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Original Article

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Comparative Analysis of Dose Variations in Tumour Volumes and Organs at Risk in IMRT Plans for Head-and –Neck, Pelvis and Brain Cancers with Varying Dose Calculation Grid Sizes

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Abstract

Aims: The aim of this study was to compare the plan results that were obtained by using different calculation grid sizes ranging from 3mm to 10mm, and the same dose calculation algorithm Pencil Beam (PB), in Intensity Modulated Radiotherapy (IMRT) for different treatment sites Head-And –Neck, Pelvis (Carcinoma Cervix) And Brain Cancers. **Introduction:** Ever since the advent and development of treatment planning systems, the uncertainty associated with calculation grid size has been an issue. Even to this day , with highly sophisticated 3D conformal and intensity-modulated radiation therapy (IMRT) treatment planning systems (TPS), dose uncertainty due to grid size is still a concern. **Methods and Material:** Twelve patients in which four patients of Head-And –Neck, Pelvis And Brain tumours respectively were considered for the study. IMRT Plans were generated for a 6,600cGy, 5,000cGy & 5,400cGy prescribed doses for Head-and–Neck, Pelvis and Brain tumours respectively using Oncentra v 4.3 TPS . For each patient, dose calculation with PB algorithms using dose grid sizes of 3.0 mm, 5.0 mm, and 10.0 mm were performed. **Results:** The plans were evaluated as per the ICRU guidelines and dose constraints were maintained as per the Quantec guidelines. The dose differences for the varying grid sizes in Tumour Volumes and Organs at Risk were analyzed and tabulated. **Conclusions:** Overall, the effect of varying grid size on dose variation appears to be insignificant. However, 3 mm is recommended to ensure acceptable dose calculations, especially in high gradient regions.

Keywords: Dose grid; 2D array; Organs at risk; Intensity-modulated radiotherapy; Dose-volume changes; Head-and-neck cancers.

Introduction

The benefit of intensity-modulated radiation therapy (IMRT) in the treatment of head-and-neck cancer (HNC) has been demonstrated in numerous studies.[1–3] Highly conformal radiation allows for a high dose to high-risk areas, whilst sparing adjacent organs at risk (OAR) such as the parotid glands. Clinical studies have shown that IMRT reduces grade-3 xerostomia comparison to three-dimensional conformal radiotherapy (3D CRT).[4-5] for that reason, IMRT has become the standard treatment in many centers. IMRT dose distributions, with steep dose gradients, are very sensitive to geometrical uncertainties, and hence, deviations between planned and delivered dose distributions have to be minimized. One way of improving the treatment accuracy is to reduce geometrical errors. Rigid errors, such as setup, have been extensively studied. Mechalakos *et al*[6] for instance evaluated the interfraction and interfraction errors in treatments of HNC and compared their results with previous studies from others authors. Margins are added to

clinical volumes in order to take into account geometrical uncertainties. These planning margins are commonly calculated from measured systematic and random geometrical errors.[7]

However, it is well known that many HNC patients treated with radiotherapy (RT) suffer significant anatomical changes due to tumor shrinkage or weight loss. Several scheduled rescanning studies have evaluated these volumetric changes in both target volumes and normal tissues,[8–11] mostly on the parotid glands and their consequent effects on dose distribution.[12–15]

The purpose of the present study was to analyze the variation on the dose distribution in Planning target volumes (PTVs) and organs at risk (OAR). The use of IMRT implies the irradiation of more OARs than conventional 3D CRT. Therefore, beside typical susceptible organs such as the eyes, optic nerves, optic chiasm, spinal cord, parotid glands, bladder, rectum, and bowel we have also included additional OARs such as the brainstem, and femur head.

The IMRT technique has the potential benefit over conventional whole-pelvis irradiation of improving target dose coverage, reducing the volume of the organs at risk (OARs) that receive irradiation, and reducing the toxicity to normal tissue.[16-19] Despite the significant benefits of IMRT, there are some disadvantages. The technique usually requires multiple fixed-angle radiation beams, which can increase treatment delivery time. This has an impact on patient comfort, reproducibility of the treatment position, and intra-fraction motion. Moreover, IMRT uses a larger number of monitor units (MUs) compared with conventional conformal radiotherapy (CRT), leading to an increase in the amount of low-dose radiation received by the rest of the body. This raises the concern of secondary radiation-induced malignancy, which is of particular relevance to young patients or those with long future life expectancies.[20-23]

In the past, whole-brain radiotherapy (WBRT) planning was simple. Today, new clinical and dosimetric considerations are taken into consideration when approaching such planning. It has been found that as many as 11% of patients who were treated by WBRT and survived more than 12 months developed dementia, especially with the use of a larger dose-per-fraction regimen.[24] However, regression of the lesions after WBRT was found to correlate with survival and improved neurocognitive function. Therefore, achievement of macroscopic lesion control is the mainstay of treatment. Thus, treatment-dose compromise is unjust for preserving these neurocognitive functions. Furthermore, memory functions were found to be most susceptible to early decline, even in patients with nonprogressing brain metastases.[25] These concerns became more significant as WBRT was instituted for prophylactic brain irradiation (PCI) for various neoplasms to decrease intracranial failure in patients with potential long-term survival.[26]

Subjects and Methods

A.C.T. Acquisition and Contouring

CT scans were acquired using a Somatom Power Spirit CT Simulator (Siemens) with 3–5 mm slice spacing. Patients were in the supine position and immobilized with a thermoplastic head–shoulder mask. A planning CT scan (CT) was acquired one week before RT treatment. The Oncentra version 4.3 (Nucletron) treatment planning system was used for delineation and dose distribution calculations. Target volumes and normal tissues were manually contoured by a physician on each axial slice of the CT using MRI or contrast-enhanced CT. The definition of volumes was in accordance with ICRU Reports 50-62, but dose-volume parameters were reported according to the new ICRU Report 83 IMRT recommendations. Gross tumour volume (GTV) included the primary tumour and affected lymph nodes. The GTV was expanded to include the high-risk regions (CTV).

To compensate for geometrical uncertainties such as setup and organ motion, a 5 mm

margin was automatically added to CTVs to obtain the planning target volume (PTV). In order to avoid dose compensation in the build-up region, in cases with no skin infiltration, the PTVs were manually modified excluding areas where the distance to the skin was less than 3 mm. Although these modified PTVs were used during optimization process, the absorbed dose was reported over the whole PTV. Prescribed doses were 6,600cGy, 5,000cGy & 5,400cGy for Head-and–Neck, Pelvis (Carcinoma Cervix), & Brain respectively.

The critical structures contoured were: the parotid glands, spinal cord, mandible, eyes, oral cavity, brainstem, brain, optic nerves, optic chiasm, bladder, rectum, bowel & femur heads.

B. Treatment Planning

IMRT treatment plans were generated on the CT with nine 6 MV fields on the Oncentra treatment planning system. For each of the calculation grid sizes, three different sites; namely, Head -and-Neck, Cervix, and Brain were analyzed as shown in figures: 1(a) (b) (c), 2(a) (b) (c) & 3(a) (b) (c). The IMRT plans were optimized using an inverse planning algorithm. The final dose distribution was calculated using the Pencil Beam (PB) with heterogeneity correction and 3-10 mm grid resolu-tion. Dose volume histograms were generated for each of the cases and statistical analysis performed included mean relative difference, Homogeneity Index and Conformity Index for target structures. Comparison was done first by using 3mm calculation grid as a golden standard and keeping the same number of monitor units (MUs) per beam for each grid size, then the second part involved renormalizing plans to have the same target coverage (95% of the prescription dose covering at least 95% of the target volume) for each grid size used.

Future study plans include their verification with the PTW 2D Array.

Optimization goals were as follows: 1) prescription doses (Dpres) must encompass at least 95% of target volumes; 2) near-minimum absorbed doses (D98%) of PTVs should be higher than 92% of Dpres; 3) the near-maximum absorbed dose (D2%) of the PTVs should be less than 110% of Dpres.

