

## Brachial plexus injuries after radiotherapy – analysis of 6 cases

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### Abstract

*Radiation-induced brachial plexus neuropathy is caused by compression of the nerve fibres by dense and inelastic fibrous connective tissue. In this study our own experience in treatment of lesions of the brachial plexus after radiotherapy is presented. The clinical material consisted of 6 patients aged from 40 to 64 years with injuries of the brachial plexus after radiotherapy. The analysis of the material comprised: basic disease, duration of radiotherapy, radiated fields, total dose of radiation, onset and character of symptoms, location and severity of injury. 5 women were qualified for surgical treatment. After neurolysis of the brachial plexus a significant improvement was obtained in 2 cases. In one patient remission of pain and sensory recovery was temporary. No improvement was observed in the remaining 2 patients. Lesions of the brachial plexus after radiotherapy are rare but difficult to prevent. The treatment depends on the grade of severity of injury. Surgical neurolysis is advised for grades 3 and 4 on the LENT-SOMA scale.*

**Key words:** radiotherapy, brachial plexus injuries, neurolysis, histopathological examination

### Introduction

Injuries of the brachial plexus due to radiation therapy are rarely observed in medical practice [2,5,6]. This kind of damage is caused by compression of the neural elements of the brachial plexus by fibrotic connective tissue [6,11]. Fibrosis around the brachial plexus has a relatively slow, progressive course [7]. Lesions of the brachial plexus may develop in patients who have had radiotherapy to the supra- and infraclavicular regions and axilla [9,12]. Surgical exploration of the brachial plexus is recommended in advanced stages of the disease [5,12].

### Material and methods

The clinical material consisted of 6 women aged from 40 to 64 years with radiation-induced brachial plexus neuropathy treated (surgically – 5, conservatively – 1) at the Department of Trauma and Hand Surgery, Medical University of Wrocław, in the period of 1999-2005. We analysed the basic disease and its treatment, duration of radiotherapy, radiated fields and total dose of radiation. The onset and character of symptoms, location and severity of injury were established. The most important clinical data are shown in Tables I and II. The results of the surgical treatment based on the assessment of remission of

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pain and improvement of sensory and motor function have also been evaluated.

## Results

The results of the surgical treatment are shown in Table III.

## Discussion

Injuries of the brachial plexus may occur after radiotherapy of neck and thorax neoplasms [2,3,8,11,12]. In our own material 5 women have had diagnosed breast cancer and 1 woman parotid gland

neoplasm. Radiation therapy has been used as a supplement to surgical treatment in 5 women and in 1 woman as a basic cure (case 3). The total dose of radiation varied in the described cases from 45 to 60 Gy (on average 50 Gy), which confirms the observations of other authors about doses which may cause injuries of the brachial plexus [1,4]. The radiotherapy concerned the supraclavicular area and axilla in 3 patients (cases 1, 2, 5) and only the supraclavicular area in the other patients (case 3, 4, 6). In 2 women (cases 3, 4) with irradiation of the supraclavicular area the injury was localised in the superior part of the brachial plexus (C<sub>5</sub>-C<sub>6</sub>-C<sub>7</sub>). This

**Table I.** Clinical data of patients with radiation-induced brachial plexus neuropathy

Case no.	Patient data*	Basic disease	Chemo-therapy	Surgical treatment	Radiotherapy		
					Duration (weeks)	Fields	Total dose
1	Sz.J., 59	Right breast cancer	+	Breast amputation (13.12.2001)	7	Supraclavicular area Axilla	50Gy 50Gy
2	G.B., 40	Left breast cancer	+	Breast amputation (24.09.2002)	6	Supraclavicular area Axilla	50Gy 50Gy
3	O.L., 64	Left breast cancer	+	–	6	Supraclavicular area	45Gy
4	P.W., 59	Right parotid gland neoplasm	–	Parotid gland extirpation (14.07.2000)	7	Supraclavicular area	60Gy
5	O-K.G., 64	Right breast cancer	–	Breast amputation (26.08.1982)	6	Supraclavicular area Axilla	45Gy 45Gy
6	K.B., 56	Right breast cancer	–	Breast amputation (1979)	6	Supraclavicular area	**

\* – Initials, age (years).

\*\* – Unknown.

**Table II.** Clinical data of patients with radiation-induced brachial plexus neuropathy

Case no.	Patient data*	Onset of symptoms after radiotherapy	Character of symptoms	Localization of injury	Severity of injury [LENT-SOMA scale]
1	Sz.J., 59	1 year	pain, sensory and motor deficits together	C5-Th1	grade 4
2	G.B., 40	1 year	first motor deficits, next pain and sensory disorders	C5-Th1	grade 4
3	O.L., 64	from 1 to 3 years	first motor deficits and pain, next sensory disorders	C5-C6-C7	grade 4
4	P.W., 59	1 year	first motor deficits and pain, next sensory disorders	C5-C6-C7	grade 3
5	O-K.G., 64	from 20 to 23 years	first motor deficits and pain, next sensory disorders	C5-Th1	grade 4
6	K.B., 56	18 years	pain, sensory and motor deficits together	C5-Th1	grade 4

\* – Initials, age (years).

