

# Effect of *Ganoderma Lucidum* on Leukocyte Counts in r-Irradiated Mice

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## ABSTRACT

The present study was conducted to investigate the effect of *Ganoderma lucidum* (G1) on total leukocyte count and the differential leukocyte count in the r-irradiated mice. In this research, 120 male mice (ICR strain), 6-8 weeks of age, were selected and divided into four groups. Group A was served as the normal control. Groups B and C, as the experimental control groups, were treated with G1 and Cs<sup>137</sup> r-ray respectively. Group D, as the experimental group, was treated with G1 at a 24 hours interval for 26 days after being exposed to r-irradiation.

The present results led to the following conclusions:

1. It showed that r-irradiation had an evident destructive effects on counts of total leukocyte, neutrocyte and lymphocyte.

2. It also showed that *Ganoderma lucidum* was able to help the r-irradiated mice to recover the counts of total leukocyte, lymphocyte and neutrocyte on day 33 after irradiation. However, it did not recover

to the normal in the r-irradiated control group at the same time after r-irradiation.

### INTRODUCTION

*Ganoderma lucidum* (G1) was thought to be able to cure all diseases and make people live forever from the ancient time. Let us suspect it to be true.

It has been reported that the clinic effects of *Ganoderma lucidum* on chronic bronchitis, hyperlipemia, neurasthenia, hepatitis and leukopenia were good<sup>(1)</sup>. It was also demonstrated that G1 could increase count of leukocyte<sup>(2)</sup> and inhibit the growth of tumor<sup>(3)</sup>.

There have been many reports investigating the effects of r-irradiation on animals. The authors also made several experiments which showed that r-irradiation would interfere with embryonic development, result in malformation<sup>(4-6)</sup> and cause damage to the tissues and organs in animals, particularly to hematopoietic organs and hematocytes<sup>(7-9)</sup>. So, the

purpose of this study was to investigate if G1 could help the decreased leukocyte count and the differential leukocyte counts recover to the normal sooner in r-irradiated mice.

### Materials and Methods

1. *Animals*: 120 male mice (ICR strain), 6-8 weeks old, were selected and divided into 4 groups: group A was the normal control and groups B and C, as the experimental control groups. Group D served as the experimental group. Group B accepted the whole body irradiation of 400 rads; group C was treated with *Ganoderma lucidum* (G1) only, 75 mg/g body weight daily for 26 days continuously. Group D was treated with G1 (the method was the same as group C) after exposed to r-irradiation.

2. *Irradiation treatment*: Mice were put together in a round wood box to receive Cs<sup>137</sup> r-ray whole body irradiation. Source skin

distance was 33 cm, and the dose rate was 60 rad/min. The time of each duration was 6 minutes and 40 seconds; the total dose was 400 rad.

3. *Items examined:* The peripheral blood of animals was obtained on day 1, 5, 12, 19 and 33 post irradiation. The total of leukocytes was counted by hemocytometer, and the percentages and absolute values of both lymphocytes and neutrophils were calculated by the method of differential leukocyte count<sup>(10)</sup>.

## RESULTS

### 1. *Counts of leukocyte :*

The average and standard deviation of leukocyte counts were listed in Table 1 and made Fig. 1. The results indicated that counts of leukocytes in mice decreased rapidly after irradiation, especially on day 5, and then increased gradually. Mice treated with *Ganoderma lucidum* recovered to the normal on day 33 after irradiation, while the others did not.

### 2. *Counts of lymphocyte :*

The average and standard deviation of lymphocyte counts

were also calculated and listed in Table 2 and Fig. 2. The outcome showed that on day 5 post-irradiation, counts of lymphocytes decreased to the least and then increased. Mice that received G1 recovered to the normal on day 12 after irradiation. However, the other mice did not get over until the 26th day (Fig.2).

### 3. *Counts of neutrophil :*

Also, the average and standard deviation were measured (Table 3 and Fig. 3). After irradiation, counts of neutrophils decreased, and it did not increase until the 5th day. On day 33, group D almost recovered completely, yet group B did not.

## DISCUSSION

Tsuzuk found that X-ray could decrease counts of leukocyte in rabbits<sup>(1)</sup>. The authors also found that X-ray decreased leukocyte counts in rats and guinea pigs and r-ray would decrease leukocyte count and the differential leukocyte counts in mice<sup>(12,13)</sup>. The results of the present work showed that the effects of 400 rad r-ray irradiation to

Table 1. Effect of Ganoderma lucidum on Leukocyte count ( $10^3/\text{mm}^3$ ) in r-irradiated mice.