High priority constraints to normal critical structures were: no more than 1.0 cm3 of spinal cord could receive more than 46 Gy ; 2) no more than 1% of brainstem could receive more 54Gy; 3) the parotid gland volume receiving 26Gy should be less than 50% in at least one gland; 4) optic nerves Dmax should be less than 56Gy 5)optic chiasm Dmax should be less than 54Gy 6) Bowel 195cc should be less than 45Gy; 7) bladder Dmax should be less than 45Gy; 8) Rectum Dmax should be less than 50Gy; 4) D2% of normal tissue should be less than Dpres.

Low priority constraints that should not compromise target coverage were: 1) eyes Dmax should be less than 50 Gy;

Conclusions

IMRT places a higher requirement on dose grid resolution than conventional radiation therapy. While 3 mm-5 mm grid was assumed adequate for conformal treatment planning, smaller dose grid is required at least in the areas of high dose. In the cases where steep dose gradients exist smaller grid size should be used while calculating and evaluating treatment plans, as the choice of the calculation grid size may in certain cases even

Figure I(a)

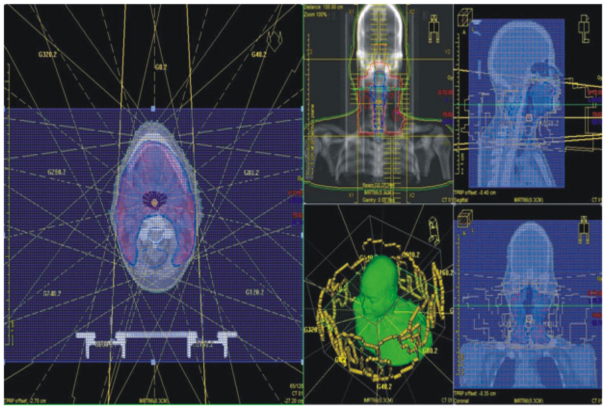


Figure I(b)

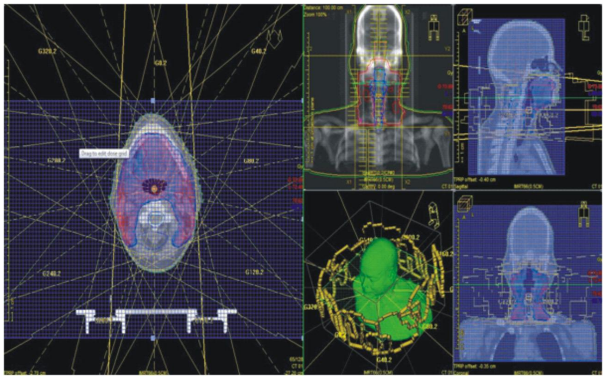
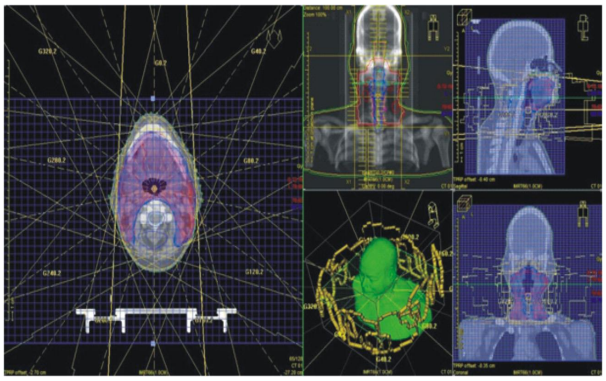


Figure I(c)



influence clinical results. The statistical analysis showed that there were no significant differences in conformity & homogeneity except in some cases of 10mm grid size IMRT plan. Thus 3 mm is recommended to ensure acceptable dose calculations, especially in high gradient regions.

Figure I. Showing 95% Isodose distribution In Head & Neck Cancer. (a) With 3mm Dose Calculation Grid Size (b) With 5mm Dose Calculation Grid Size (c) With 10mm Dose Calculation Grid Size

Figure II(b)

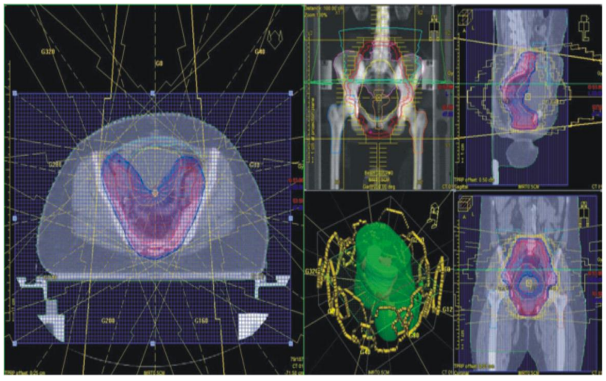


Figure II(c)

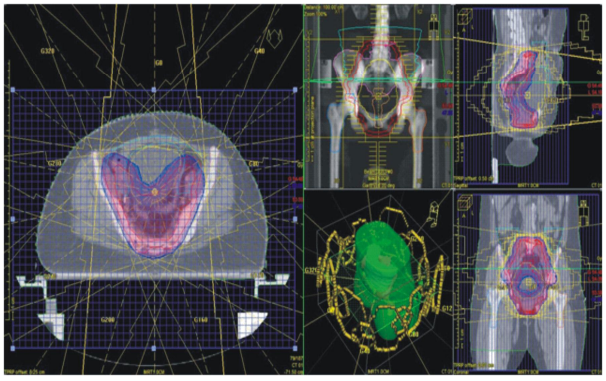


Figure II. Showing 95% Isodose distribution In Pelvis (Carcinoma Cervix) Cancer. (a) With 3mm Dose Calculation Grid Size (b) With 5mm Dose Calculation Grid Size (c) With 10mm Dose Calculation Grid Size

Figure III. Showing 95% Isodose distribution In Brain Cancer. (a) With 3mm Dose Calculation Grid Size (b) With 5mm Dose Calculation Grid Size (c) With 10mm Dose

Figure II(a)

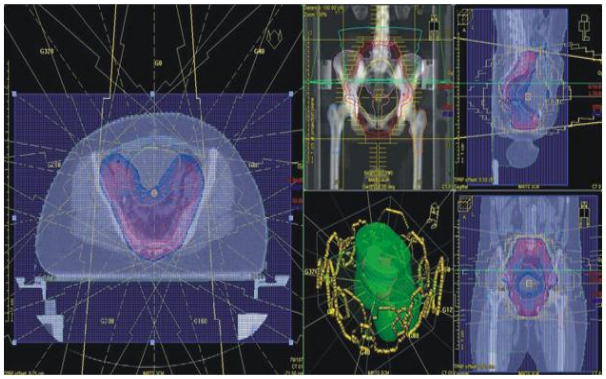


Figure III(a)

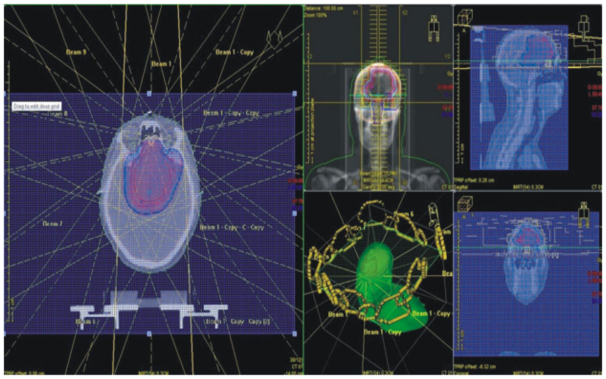
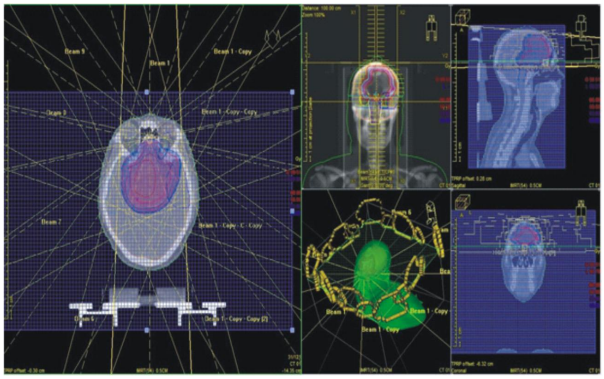