**Table III.** Results of surgical treatment of brachial plexus injuries after radiotherapy

Case no.	Patient data*	Type of surgical procedure	Interval between radiotherapy and surgical treatment	Results of treatment					
				Pain		Sensory deficits		Motor deficits	
				Pre^	Post^	Pre^	Post^	Pre^	Post^
1	Sz.J., 59	conservative treatment	–	no change		no change		no change	
2	G.B., 40	neurolysis (29.06.2004)	1.5 year	+	+	+	+	+	+
3	O.L., 64	neurolysis (23.10.2000)	10 years	+	+	+	+	+	+
4	P.W., 59	neurolysis (09.03.2004)	4 years	+	–	+	–	+	**
5	O-K.G., 64	neurolysis (31.10.2005)	23 years	+	–	+	–	+	***
6	K.B., 56	double neurolysis (01.09.1999, 01.07.2002)	20 and 23 years	+	Ti	+	Ti	+	+

\* – Initials, age (years).

^ – Pre – preoperative, Post – postoperative.

\*\* – Diminished.

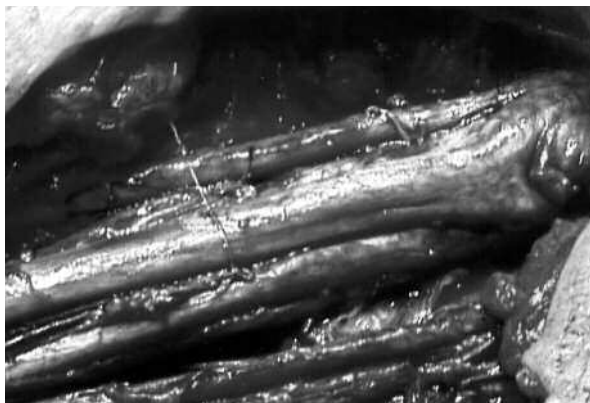
\*\*\* – Diminished (superior part of the brachial plexus).

Ti – Temporary improvement.

may confirm observations made by Kori about the greater sensibility of the superior part of the brachial plexus after radiation therapy of the supraclavicular area [8]. However, in case 6, in which the radiation field was limited to the supraclavicular area, a total lesion of the brachial plexus was observed in clinical examination. The symptoms of brachial plexus injury after radiotherapy include pain and sensory and motor disorders of the upper extremities and are classified according to a 4-grade scale of severity of injury – the LENT-SOMA scale [1,2,5]. In our own material in 5 patients a lesion of the brachial plexus reached grade 4 and in one patient (case 4) grade 3 on the LENT-SOMA scale. In 2 cases gradual progression of symptoms from grade 1 to grade 4 during 2 (case 3) and 3 years (case 5) was ascertained. The same events were observed by Bajrovic and co-workers [1]. The interval between completion of the radiotherapy and occurrence of the neurological symptoms was reported to be 1-4 years [1]. In the presented material the time of occurrence of brachial plexus injury symptoms varied from 1 year to 20 years (on average 7 years). Late onset of symptoms was observed in cases 5 and 6. These patients were not treated with chemotherapy, which in the opinion of some authors increased the risk of lesion of the brachial plexus after radiotherapy [10]. However, in case 4, in which chemotherapy was not used, onset of symptoms was

as quick (1 year) as in the other 3 cases (case 1, 2, 3) treated with chemotherapy. In the discussed material 5 women were qualified for surgical treatment. The degree of severity (grade 3 and 4 on the LENT-SOMA scale) motivated surgical exploration of the brachial plexus in these cases [5,9,12]. One woman was not operated on due to presence of metastases in the lungs (case 1). In cases with radiation therapy limited to the supraclavicular area only supraclavicular surgical access was realised (cases 3, 4, 6). In the other 3 cases with radiotherapy both the supraclavicular area and axilla, nerves in this region (axillary area) were in addition exposed (Fig. 1). Compression of the

**Fig. 1.** Intrasurgical view: exposition of neural elements in axilla



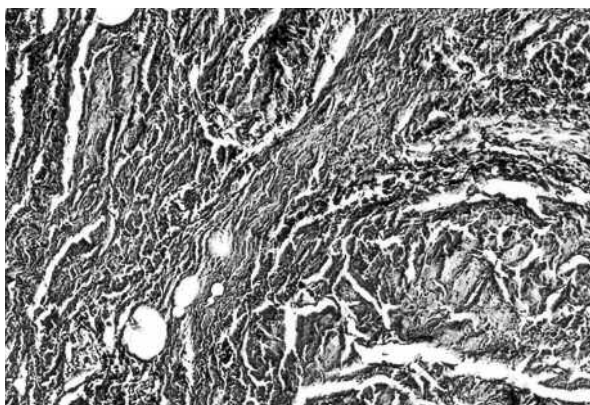
**Fig. 2.** Intraoperative view: status after external neurolysis of the nerves in axilla



