

Upper-limb pain in long-term poliomyelitis

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Summary

Background: Late functional deterioration is common in long-term poliomyelitis patients. While upper-limb pain in individual functional regions is common, its overall prevalence and pattern in long-term poliomyelitis is poorly documented.

Aim: To assess the nature of upper-limb pain in these patients and examine its association with dependence on mobility aids (and therefore upper limb 'overuse').

Design: Questionnaire-based survey of patients attending a specialist unit.

Methods: Questionnaires were sent to 139 patients with known long-term poliomyelitis (mean 49.8 years post polio), attending the Lane Fox Unit out-patient clinic at St Thomas' Hospital between January 1998 and December 1998. There were

questions on the nature of the patient's acute illness, limb involvement at initial infection ('polio-affected' limbs), the site and onset of upper-limb pain, hand dominance, previous injuries and surgery, and the use of mobility aids. Limbs that had sustained an injury or undergone surgery, at or preceding onset of upper-limb pain, were excluded from analysis.

Results: Among 103 valid replies, the prevalence of upper limb pain was 64%. Mobility aids were used by 74%, and were associated with an increased risk of upper-limb pain, while 'polio-affected' limbs were at reduced risk.

Discussion: These data support 'overuse' due to greater mobility aid dependence as a cause of increasing upper-limb pain in long-term poliomyelitis.

Introduction

The functional deterioration that occurs in patients many years after their initial poliomyelitis infection is a common and well-recognized phenomenon. The clinical entity known as post-polio syndrome is thought by some to account for a large number of these cases, although its precise definition, incidence and aetiology have been debated.^{1–4} Respiratory, neurological and orthopaedic problems are common causes of functional deterioration in these patients, and they may also interact, for example in those who have scoliosis and impaired respiratory muscle function.^{1–7}

Until recently, studies into orthopaedic problems in patients with long-term poliomyelitis have concentrated on spinal and lower-limb pathologies,

primarily because of their frequency and their impact on the activities of daily living.⁸ In recent times, there has been an increasing body of literature reporting the development of upper-limb problems in long-term poliomyelitis patients. The relationship between 'overuse' symptoms caused by increased dependence on mobility aids, and upper limb deterioration, has previously been noted. However, studies describing this relationship have tended to focus on individual functional regions, such as the shoulder or wrist and hand.^{8–10}

In our orthopaedic clinic, upper-limb pain is a common and debilitating symptom associated with loss of function in the upper limbs of long-term poliomyelitis patients. In particular, we have

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observed an increasing incidence of painful upper-limb problems, such as tendinopathies and arthropathies that would normally be ascribed to 'overuse' in those without poliomyelitis. Many of these patients are also dependent on aids to maintain their mobility. Review of the literature regarding long-term poliomyelitis shows that the prevalence rate and pattern of upper-limb pain in this group is unknown. We therefore attempted to assess the nature of upper-limb pain in these patients and to determine whether increasing dependence on mobility aids, and therefore upper limb 'overuse', was associated with the high prevalence of symptoms that we have observed.

Methods

Questionnaires were sent to 139 patients with known long-term poliomyelitis, who attended the Lane Fox Unit out-patient clinic at St Thomas' Hospital between January 1998 and December 1998. The Lane Fox Unit is a multidisciplinary team, specializing in the management of poliomyelitis patients and receives referrals from all parts of the UK. Patient demographics were collected from in-patient notes kept in the Lane Fox Unit.

The questionnaire generated data on the *nature of the patient's acute illness*, including year of the initial infection and the patients' recollection of the pattern of limb involvement at initial infection ('polio-affected' limbs). Patients were asked to report on the *presence of upper-limb pain*, in particular the site and year of onset of pain. The anatomical site of upper limb pain was assigned to one or more of the three functional units of the arm—the shoulder, the elbow and the hand. They were also asked about their hand dominance and the date of previous injuries and surgery to the upper limb. Information about the use of mobility aids (crutch, stick or wheelchair) in this group of patients was also collected, including the year in which the patients commenced mobility aid use.

Data regarding the demographics of the patient population were analysed. Estimates of relative risk were generated with STATA 5.0 statistical and data analysis software for the risk factors surveyed in each limb and each functional unit. The risk factors included mobility aid use, limb dominance and whether limbs were 'polio-affected'. Limbs that had sustained an injury or had undergone surgery in the same or preceding years were excluded from analysis to eliminate potentially confounding non-poliomyelitis-related problems as a source of pain. Statistical significance was set at $p < 0.05$.

Results

We received 116 replies, giving an 83% response rate overall. Thirteen patients were excluded from the analysis because of inadequate completion of the questionnaire. Of note, twelve of these patients had indicated with 'ticks' that they had experienced upper-limb pain. We thus analysed 74% of the questionnaires distributed.

In the 103 patients that were included in the analysis, mean age at time of survey was 58.1 years (range 35–82, SD 10.6), with 43% of respondents being male and 57% female. Mean age at initial infection with poliomyelitis was 8.3 years (range 0–51, SD 9.1). The average 'post-polio interval' was 49.8 years. Upper-limb involvement at the initial infection occurred in 64% of patients, while 88% of patients reported lower-limb involvement at initial infection (Table 1).