Figure III(b)



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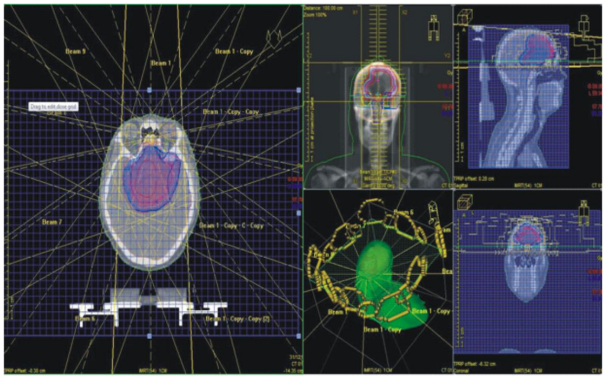

Calculation Grid Size

Results

The maximum percentage of variation recorded between calculation grid sizes used was in the case of the Head and Neck treatments. For the Cervix and Brain cases there was little variation in the results based on the calculation grid size chosen. However head and neck cases with nodal involvement showed significant variation in the dosimetric results based on the grid size chosen. Overall results vary from case to case and also depend on the plan complexity. For larger treatment areas calculating with the grid size smaller than 3mm may be impossible as time needed for calculation rises exponentially with the field size involved.

In gamma function tests, all grid sizes met the criteria of acceptability (i.e., 95% of the region resulted in gamma index less or equal to 1 with a 3% dose difference and a 3 mm Distance to target agreement (DTA) criteria) except for deep target and 5mm and 10mm grid sizes where 95% of the region resulted in gamma index less or equal to 1 with a 5% dose difference and a 5 mm DTA criteria. It was observed that larger grid spacing produces higher dose gradient.

There are enduring uncertainties regarding the optimal dose grid resolution for use with pelvic intensity-modulated radiotherapy (IMRT) plans in which the adjacent organs at risk are slender and transect the field edge.

Table I (a), (b) & (c) shows target volume averaged dose parameters at CT with varying grid sizes for different sites viz. Head & Neck, Pelvis & Brain. Values are presented as a percentage of Dpres of PTV.

Table II(a), (b) & (c) summarizes dose distribution changes on OAR with varying grid sizes for different sites viz. Head and Neck, Pelvis, Brain, which showed some significant varia-tion between planning CT.

Table III(a), (b) & (c) above shows statistical analysis of the IMRT plans with the Conformity Index(C.I) & Homogeneity Index(H.I) for different sites with varying grid sizes where :

Table I (a)

Head-And-Neck (66Gy /33#)									
Grid Sizes (mm)									
Cases	3.0			5.0			10.0		
	V95%	V107%	V110%	V95%	V107%	V110%	V95%	V107%	V110%
Case1	96.18%	1.39%	0.13%	96.03%	1.85%	0.25%	95.01%	1.78	0.09%
Case2	95.55%	0.11%	0.00%	95.45%	0.96%	0.03%	95.22%	0.15%	0.00%
Case3	95.07%	1.23%	0.06%	95.72%	3.24%	0.66%	95.40%	2.75%	0.00%
Case4	95.56%	0.30%	0.00%	95.05%	1.85%	0.39%	95.22%	0.59%	0.00%
Avg.	95.59%	0.76%	0.05%	95.56%	1.98%	0.33%	95.21%	1.32%	0.02%
Std.Dev	0.2470	0.5690	0.6180	0.4030	0.9410	0.2630	0.1590	0.118	0.420

Table I (b)

Pelvis (Carcinoma Cervix) [50Gy/25#]									
Grid Sizes (mm)									
Cases	3.0			5.0			10.0		
	V95%	V107%	V110%	V95%	V107%	V110%	V95%	V107%	V110%
Case1	97.79%	0.31%	0.00%	97.75%	0.38%	0.00%	96.86%	0.17%	0.00%
Case2	96.07%	0.27%	0.00%	96.09%	0.17%	0.00%	96.13%	0.99%	0.00%
Case3	95.58%	0.84%	0.00%	95.59%	0.23%	0.00%	95.49%	1.00%	0.00%
Case4	96.02%	0.20%	0.01%	95.26%	0.08%	0.00%	95.14%	0.65%	0.30%
Avg.	96.37%	0.41%	0.00%	96.17%	0.22%	0.00%	95.91%	0.70%	0.08%
Std.Dev	0.9751	0.2924	0.0050	1.1056	0.1260	0.0000	0.7572	0.3905	0.15

Table I (c)

Brain (54 Gy/27#)									
Grid Sizes (mm)									
Cases	3.0			5.0			10.0		
	V95%	V107%	V110%	V95%	V107%	V110%	V95%	V107%	V110%
Case1	98.33%	0.00%	**0.00%**	98.56%	0.27%	**0.00%**	96.16%	0.95%	**0.15%**
Case2	96.80%	1.13%	**0.00%**	96.08%	1.39%	**0.00%**	95.02%	3.25%	**0.37%**
Case3	95.41%	1.42%	**0.00%**	95.30%	3.22%	**0.02%**	95.31%	2.55%	**0.00%**
Case4	95.15%	2.34%	**0.20%**	95.17%	2.97%	**0.25%**	95.44%	2.19%	**0.16%**
Avg.	96.42%	1.22%	0.05%	96.28%	1.96%	0.07%	95.48%	2.24%	0.17%
Std.Dev	1.4634	0.9645	0.0946	1.5738	1.3890	0.1220	0.4845	0.8340	0.152

Table II (a)

Head-And-Neck (66Gy/33#)									
Grid Sizes(mm)									
Organs At Risk	3.0			5.0			10.0		
	D1cc (Gy)	Dmax (Gy)	Mean Dose (Gy)	D1cc (Gy)	Dmax (Gy)	Mean Dose (Gy)	D1cc (Gy)	Dmax (Gy)	Mean Dose (Gy)
Spinal Cord									
Case1	40.18	43.50		41.53	43.24		44.93	42.16	
Case2	44.26	46.84		43.04	45.59		46.18	46.45	
Case3	40.72	43.19		43.19	44.87		45.11	45.11	
Case4	43.19	46.05		44.87	42.54		44.89	41.56	
Spinal cord PRV									
Case1	47.59	49.72			48.84		49.42	47.01	
Case2	48.22	50.89			47.01		48.48	46.53	
Case3	48.14	49.69			48.97		51.81	47.33	
Case4	48.42	51.72			49.98		48.76	47.50	
Brain Stem									
Case1	40.40	47.07		39.60	44.00		44.77	46.91	
Case2	32.83	38.32		32.90	36.78		33.06	35.02	
Case3	51.66	53.95		52.77	54.86		53.44	54.76	
Case4	45.31	49.68		45.38	50.42		49.50	49.88	
Brain Stem PRV									
Case1	47.42	56.24			52.40		49.86	53.84	
Case2	36.40	40.53			40.16		36.57	36.48	
Case3	55.65	59.58			59.87		56.35	57.10	
Case4	55.15	55.15			56.21		59.26	59.26	
Parotid									
Case1			35.42			34.49			31.97
Case2			35.42			34.50			32.50
Case3			33.40			34.50			35.00
Case4			34.50			38.83			40.00

Table II (b)