Group	Treated condition		Days after treatment					
	Mode	Fraction	1	5	12	19	26	33
A	Control		11.99 ±1.59	11.17 ±2.69	12.45 ±1.93	12.17 ±1.71	10.95 ±1.02	12.00 ±1.08
B	RT	1	10.35 ±1.61	5.50** ±3.75	8.87** ±1.87	8.54** ±1.26	8.77* ±1.68	8.41** ±2.46
C	GL	26	11.55 ±1.01	11.55 ±1.57	11.95 ±1.91	11.17 ±1.08	10.52 ±1.04	10.71* ±1.06
D	RT + GL	1 26	10.75 ±1.95	5.68** ±2.11	8.80** ±1.69	9.84* ±2.21	10.08 ±2.21	10.35** ±0.89

RT: Radiation treatment (400 rad), GL: Ganoderma lucidum

\* :  $P < 0.05$  ; \*\* :  $P < 0.01$  (Student's t test)

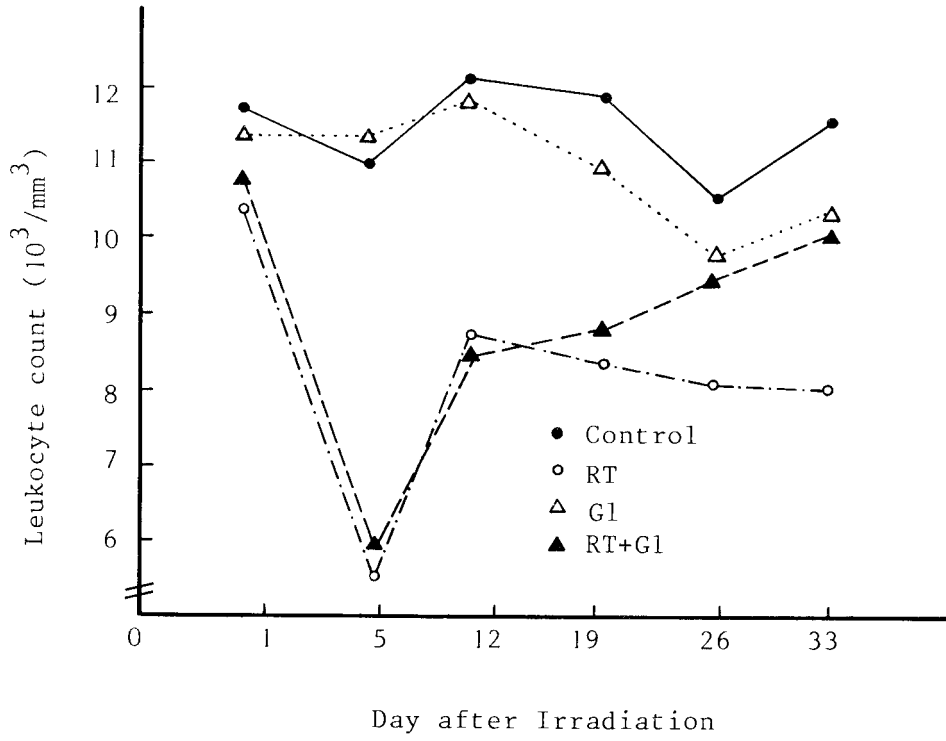


Fig. 1. Effect of *Ganoderma lucidum* on leukocyte count in r-irradiated mice

Table 2. Effect of Ganoderma lucidum on Lymphocyte count ( $10^3/\text{mm}^3$ ) in r-irradiated mice.

Group	Treated condition		Days after treatment					
	Mode	Fraction	1	5	12	19	26	33
A	Control		5.29	6.03	5.57	5.39	5.24	5.59
			$\pm 1.40$	$\pm 1.65$	$\pm 2.16$	$\pm 2.26$	$\pm 2.18$	$\pm 1.54$
B	RT	1	5.15	3.84	5.14	5.29	5.69	5.92
			$\pm 0.46$	$\pm 2.45$	$\pm 1.97$	$\pm 1.90$	$\pm 0.97$	$\pm 2.91$
C	GL	26	5.78	5.73	6.00	5.96	5.75	5.73
			$\pm 1.40$	$\pm 1.48$	$\pm 0.86$	$\pm 0.89$	$\pm 2.30$	$\pm 0.98$
D	RT + GL	1 26	5.49	3.53 <sup>**</sup>	5.93	5.40	5.47	5.68
			$\pm 1.59$	$\pm 1.23$	$\pm 2.38$	$\pm 3.46$	$\pm 1.47$	$\pm 0.98$