In 13/103 patients, 15 upper-limb regions were excluded because of surgery or an injury to that region in the same or preceding years. The regions excluded comprised five shoulders, two elbows and eight hands. Two patients had more than one region excluded. The results of the questionnaire in the remaining limbs are displayed in Tables 2 to 6. Upper-limb pain was a frequent finding (64%). Shoulder pain (55%) was more common than hand pain (34%) and elbow pain (31%). Males (61%)

Table 1 Distribution of 'polio-affected' limbs per patient at initial infection

Polio-affected limbs	<i>n</i>	No. with polio-affected ULs	No. with polio-affected LLs
0	3	38	12
1	26	22	34
2	29	43	57
3	9	–	–
4	36	–	–

UL, upper limb; LL, lower limb.

Table 2 Upper-limb pain per patient: functional region distribution

Painful limbs/regions	No. with UL pain (<i>n</i> = 103)	Prevalence of UL pain
UL overall	66	64%
Shoulder	57	55%
Elbow	32	31%
Hand	35	34%

UL, upper limb.

and females (66%) were equally affected by upper-limb pain. Upper-limb pain was more common in younger patients, peaking in the 50–59 year old age group, although this largely reflects the age distribution of the population surveyed. The mean delay before onset of upper-limb pain following initial poliomyelitis infection was 41.4 years.

Of the 103 patients, 74% (76 patients) reported using one or more mobility aids: 23 used one or more crutches; 45 patients used a walking stick or sticks; and 44 used a wheelchair. Of the 76 patients who used mobility aids, 54 (71%) also reported upper-limb pain in one or more regions. The mean duration of use of mobility aids was 14.6 years for walking sticks, 19.4 years for crutches, 22.3 years for wheelchairs, and 18.3 years when all aids were considered. Twelve patients did not report the year in which they commenced using mobility aids.

The risk-factor analysis for upper-limb pain is presented in Tables 7 to 10. The use of crutch or stick mobility aids was associated with a 66% increased risk of upper-limb pain; this was also true when individual functional units were analysed separately. The shoulder, elbow and hand regions demonstrated 67%, 130% and 71% increased risk of upper-limb pain with crutch and/or stick mobility aid use, respectively. The elbow was the only

functional region in which wheelchair use, when analysed alone, and in conjunction with other mobility aids, demonstrated an increased risk (78%) of upper-limb pain. Although dominant limbs and functional units did not have a significantly increased risk of upper-limb pain, 'affected' limbs were at (25%) reduced risk of upper-limb pain. This was not the case when the functional units were analysed individually, however.

Discussion

An increasing volume of information concerning the long-term problems that occur in poliomyelitis patients has accumulated from centres around the world over the past three decades. Orthopaedic complications are frequent in those patients more than 30 years after initial poliomyelitis infection.^{1–6} In the early literature, problems about the hip, knee, and spine were particularly common.^{1–3,5–7,11} Musculoskeletal pain and weakness are frequent symptoms associated with the functional deterioration that occurs in these patients.^{5,6} In recent times, studies of long-term polio patients ('polio survivors') have reported an increasing incidence of upper-limb pain and dysfunction. Several authors have suggested that this change in pattern of orthopaedic disability may be due to 'overuse' caused by increased upper-limb weight-bearing.^{7–10} We have had a similar experience managing the upper-limb problems of 'polio survivors' in our orthopaedic

Table 3 Upper-limb pain per patient: age distribution

Age group (years)	Pain	No pain
30–49	15	7
50–59	31	11
60–69	12	10
>70	8	9

Table 4 Upper-limb pain per patient: sex distribution

Sex	Pain	No pain
Female	39	20
Male	27	17

Table 5 Upper-limb pain per patient: mobility aid use

	Crutch use	Stick use	Wheelchair use	Any aid use
No. using mobility aid(s)	23 (22%)	45 (44%)	44 (43%)	76 (74%)
Right UL use	23	32	–	–
Left UL use	19	24	–	–
Both ULs	18	9	–	–
Mean duration of use (years)	14.6	19.4	22.3	18.3

UL, upper limb.

Table 6 Mean time to onset of upper-limb pain

Painful region	Years to onset of UL pain
Right shoulder	42.1
Left shoulder	41.1
Right elbow	41.3
Left elbow	39.7
Right hand	41.7
Left hand	42.2
Upper limb overall	41.4

UL, upper limb.