Pelvis (Carcinoma Cervix) [50Gy/25#]									
	Grid Sizes (mm)								
Organs At Risk	3.0			5.0			10.0		
	D1cc (Gy)	Dmax (Gy)	Mean Dose (Gy)	D1cc (Gy)	Dmax (Gy)	Mean Dose (Gy)	D1cc (Gy)	Dmax (Gy)	Mean Dose (Gy)
Bladder									
Case1	50.94	51.29		51.70	52.02		52.04	52.04	
Case 2	50.50	51.00		50.57	50.94		51.58	51.56	
Case 3	51.82	52.09		51.18	51.71		52.84	52.94	
Case4	49.85	50.25		50.51	50.83		50.64	50.68	
Rectum	52.14	52.63		52.71	53.10		52.75	53.05	
Case1	50.15	50.99		50.79	51.62		50.88	50.92	
Case 2	52.38	52.62		51.40	51.90		52.78	52.68	
Case 3	50.98	51.54		51.35	51.67		51.48	51.59	
Case4									
Rt FH									
Case1		44.53			44.64			45.13	
Case 2		50.55			50.86			50.12	
Case 3		50.82			49.21			47.08	
Case4		46.96			46.01			41.50	
Lt.FH									
Case1		44.59			44.56			45.70	
Case 2		51.15			50.75			53.62	
Case 3		51.60			50.64			51.18	
Case4		48.01			45.26			43.56	
Bowel	D195cc(Gy)	Dmax (Gy)	Mean Dose (Gy)	D195cc(Gy)	Dmax(Gy)	Mean Dose (Gy)	D195cc(Gy)	Dmax (Gy)	Mean Dose (Gy)
Case1	41.62	53.47		41.93	52.74		41.73	51.73	
Case 2	39.77	53.65		39.30	53.56		39.62	53.62	
Case 3	45.29	53.48		45.04	52.49		46.17	53.41	
Case4	42.47	53.37		42.34	53.85		42.99	52.19	

Table II (c)

Brain(54Gy/27#)									
	Grid Size (mm)								
Organs at Risk	3			5			10		
	D1cc (Gy)	Dmax (GY)	Mean Dose(GY)	D1cc (Gy)	Dmax (GY)	Mean Dose(GY)	D1cc (Gy)	Dmax (GY)	Mean Dose(GY)
Optic chiasm									
Case1	20.11	29.32		21.13	26.98		21.57	28.36	
Case2	53.0	53.82		51.39	55.21		51.39	53.69	
Case3	51.21	55.23		51.39	55.21		51.48	55.33	
Case4	35.66	49.65		35.74	46.96		35.07	46.96	
Optic chiasm PRV									
Case1	26.62	35.16		27.03	34.37		26.97	30.11	
Case2	53.69	55.64		55.61	57.68		53.69	57.18	
Case3	55.25	56.57		55.66	56.34		55.39	55.78	
Case4	47.36	53.10		46.97	51.87		47.88	47.50	
Brain Stem									
Case1	52.17	53.36		53.28	54.76		53.23	54.75	
Case2	52.78	59.10		54.23	55.88		55.81	56.95	
Case3	35.75	37.28		36.02	37.23		16.77	37.04	
Case4	54.00	54.68		53.59	53.98		54.69	55.19	
Brain Stem PRV									
Case1	53.92	55.35		54.82	55.93		53.75	55.75	
Case2	54.61	55.90		55.35	55.96		56.63	58.45	
Case3	50.16	52.15		50.63	51.62		50.97	51.79	
Case4	54.12	54.77		53.77	54.21		54.92	55.19	
Rt.Eye									
Case1		6.27	4.81		7.83	5.66		6.56	5.06
Case2		31.08	14.39		28.34	14.32		14.04	26.9
Case3		40.29	22.46		38.33	21.96		34.15	22.4
Case4		22.64	7.27		22.44	7.31		19.78	7.31
Lt.Eye									
Case1		17.18	15.10		17.93	15.8		17.98	16.28
Case2		44.60	19.34		42.28	19.66		38.91	15.93
Case3		40.09	20.17		38.81	19.79		33.05	19.89
Case4		15.06	4.50		14.88	4.40		14.08	4.40

Table III (a)

Head-And-Neck (66Gy/33#) Grid Sizes (mm)															
Cases	3					5					10				
	D2% (Gy)	D98% (Gy)	D50% (Gy)	C.I	H.I	D2% (Gy)	D98% (Gy)	D50% (Gy)	C.I	H.I	D2% (Gy)	D98% (Gy)	D50% (Gy)	C.I	H.I
Case1	70.32	60.78	67.35	0.95	0.14	70.56	60.52	67.2	0.95	0.15	70.52	59.22	67.6	0.95	0.17
Case2	69.01	60.64	65.82	0.95	0.13	69.83	61.02	65.88	0.95	0.13	69.54	59.73	66.33	0.95	0.15
Case3	70.25	60.84	66.57	0.95	0.14	71.16	60.69	67.34	0.95	0.16	70.79	58.91	67.87	0.95	0.18
Case4	69.27	61.03	65.92	0.95	0.13	70.46	60.6	66.17	0.95	0.15	69.98	59.36	67.17	0.95	0.16

Table III (b)

Pelvis (50Gy/25#) Grid Sizes (mm)															
Cases	3					5					10				
	D2% (Gy)	D98% (Gy)	D50% (Gy)	C.I	H.I	D2% (Gy)	D98% (Gy)	D50% (Gy)	C.I	H.I	D2% (Gy)	D98% (Gy)	D50% (Gy)	C.I	H.I
Case1	52.95	46.91	50.64	0.95	0.12	52.95	46.61	50.67	0.95	0.13	53.19	46.3	50.83	0.95	0.14
Case2	52.86	47.38	50.59	0.95	0.1	52.96	47.35	50.73	0.95	0.11	52.95	46.72	50.98	0.95	0.12
Case3	53.29	46.35	51.48	0.949	0.13	52.79	46.02	50.83	0.95	0.13	53.31	46.02	51.38	0.95	0.14
Case4	52.5	46.43	50.55	0.95	0.12	51.82	46.08	50.31	0.95	0.11	52	45.64	50.54	0.95	0.13

Table III (c)

Brain (54Gy/27#) Grid Sizes (mm)															
Cases	3					5					10				
	D2% (Gy)	D98% (Gy)	D50% (Gy)	C.I	H.I	D2% (Gy)	D98% (Gy)	D50% (Gy)	C.I	H.I	D2% (Gy)	D98% (Gy)	D50% (Gy)	C.I	H.I
Case1	56.4	50.02	55.18	0.95	0.11	56.28	49.8	54.66	0.95	0.12	56.96	49.64	55.38	0.95	0.13
Case2	57.52	50.15	54.68	0.95	0.13	57.61	49.72	54.25	0.95	0.14	58.13	48.78	54.4	0.95	0.17
Case3	57.61	50.17	55.4	0.95	0.13	58.07	50.18	55.33	0.95	0.14	57.93	50.02	54.54	0.95	0.14
Case4	57.91	49.69	53.67	0.95	0.15	58.13	49.65	53.79	0.95	0.16	57.87	47.57	54.7	0.95	0.19

H.I – Homogeneity Index = D2% - D98%/ D50% where D2%, D98% & D50% are doses at the near-maximum absorbed dose of the PTV , near-minimum absorbed doses of PTV & received by 50% volume of PTV of the prescribed dose respectively.

C.I – Conformity Index = TV / PTV,where TV & PTV are the treated volume at the specified isodoseline & total planning target volume respectively.

P value and statistical significance: The two-tailed P value is less than 0.001 by conventional criteria, this difference is considered to be extremely statistically sign.

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Original Article

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Radiation Therapy Anxiety among Cancer Patients

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Introduction

All patients do have some emotional reactions before going for a new treatment due to uncertainty about the procedure. Especially for Cancer patients the diagnosis of cancer itself is a greater stress. The treatment of choice either Radiation therapy or Chemotherapy further aggravates and creates terrifying images in the patient. Most patients who are about to undergo radiation therapy have fear including fear of the unknown, of pain, of being burned, loss of job, causing sterility, of cancer, of sickness, or vomiting, increase burden on family members and the threat of permanent disability. This further aggravates the emotional strain on the patient, produced by the radiation therapy. Anxiety may decrease if patient views radiation therapy as having positive results such as curing the cancer; relieving the discomfort or prolonging the life. In contrast anxiety usually increases when the underlying pathologic condition is perceived to be life threatening.

Dr. Larry's Couch, Psychologist (1999) stated that patients receiving radiation will be faced with a number of stressors, emotionally and socially. He recommended that the radiation team members should provide the patient with orientation that consists of a complete visit to the radiation unit settings, as well as meeting the health team members, seeing the radiation machines and receiving a video presentation of how they work which will give better emotional and physical relaxation. In India there are limited studies related to radiation therapy and its interventions.

Statement of the Problem

A study to assess the effectiveness of orientation program on anxiety of patients waiting for radiation therapy and their behavioral response during radiation therapy in a selected hospital at Trichy.