RT: Radiation treatment (400 rad), GL: Ganoderma lucidum

\* :  $P < 0.05$  ; \*\* :  $P < 0.01$  (Student's t test)

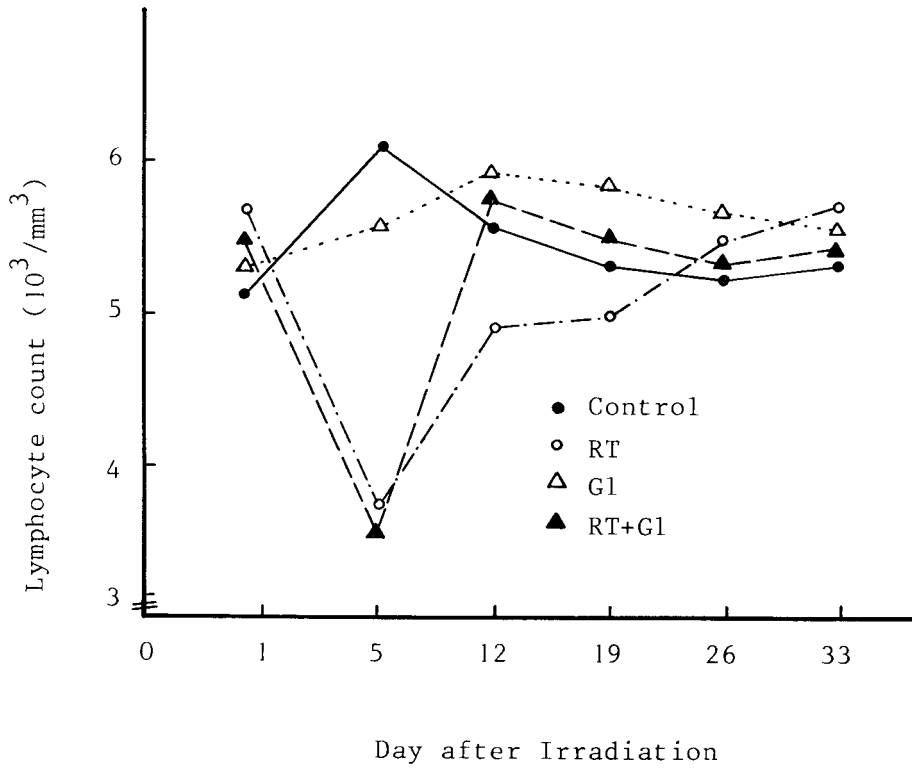


Fig. 2. Effect of Ganoderma lucidum on lymphocyte count in  $\gamma$ -irradiated mice.

Table 3. Effect of Ganoderma lucidum on Neutrophil count ( $10^3/\text{mm}^3$ ) in r-irradiated mice.

Group	Treated condition		Days				treatment	
	Mode	Fraction	1	5	12	19		26
A	Control		5.06 $\pm 1.25$	4.45 $\pm 1.23$	4.90 $\pm 0.93$	4.76 $\pm 1.10$	4.84 $\pm 0.96$	4.52 $\pm 0.88$
B	RT	1	4.06 $\pm 1.07$	1.04 <sup>**</sup> $\pm 1.06$	2.14 <sup>**</sup> $\pm 1.04$	2.22 <sup>**</sup> $\pm 1.01$	2.06 <sup>**</sup> $\pm 1.87$	2.14 <sup>**</sup> $\pm 1.71$
C	GL	26	4.13 $\pm 1.02$	4.26 $\pm 0.93$	4.35 $\pm 0.89$	4.53 $\pm 1.93$	4.07 $\pm 1.59$	4.11 $\pm 1.01$
D	RT + GL	1 26	4.08 $\pm 1.04$	1.35 <sup>**</sup> $\pm 1.08$	2.44 <sup>**</sup> $\pm 1.02$	3.50 $\pm 1.71$	3.85 $\pm 1.69$	3.89 $\pm 1.57$

RT: Radiation treatment (400 rad), GL: Ganoderma lucidum

\* :  $F < 0.05$  ; \*\* :  $P < 0.01$  (Student's t test)



