, glucan-S, krestin, and glucan-F (at least comparable with glucan-P) but not at all by mannan-R, levan, lentinan, or glucan-C. |

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| Patchen ML, MacVittie TJ, Wathen LM.<br><br>**Effects of pre- and post-irradiation glucan treatment on pluripotent stem cells, granulocyte, macrophage and erythroid progenitor cells, and hemopoietic stromal cells.**<br><br>*Experientia*. 1984 Nov 15;40(11): 1240-4.<br><br>PMID: 6500009 [PubMed - indexed for MEDLINE] | Glucan, a beta-1,3 polyglucose, was administered to mice either 1 h before or 1 h after a 650 rad exposure to cobalt-60 radiation. Compared to radiation controls, glucan-treated mice consistently exhibited a more rapid recovery of pluripotent stem cells and committed granulocyte, macrophage, and erythroid progenitor cells. This may partially explain the mechanism by which glucan also enhances survival in otherwise lethally irradiated mice. |