Aim of the Study

The aim of the study was to determine whether orientation program makes any difference in the anxiety of patients waiting for radiation therapy and their behavioral response during the treatment compared to patients without any orientation.

Objectives

- To assess and compare the level of anxiety among experimental group

before and after orientation program

- To assess and compare the level of anxiety among control group two days before and on the day of radiation therapy.
- To assess and compare the behavioral response among the experimental and control groups during the radiation therapy.

Hypothesis

H_1: There will be significant difference between the mean anxiety score of experimental and control group after intervention.

H_2: There will be significant difference between the behavioral response of experimental and control group during the radiation therapy.

Conceptual Framework

Calista Roy's Adoptation model (1966) was used in this study to illustrate the patient's adaptation to new cancer treatment by providing the orientation program.

Research Methodology

An evaluative approach was used in this study to assess the effectiveness of orientation program on radiation therapy anxiety. The study was conducted in a radiation oncology department of a selected private hospital at Trichy. A non probability convenient sampling of 50 patients who were waiting for radiation therapy for the first time was taken. Radiation therapy anxiety scale (4 point) was used to measure the anxiety in three areas (state, Radiation therapy and Radiation therapy effects) and a behavioral assessment checklist was used to assess the patient's response during radiation therapy. The reliability of the tool was established by Karl Pearson (0.8) and inter rater method (0.9) respectively.

Research Design

A quasi – experimental pre- test and post test control - group design was used to test the effectiveness of orientation program on radiation therapy anxiety.

Experimental group

O_1 .....X.....O_2

Control group

O_1 .....O_2

O_1- Assessment of anxiety two days before radiation therapy for the experimental and control group.

O_2- Assessment of anxiety on the day of radiation therapy for the experimental and control group.

X – Information through orientation program including a visit to respective radiation units like Planning room, Monitoring room, Radiation treatment room and Outpatient room where patients were explained about the radiation unit settings, procedure, duration of treatment and showed the radiation machine, monitoring devices, finally the patients were made to interact with the health team members.

Data Collection Method

The data was collected for a period of one month. Using interview technique two days before the treatment the anxiety level of the patients waiting for radiation therapy was assessed. The experimental groups were received orientation program on the same day. The patient's anxiety level was again assessed on the day of radiation therapy before they undergone the treatment. During the radiation therapy the patient's behavioral response was assessed using a behavior assessment checklist.

Data Analysis and Interpretation

The data obtained was analyzed using descriptive and inferential statistics.

Figure I: Mean Score Percentage of Experimental Group in Three Areas of Anxiety before and after Intervention

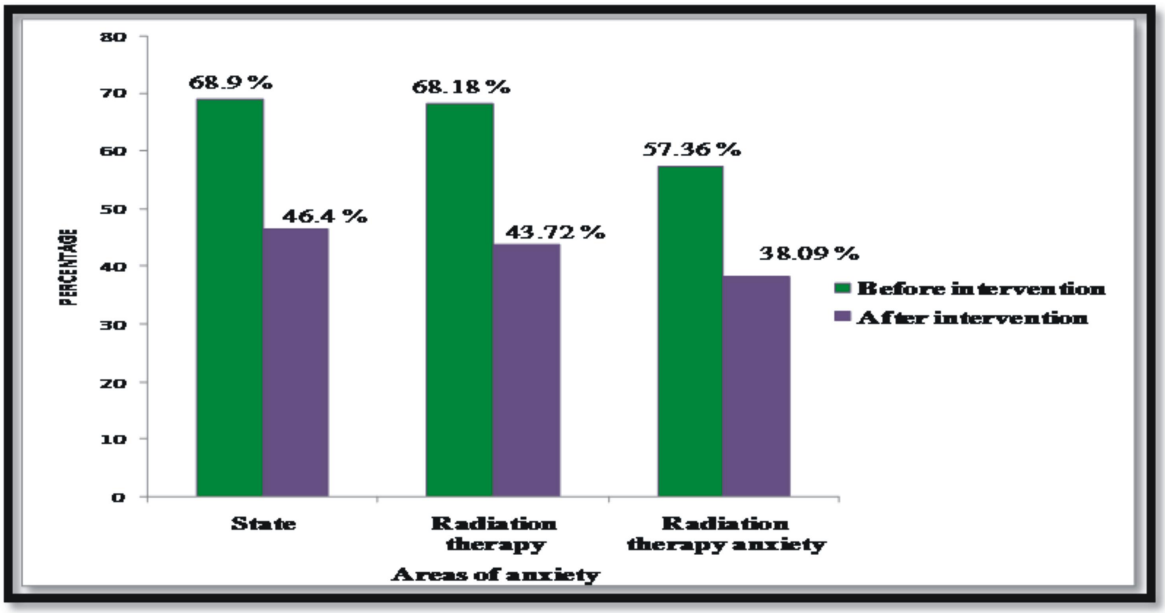
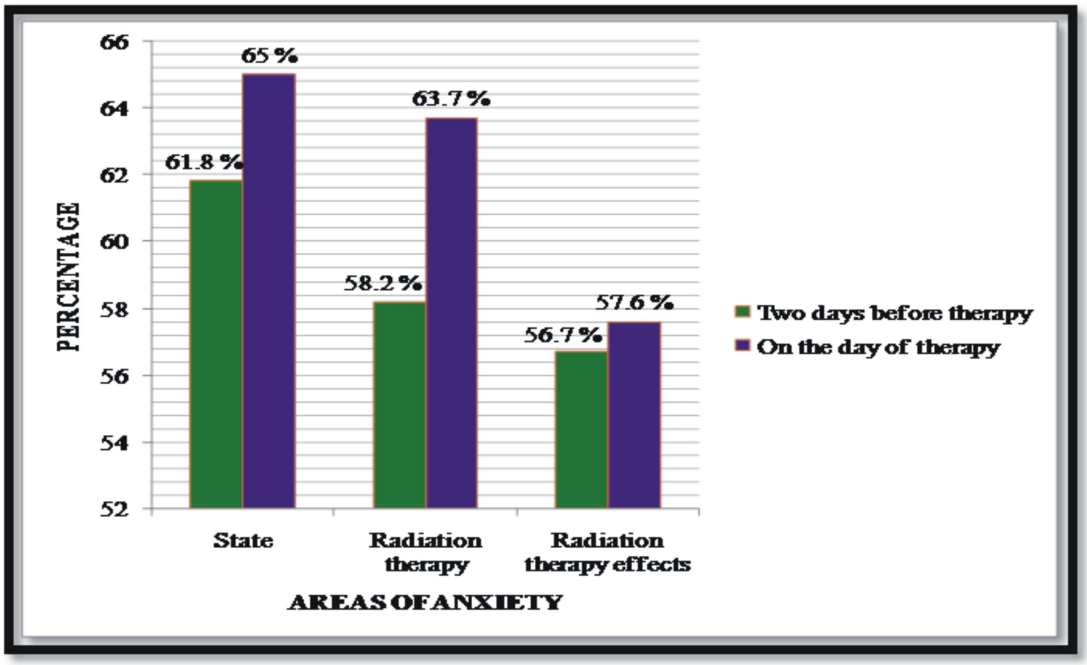


Figure II: Mean Score Percentage of Control Group in Three Areas of Anxiety Two Days before and on the Day of Radiation Therapy



Behavioral response	Experimental group		Control group		Mean difference	Unpaired "t" test P < 0.05 df - 48
	Mean score	SD	Mean score	SD		
Positive response	4.56	1.12	2.44	0.712	2.12	7.98*
Negative response	3.84	1.54	6.32	1.70	2.48	5.39*

Interpretation

Mean Anxiety Score of Experimental Group before and after Intervention in Different Areas

In the experimental group two days before radiation therapy, the anxiety mean score ranged from 57% to 68%. On the day of radiation therapy the anxiety mean score ranged from 38% to 46%. The least anxiety mean score was shown in the area of radiation therapy effects (38%). After intervention there was statistically significant reduction of anxiety mean score in all the three areas of anxiety on radiation therapy showed the effectiveness of orientation program

Mean Anxiety Score of Control Group in Two Days before and on the Day of Radiation Therapy

On the day of radiation therapy the anxiety mean score increased ranging from (57% to 65%). The highest anxiety mean score was shown in the area of state anxiety (65%), radiation therapy (63%) and in the radiation therapy effects (57%). Statistically there was no significant difference among the control group two days before and on the day of radiation therapy.