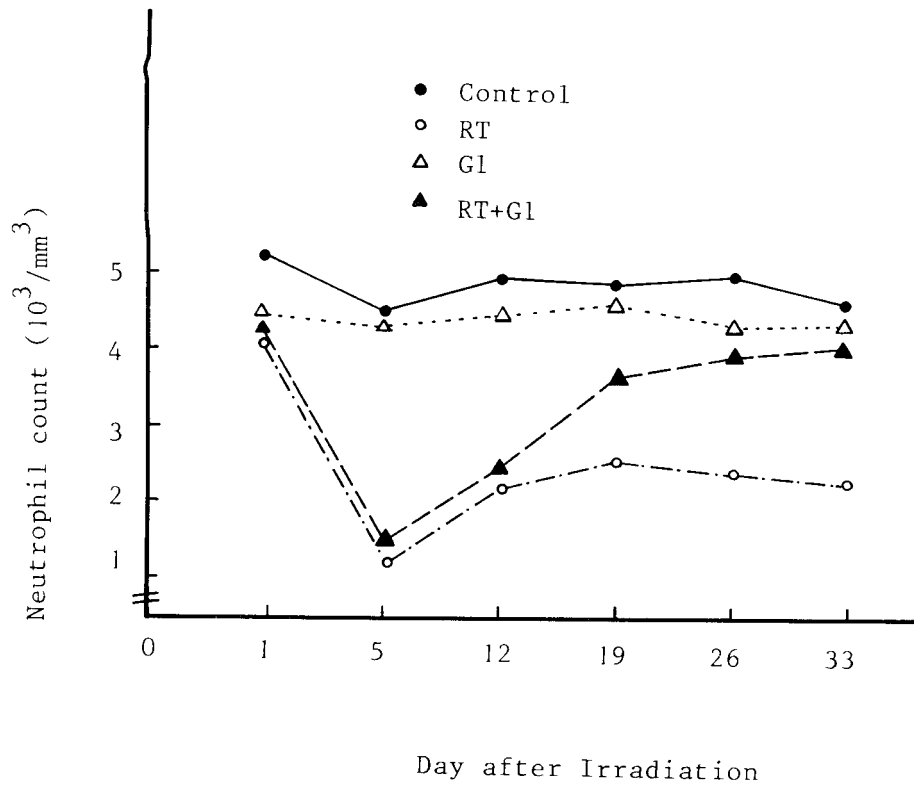


Fig. 3. Effect of *Ganoderma lucidum* on Neutrophil count in  $\gamma$ -irradiated mice.

decrease leukocyte count and the differential leukocyte counts were obvious. Perhaps, irradiation decreased count of leukocytes and their differential counts by destroying lymphocytes directly and inhibiting the functions of hematopoietic organs, such as bone marrow, spleen and thymus.

It has been demonstrated that *Ganoderma lucidum* had clinic effect on leukopenia<sup>(1)</sup> and could increase counts of natural killer (NK) cells<sup>(2)</sup>. NK cell was a kind of pre T lymphocyte and it had something to do with immunity<sup>(14)</sup>. *Ganoderma lucidum* could help counts of lymphocyte recover earlier, increase counts of NK cells and so enhance immunity.

Some researches indicated that extracts of fungi was polysaccharides and would enhance immunity. Lentinan, for example, was taken from *Lentinus edodes* and it could promote the activity of T helper cells<sup>(15,16)</sup>; Krestin, one type of fungi, could promote immunity, too<sup>(17)</sup>. *Ganoderma lucidum* also belongs to fungi. It helped to increase leukocyte count and the differential leukocyte count and enhance

immunity perhaps by strengthening the functions of hematopoietic organs.

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# 鹿角靈芝對於照過 $\gamma$ 射線 小白鼠的白血球及其分類計數的影響

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## 中文摘要

本研究之目的在探討鹿角靈芝對於照過 $\gamma$ 射線小白鼠的白血球及其分類計數的影響。本研究選取6~8週大小之雄性ICR種系小白鼠120隻分成四組：一組為正常對照組，其餘為實驗組，分別接受輻射或/和靈芝之處理，然後檢查各組白血球及其分類計數的變化。

本研究結果顯示：動物接受輻射後，其白血球及其分類計數，均迅速下降，至輻射後第5天降至最低，然後逐漸恢復，經服用靈芝者，其恢復較快，於輻射後第33天，其恢復已接近正常，然而未服用靈芝者，其恢復較慢，至輻射後33天，其白血球總數及中性球計數均未恢復正常。