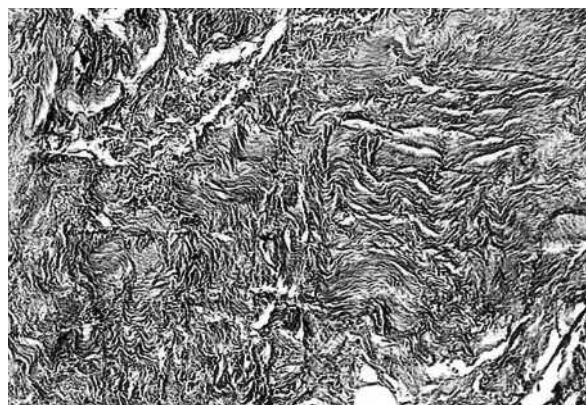
**Fig. 3.** Intraoperative view: status after external neurolysis of the superior trunk of the brachial plexus

neural elements by dense fibrous connective tissue was intraoperatively observed. The performed neurolysis allowed liberation of the brachial plexus (Figs. 2, 3) and also collection of material for histopathological examination (case 5 – Figs. 4, 5). The result of this exam constitutes a basis for the ultimate differential diagnostics between radiation-induced brachial plexus neuropathy and neoplasm infiltration [7]. After surgical treatment in 2 patients (cases 4, 5) a significant improvement was obtained – release of pain and sensory disorders, reduction of motor deficits. In one case

the improvement was temporary – release of pain and sensory recovery after neurolysis performed in 1999 (case 6). The improvement persisted for a 2-year period and then deterioration occurred. It induced us to repeated exploration of the brachial plexus in 2002. Similarly as after the first operation the improvement was temporary. After surgical treatment in the remaining 2 cases (cases 2, 3) no improvement was observed in clinical conditions. The surgical management was justifiable in these cases because of the possibility of collection of specimens for histopathological examination.



**Fig. 4.** O-K. G. 64F Histopathological specimen result: fibrous connective tissue, strongly collagenized and hyalinized without inflammatory infiltration. Stain. HE



**Fig. 5.** O-K. G. 64F Histopathological specimen result: strongly collagenized fibrous connective tissue. Stain. van Gieson

## References

1. Bajrovic A, Rades D, Fehlauer F, Tribius S, Hoeller U, Rudat V, Jung H, Alberti W. Is there a life-long risk of brachial plexopathy after radiotherapy of supraclavicular lymph nodes in breast cancer patients? *Radiother Oncol* 2004; 71: 297-301.
2. Brennan MJ. Breast cancer recurrence in a patient with a previous history of radiation injury of the brachial plexus: a case report. *Arch Phys Med Rehabil* 1995; 76: 974-976.
3. Churn M, Clough V, Slater A. Early onset of bilateral brachial plexopathy during mantle radiotherapy for Hodgkin's disease. *Clin Oncol* 2000; 12: 289-291.
4. Emami B, Lyman J, Brown A, Coia L, Goitein M, Munzenrider JE, Shank B, Solin LJ, Wesson M. Tolerance of normal tissue to therapeutic irradiation. *Int J Radiat Oncol Biol Phys* 1991; 21: 109-122.
5. Gillette EL, Mahler PA, Powers BE, Gillette SM, Vujaskovic Z. Late radiation injury to muscle and peripheral nerves. *Int J Radiat Oncol Biol Phys* 1995; 31: 1309-1318.
6. Hoeller U, Bonacker M, Bajrovic A, Alberti W, Adam G. Radiation-induced plexopathy and fibrosis. Is magnetic resonance imaging the adequate diagnostic tool? *Strahlenther Onkol* 2004; 180: 650-654.
7. Johansson S, Svensson H, Denekamp J. Timescale of evolution of late radiation injury after postoperative radiotherapy of breast cancer patients. *Int J Radiat Oncol Biol Phys* 2000; 48: 745-750.
8. Kori SH, Foley KM, Posner JB. Brachial plexus lesions in patients with cancer: 100 cases. *Neurology* 1981; 31: 45-50.
9. Nich C, Bonnin P, Laredo JD, Sedel L. An uncommon form of delayed radio-induced brachial plexopathy. *Chir Main* 2005; 24: 48-51.
10. Olsen NK, Pfeiffer P, Johannsen L, Schroder H, Rose C. Radiation-induced brachial plexopathy: neurological follow-up in 161 recurrence-free breast cancer patients. *Int J Radiat Oncol Biol Phys* 1993; 26: 43-49.
11. Wadd NJ, Lucraft HH. Brachial plexus neuropathy following mantle radiotherapy. *Clin Oncol* 1998; 10: 399-400.
12. Wouter van Es H, Engelen AM, Witkamp TD, Ramos LM, Feldberg MA. Radiation-induced brachial plexopathy: MR imaging. *Skeletal Radiol* 1997; 26: 284-288.