Mean Score of Behavioural Response during the Radiation Therapy

After the intervention the experimental group showed more positive behavior (4.56) towards the therapy compared to the control group where the negative behavior (6.32) towards the treatment was predominant.

Conclusion

The study concludes that the patients who are waiting for radiation therapy have greater level of anxiety. Those who received the orientation program showed significant reduction in the level of anxiety compared to those who were not received any orientation program. Patients said that the information given through the orientation program and seeing the radiation unit settings prior to the procedure was very useful for them to clarify their doubts and also it gave the exact idea about the procedure.

Nursing Implications

1. Nursing curriculum should emphasis the students on the psychological intervention in reducing the anxiety on radiation therapy. The orientation program is a simple technique to administer, offers firsthand gives experience to the patients regarding the therapy and also improves the interaction between the staff and the patient.
2. Nursing personnel working in hospital should arrange for such orientation Sessions prior to simulation either in group or individually, which will helps to improve the holistic nursing care approach.

Recommendations

1. A study can be conducted among patients undergoing various treatments for cancer.
2. A comparative study can be conducted by using different interventions with orientation program.
3. A study can be conducted among cancer patients to find the various learning/ informational needs about radiation therapy.
4. A similar study can be conducted for the patients undergoing various diagnostic procedures for cancer.

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Review Article

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Theoretical-based Mechanisms of Action of Ayurveda Therapy in Cancer-related Symptoms

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Abstract

In Ayurvedic science, the clinical entities of *Granthi* (glandular cyst) group of diseases include cancer (*Arbuda*) and the progressive stages of cancer. Theoretical based mechanisms of action of Ayurvedic therapy is supposed to treat and prevent these entities well fully by which patient's quality of life improves. In the Bruhataryi (foremost texts) of Ayurveda; Charaka, Sushruta and Ashtanga Hridya samhita, the absolute explanation of cancer related signs and symptoms are seen in scattered ways which are explained in a single chapter of contemporary sciences. New findings gained through scientific developments add up to Ayurvedic science that develops an integrated approach to manage cancer and its related symptoms. Review of literature on anticancer drugs of plant origin revealed identification of newer Ayurvedic drugs that are not mentioned in the ancient texts. Many of herbals and traditional compounds are being screened worldwide to validate their use as anti-cancerous drugs on various cancer cell lines and in vivo study. Clinical studies established that the use of Rasayana drugs of Ayurveda is helpful to reduce side effects of chemo and radio therapeutic agents while adjoining with these therapies.

Hence, an attempt is made in this review to discuss about the pathology and the principle of therapeutic management of various cancers described in Ayurveda.

Keywords: Arbuda; Ayurvedic principle; Cancer; Rasayana.

Introduction

The world is facing second cause of death by survival of cancer.[1] Cancer is a chronic disease & affects patients of both sexes and all age groups, more in later age of life. Though cancer is not directly mentioned in Ayurvedic texts, but symptoms related to Granthi (glandular cyst) - Arbuda (cancer or tumour) group of diseases are well matched with various types of cancer or cancer related symptoms.[2] The treating cancer has more challengeable to medical scientists due to known adverse effects with three principal modes of treatment viz. Surgery, chemotherapy and radiotherapy, because each of these has its own limitation.

The Ayurvedic literature describes how this therapy aims to restore a balance of humours (Dosha), bodily tissues (Dhatu) and spirit for good health.[3] Naishthika chikitsa (spiritual healing) along with the main treatment gives complete wellness of humanity in such life hold diseases.[4] Ayurveda offers treatment with many single and poly herbal or herbo-mineral preparations which promote immunity and mange cancer and its related symptoms. By adjuvant with established treatment, Ayurveda provide better quality

and prolonged life.[5] Ayurvedic therapeutic approaches, such as changes in lifestyle, diet, drugs, Panchakarma (body cleansing mechanism), exercise, and meditation help to strength and purity the body and mind. These holistic treatment procedures not only cure several diseases; but also improve the bodily resistance and rejuvenate the tissues of the body through Rasayana (restoration of normal function of tissue) therapy. The positivity of health is feeling by the patient and patient may get relief with his/her pain and anxiety. The health promotive, disease preventive and rejuvenation approach Ayurveda is gaining greater attention and popularity in many regions of the world.

Probable Pathogenesis of Cancer in Ayurveda

According to Ayurvedic principles, the disease cannot be named on its own because it differs between persons in terms of illness, clinical presentation and also the treatment required.[6] Ayurveda is explained each individual has a unique combination of bioenergetics principles called Doshas which involve in pathogenesis of diseases. Each individual's health is influenced by the innate proportion of the three Doshas, known as Prakruti (genotype- nature), and by the state of disequilibrium of these Doshas, known as Vikruti (i.e., the current state of imbalance of the Doshas). Agni (biologic fire of the body), which is present in each and every cell, is responsible for digestion and metabolism in human body. The decrease in Agni is the responsible for production of Ama (Autotoxins) which leads to impairment of body channels (Srotamsi). Thus inverse proportional of the related tissue form which leads to manifestation of Arbuda. Therefore in Arbuda, the decreased state of Dhatwagni (deranged metabolism) will result in excessive tissue growth. Vata can be correlated with the anabolic phase of growth whereas Kapha to the catabolic phase. Cancer originates due to a metabolic crisis, i.e. aggravation of Vata forces and suppression of Kapha forces, both interacting with one another resulting in proliferation. However, the abnormal cancerous growth at a specific organ (Ekadesavriddhi) is managed by compensation from other parts of the body (Anyasthaniyakshaya), e.g. body weight loss (cachexia).[7]

Thus, Vikriti turns into disease. Sushruta has proposed six stages in the pathogenesis of all diseases (Shatha Kriya kala) but this concept suits more to the pathology of the tumour than pathogenesis itself.

1. *Sanchaya (Stage of Aggravation):* early stages of localized neoplastic changes.
2. *Prakopa (Stage of Accumulation):* transformation of primary growths into metastatic tumours.
3. *Prasara (Stage of Overflow):* metastasis.
4. *Sthana Samsraya (Stage of Relocation):* complete metastasis and secondary growth.
5. *Vyakti (Stage of Build-up in a New Location):* clinical signs and symptoms are expressed.
6. *Bheda (Stage of Manifestation):* the stage where differentiation of growth occurs on the basis of histopathology.[7]

Basic Classification of Cancer and its Related Symptoms

Ayurvedic classification of neoplasm depends on various clinical symptoms in relation to Tridoshas.[8,9]

- *Group I:* Diseases that can be named as clear malignancy, which includes Arbuda and Granthi, e.g. Mamsarbuda (melanoma) and Raktarbuda (leukemia), Mukharbuda (oral cancer), etc.
- *Group II:* Diseases that can be considered as cancer, such as incurable ulcers with e.g. Tridoshaj Gulmas (abdominal tumours like carcinomas of the stomach and liver or lymphomas).
- *Group III:* Diseases with the possibility of malignancy, e.g. Visarpa (erysipelas), Asadhya Kamala (incurable jaundice) and Nadi vrana (sinusitis).

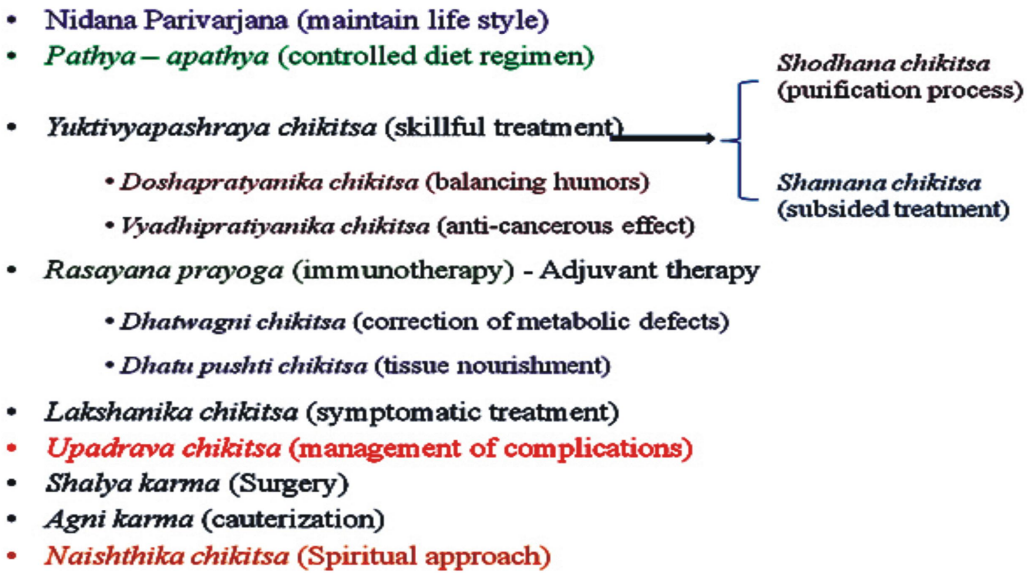
Principles of Ayurvedic Healing

The causative factors which upset the balancing of Dhosha and Dhatu of human system and leads to disease like cancer. It classifies disease development into six stages that include aggravation, accumulation, overflow, relocation, build-up in a new location, and manifestation into a recognizable disease. The aim of Ayurvedic therapy is to diagnose an illness at even initial stages of disease and maintain a balance by supplying deficient substances as well as reducing the excessive ones.[10] The foremost physician of Ayurveda, tried to achieve equilibrium state of vitiated humors and related tissues (Dosha-dushya Sammmurchhana) by destruction in pathogenesis (Samprapti-vighatana) of disease which brings the cure. The Ayurvedic system of medicine was well founded on the basic principles of nature and its elements after a careful and thorough study of human physiology (Loka- purusha samtavada). This is the first system to emphasize health as the perfect state of physical, psychological, social and spiritual component of a human being. The therapeutic approach of Ayurveda has been divided into four categories as Prakritisthapani chikitsa (health maintenance), Roganashani chikitsa (disease cure), Rasayana chikitsa (restoration of normal function) and Naishthiki chikitsa (spiritual approach).[11] Surgery is considered only for advanced cases.[12] Finding the cause of an illness is the basic goal of Ayurvedic therapy through Yuktivyapasraya chikitsa (skillful treatment by physician) and in cancer. [Figure]

Pathya-apathya (Life Style and Dietary Management)

Ayurvedic anticancer therapy includes recommendations for lifestyle and use of specific foods and herbs which are very helpful not only in preventing the progression of the disease but also makes the patients feel better and comfortable overcoming the symptoms. Allium sativum (garlic) could be helpful to manage pain and ache. Bacopa monniera strengthens mental faculties and helps to manage insomnia or sleeplessness due to stress.[13] Dietary agents also synergize with chemotherapeutic drugs, thereby reducing the toxicity of chemotherapeutic drugs. Some of the dietary agents that are known to modulate p53 activity are curcumin.[14] Curcumin is a powerful inhibitor of tumor cell proliferation. Curcumin also inhibits cell cycle progression of immortalized human umbilical vein endothelial cells by up-regulating the cyclin-dependent kinase inhibitors, p21WAF1/CIP1,

Fig. Theoretical based action of Ayurvedic therapy for cancer



p27KIP1, and p53.[15] Dietary agents such as curcumin, genistein, and green tea can interfere with the non-receptor tyrosine kinases such as Src and FAK, thereby inhibiting the downstream PI-3 kinase signaling responsible for the induction of such angiogenic target genes as COX-2, VEGF, IL-8, and the MMPs. [16]

The active principle identified in fruit and vegetables and the molecular targets modulated may be the basis for how these dietary agents not only prevent but also treat cancer and other diseases.[17] From this discussion it is clear that numerous agents in fruits and vegetables can interfere with multiple cell-signaling pathways. These agents can be used either in their natural form for the prevention and perhaps in their pure form for the therapy, where large doses may be needed. While these agents are pharmacologically safe in most situations, one of the concerns commonly expressed is the lack of bioavailability.

Experience again indicates that these agents exhibit bio-response at serum concentrations that are insufficient to demonstrate in vitro response; thus suggesting that their bioavailability should not be evaluated in the same manner as synthetic compounds. Most modern medicines currently available for treating cancers are very expensive, toxic, and less effective in treating the disease. Thus, one must investigate further in detail the agents derived from natural sources, described traditionally, for the prevention and treatment of cancer and disease. More clinical trials are also needed to validate the usefulness of these agents either alone or in combination with existing therapy.[17] Ginger has been traditionally used in different ailments to aid digestion and treat stomach upset, diarrhoea, and nausea. Some pungent constituents present in ginger and other zingiberaceous plants have potent antioxidant and anti-inflammatory activities, and some of them exhibit cancer preventive activity in experimental carcinogenesis.[18] The anticancer properties of ginger are attributed to the presence of certain pungent vallinoids, viz. [6]-gingerol and [6]-paradol, as well as some other constituents like shogaols, zingerone etc.[19]

Yuktivyapasraya Chikitsa (Skillful Curative Approach) in Cancer

The technique applied to treat the disease and protect the progress of disease is known as Yuktivyapasraya chikitsa. In which skill based treatment approach is adopted by a physician to manage the disease condition. Shodhana chikitsa (purification process), which eliminates vitiated Doshas, have been primarily used for medical management of cancer. When both internal and external medications were given then it is called as Panchakarma chikitsa. Detoxification on cancer patients showed the increased body weight, improved serum immunoglobulins, increased hemoglobin levels and normalized liver functions. It was found helpful in minimizing the adverse effects of chemotherapeutic agents. The other type of curative therapy is called Shamana chikitsa (subsided treatment), which pacifies dosha and gradually relieves the disease. Shamana chikitsa is based on the properties of drugs which having taste like Tikta (bitter), Kashaya (astringent) act as Dhatu Vruddhikara (tissue nourishment) and Rakta Prashadhaka (improve circulation) and Lekhana (reduced the extra growth of tissue and normalized the cells) action simultaneously. Rasayana prayoga (immunotherapy through rejuvenating drugs), certain poisonous plants, mercury like metals and animal products were rendered non-toxic and harmless by the use of some specific pharmaceutics known as Shodhana and are used as rejuvenating drugs. Other methods of treatment include, Dhatwagni chikitsa (correction of metabolic defects), Vyadhipratyanika chikitsa (specific anti-cancerous drugs), Lakshanika chikitsa (symptomatic treatment)[10,20] and Upadrava chikitsa (treatment of complications).

Vyadhipratyanika Chikitsa (Anti Cancerous Activity)

The search on anti-cancerous effect of medicinal plants is executed by inhibiting cancer – activating enzymes, stimulating DNA repair mechanism, promoting production of protective enzymes, including antioxidant action and by enhancing activity of the immune cells. Some medicinal plants protect the body from cancer by enhancing detoxification functions of the body. Certain biological response modifiers derived from medicinal plants are known to inhibit growth of cancer by modulating the activity of specific hormones and enzymes. Some medicinal plants reduce toxic side effects of chemotherapy and radiotherapy.[21,22]

Most of the medicinal plants which are screened for anticancer and antitumour activity are not indicated in the treatment of Arbuda in the original texts. This confirms that cancer is not merely dealt under Arbuda. A review has been made to explain the rationality behind the ancient approach on cancer.[23]

Rasayana Therapy in Cancer

Tissue familiar Rasayana drug may protect the tissues involving in progression in pathology of disease. It may protect disease to spread. The health-related quality of life is a multidimensional construct that includes the subjective appraisal of the patient's physical, mental, and social well-being.[24,25] Quality of life outcomes are also the key goals of contemporary cancer management.[26] Rasayana preparations also increased stem cell proliferation and also prevented free radical-induced injury produced by radiation (Puri, 2003).[27] Brahma rasayana could ameliorate the oxidative damage produced in the body by radiation (Rekha *et al*, 2001).[28] Withania somnifera root produced a significant decrease in LPO, and an increase in both SOD and CAT thus indicating that Ashwagandha root powder possesses free radical scavenging activity (Panda and Kar, 1997).[29] Active glycowithanolides, sitoindosides VII-X and withaferin A of Withania somnifera (10 and 20 mg/kg, i.p.), administered once daily for 21 days, induced a dose-related increase in SOD, CAT and GSH-px activity in frontal cortex and striatum, which was statistically significant on days 14 and 21 (Bhattacharya *et al*, 1997).[30] Extract of Tinospora cordifolia has been shown to inhibit the LPO and superoxide and hydroxyl radicals in vitro (Mathew and Kuttan, 1997).[31] Ayurvedic concept of Rasayana seems not only to embody the principal aspects of new hypothesis centered on a immuno-endocrine psycho neuro axis but also to go beyond it by encompassing the entire human system with its diverse and complicated immunoendocrine pathway (Handa, 1993).[32] Aim to use Rasayana chikitsa, the drug should protect the cellular level (Shwasthya rakshanam).

Concept of Dhatupushti (Protect the Strength of Patient at Cellular Level)

Acharya Sushuruta has been quoted that "A patient's natural resistance is one the essential factor that should be preserved for the arrest of the progress of the disease".[33] If the immunity of a patient is naturally maintained, the intensity of disease will automatically decrease. According to Sushruta, Bala (strength) is defined as the factor due to which one obtains the nourishment and stability of Mamsa dhatu (~the muscular tissues of the body), ability to perform various tasks efficiently, good complexion, clearness and pleasantness of voice along with clear and efficient working of all the organs either external like Jnyaanendriya (sense organs) or Karmendriya (organs with motor functions) and internal like Manas (mind), Aatma (spirit), etc.[34,35]

Upadrava Chikitsa (Treatment of Complications) and Adjuvant Therapy in Cancer

Adjunct treatment with Ayurvedic herbo-mineral drugs Mauktikyukta-Kamdudha and Mauktikyukta-Praval Panchamrita and metallic drugs Svarnabhasmadi Yoga appear to have a significant effect on reducing the

toxic side effects of chemotherapy drugs in cancer patients.[36] These drugs showed significant improvement in the Karnofsky score and global score of the Quality of life by improving nausea, loss of appetite, constipation, and fatigue in cancer patients. Herbs of Withania somnifera[37] and Tinospora cordifolia[38] are also proven to be powerful immunostimulants, which could increase body resistance power during cancer associated immunosuppression. Ayurvedic Ghrita preparation, Indukant ghrita induced leukopoiesis and enhanced median survival time as well as life span in tumor bearing animals. Macrophage phagocytic capacity was also elevated. Flow cytometric analysis of lymphocyte subsets and MTS [3-(4,5-dimethylthiazol-2-yl)-5-(3-carboxymethoxyphenyl)-2-(4-sulphophenyl)-2H-tetrazolium salt] assay for lymphocyte proliferation, yielded promising results which reinforces its use as an adjuvant to cancer chemotherapy.[39] Primary concerns identified in the literature include the lack of control of anticipatory nausea, the inconsistent use of standardised ginger extracts and validated assessments tools, and a lack of assessment for prognostic factors that may influence individual chemotherapy induced nausea and vomiting response.[40] If successful, this trial will provide support for the efficacy of ginger as a viable adjuvant anti-emetic therapy and in doing so, help manage chemotherapy symptoms and assist in improving patient quality of life.[41]

Shalya Chikitsa (Surgical Management) and Agni Karma (Cauterization) in Cancer

When medical treatments practices fail, then the case was left to surgeons.[10] Surgical cancer management in Ayurveda include the principles of fomentation by means of external application, cleansing by internal medication, treatment to liquefy the contents of the swelling, opening the tumour surgically for evacuation of its contents, cauterisation to avoid recurrence and post-operative care for healing the wound.[42] Cauterisation with alkalis and acids were performed with herbal and mineral medicines.[10] Arbuda is excised completely from its deep root seat and cauterisation done to destroy any of the remaining cell particles.[43] Otherwise metastasized (Dwiarbuda) and re occurrence (Adhyarbuda) of tumor growth takes place. These categories also come under the incurable condition of tumor.[44]

Naishthika Chikitsa (Spiritual Approach) in Cancer

The anxiety and stress leads to vitiation of Vata (Vataprakopa), which will in turn to increase of pain. Some sorts of breathing techniques, chanting of mantras, pronouncing of Omkaara and Hanuman Chalisa as a form of Naishthika chikitsa will prepare patient to face the problem in a much better way and increase the positivity to patient and his/her relatives. These exercises subsides Vata.

Plants and Bhasma (Ash of Metals and Minerals of Ayurveda- Nanomedicine) in Cancer

Plant-derived compounds have been an important source of several clinically useful anti-cancer agents. These include vinblastine, vincristine, the camptothecin derivatives, topotecan and irinotecan, etoposide, derived from epipodophyllotoxin, and paclitaxel (taxol®).[45] A 70% methanol extract of Terminalia chebula fruit, was studied for its effects on growth in several malignant cell lines including a human (MCF-7) and mouse (S115) breast cancer cell line, a human osteosarcoma cell line (HOS-1), a human prostate cancer cell line (PC-3) and a non-tumorigenic, immortalized human prostate cell line (PNT1A) using assays for proliferation ([3H]-thymidine incorporation and coulter counting), cell viability (ATP determination) and cell death (flow cytometry and Hoechst DNA staining).[46] The extract obtained from Aegle marmelos showed activity in all assays, indicating the presence of cytotoxic substances.[47] Lambertini *et al* (2004), Lampronti *et al* (2003) Antiproliferative action of Aegle marmelos.[48,49] Baliga MS. (2010) proved that Ayurvedic formulation Triphala

is useful for treating and preventing cancer.[50]

In recent decades, modern technology has facilitated the study of medicinal plants/plant extracts in several aspects including extracting active components from plants (phytochemicals), studying mechanisms of actions of these phytochemicals, chemical modification of extracts to increase effectiveness and reduce side-effects, nanoparticle-packaging for the delivery and so on. Nanotechnology has been extensively used in the delivery of anti-cancer drugs.[51,52] Nanoparticles can get drugs rich in tumour site due to the special size of nanoparticles.[52] Ayurvedic bhasma are the best examples of nanoparticles and herbo-mineral formulations of Ayurvedic dosage form are the examples of nanoparticles combined phytochemicals.[53] Bhasma in accordance of classical expectation are Swarna Bhasma, Makshika Bhasma, Abhrak Bhasma, Tamra Bhasma and Louha Bhasma. X-ray diffraction, TEM and particle size analysis revealed that these Bhasma are in nanometer dimension. These Bhasma may be considered as nanomedicine and are free from toxicity in therapeutic doses.[53] Phytochemicals have been demonstrated to target cancer stem cells.[54] Nanoparticles have been used to deliver phytochemicals to increase their effectiveness. Phytochemicals may be used together with other anti-cancer agents to increase treatment efficacy and reduce side-effect.[55]

Conclusion

In Ayurveda, cancer and its related symptoms may be classified on the basis of Dosha, Dhatu, and tumor site and prognosis types.[56] Treatment modalities may be adopted accordingly. Effect of bio-mineral formulations on brain glioma (a case report),[57] tumor suppression gene level,[58, 59], and DU 145 (prostate) and COLO 205 (colon) human cancer cell lines etc.[60] are some examples which validate this ancient concept scientifically. By adopting these principles of Ayurvedic science,[61] and use of traditional test to diagnosis of cancer patients,[62] improve the well-being of the patient, as an adjuvant to chemotherapy and radiotherapy, which increase quality of life and person may enjoy the normal life span.

Key Messages

Clinical entities of Granthi group of diseases are similar to various type of cancer, when we search review on cancer related symptoms and pathology, we find that Dosha, Dushya, site and prognosis of cancer related condition may be similar to cancer disease.

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Standard journal article

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006;35:540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003;61:347-55.

Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997;195 Suppl 2:3-9.

Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000;71:1792-801.

Unpublished article

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

Chapter in book

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O, Kidd EAM, editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

No author given

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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