Table 7 Risk factors for upper-limb pain: overall results

	Limbs (<i>n</i> = 206)	Risk ratio	CI	<i>p</i> *
Painful limb(s)	107			
Polio-affected limbs	47	0.75	0.58–0.98	0.04
Dominant limbs	53	0.98	0.75–1.28	1.00
Crutch, stick use	57	1.66	1.28–2.45	<0.001
Wheelchair use	51	1.08	0.83–1.41	0.58
Crutch, stick, WC use	73	1.28	0.96–1.72	0.11

*Fisher's 2-sided exact *p*.**Table 8** Risk factors for shoulder pain

	Shoulders (<i>n</i> = 201)	Risk ratio	CI	<i>p</i> *
Painful shoulder(s)	87			
Affected shoulders	40	0.79	0.58–1.09	0.16
Dominant shoulders	45	1.08	0.79–1.49	0.67
Crutch, stick use	47	1.67	1.22–2.29	0.002
Wheelchair use	41	1.10	0.80–1.51	0.57
Crutch, stick, WC use	60	1.29	0.91–1.84	0.14

*Fisher's 2-sided exact *p*.**Table 9** Risk factors for elbow pain

	Elbows (<i>n</i> = 201)	Risk ratio	CI	<i>p</i> *
Painful elbow(s)	47			
Affected elbows	20	0.71	0.43–1.18	0.24
Dominant elbows	22	0.91	0.54–1.50	0.74
Crutch, stick use	29	2.30	1.37–3.86	0.001
Wheelchair use	27	1.78	1.07–2.96	0.029
Crutch, stick, WC use	37	2.28	1.20–4.31	0.006

*Fisher's 2-sided exact *p*.**Table 10** Risk factors for hand pain

	Hands (<i>n</i> = 198)	Risk ratio	CI	<i>p</i> *
Painful hand(s)	55			
Affected hands	25	0.80	0.51–1.26	0.35
Dominant hands	28	1.06	0.68–1.66	0.87
Crutch, stick use	29	1.71	1.10–2.68	0.02
Wheelchair use	24	1.05	0.67–1.65	0.87
Crutch, stick, WC use	35	1.11	0.70–1.78	0.75

*Fisher's 2-sided exact *p*.

clinic. Examining the literature on the late effects of poliomyelitis on upper limbs, we found that although information regarding individual regions such as the shoulder, wrist and hand is documented, an overall picture of the prevalence and pattern of upper-limb pain in these patients had not been described. We present a brief review of the relevant literature before discussing the findings of our study.

One paper that examined the problems faced by long-term poliomyelitis patients included a population of patients who also attended the Lane Fox Unit at St Thomas' Hospital. In this 1997 study, Kidd *et al.* reviewed the records of 239 polio patients who were newly referred to the unit for assessment between 1990 and 1994. The mean age of the patient group was 51.8 years. They found that degenerative arthropathy was common (63%

of cases), with the knees (68 cases) and spine (69 cases) being most often affected. Degenerative disease of the upper limb was considerably less frequent, however (5 cases). Relevant neurological complications in the study group included upper-limb entrapment neuropathy (7 cases) and cervical radiculopathy (17 cases) or myelopathy (3 cases); other upper limb disorders were not mentioned. The presence and type of upper-limb symptoms in these patients was not reported.¹

Another study, by Perry and Fleming, looked at long-term problems in 193 polio patients who were reviewed between 1979 and 1984. The average 'post-polio interval' was 25 years. Disorders of the lower limbs and spine were again found to be the most common problems. In order of frequency, the most common complications were brace problems (29.5%), knee recurvatum (27.9%), increasing weakness (23.3%), ankle equinus (18.1%), back pain (15.0%) and upper extremity pain (10.4%). The shoulder girdle was the commonest site for upper-limb pain, and this was related to shoulder subluxation and overuse of the upper extremities in gait. Sixty percent of patients with upper extremity pain were 30–40 years post-polio. The authors concluded that chronic mechanical strain and an 'overuse' phenomenon, also described by other authors, was responsible for the development of the above-mentioned problems.⁷

In 1989 and 1992, Werner *et al.* published two studies which specifically examined upper-limb problems in the 'postpoliomyelitis' population, in particular focusing on pathology of the wrist and hand. In the first paper, on median mononeuropathy of the wrist, 49% of the patients surveyed complained of wrist pain. The prevalence rate of carpal tunnel syndrome was 22%, compared to an accepted prevalence in the general population of <1%. They also found an increased relative risk of developing median mononeuropathy with the use of mobility aids, including canes and/or crutches and wheelchairs.⁹

The second paper examined osteoarthritis (OA) of the hand and wrist in post-poliomyelitis patients. They found a prevalence rate of 68% for patients with hand or wrist OA, although the diagnosis was a radiographic one and did not relate to symptoms. 'Age, lower limb weakness, use of assistive devices and severity of disability' were all associated with hand and wrist osteoarthritis. Increased mechanical stress on the upper limbs, in particular on the hand and wrist, with the use of mobility aids, was thought by the authors to result in an increased risk of developing hand and wrist pathology.¹⁰

More recently, a paper by Klein *et al.* examined the relationship between lower extremity weakness

and shoulder 'overuse' symptoms in polio survivors. Lower-limb weakness correlated with the presence of shoulder symptoms in a laboratory setting that included clinical evaluation with 'resistance' and 'palpation' testing for shoulder pain. The authors reported that 46% of the long-term polio patients they surveyed experienced shoulder pain, and that lower-limb weakness, in particular reduced knee extensor strength, predisposed this group of patients to shoulder overuse symptoms.⁸

In this study, the prevalence of upper-limb pain was 64% in the long-term poliomyelitis patients who correctly responded to our questionnaire. While there may be a bias towards absence of symptoms in the group of non-respondents (23 patients), we could not include the 12 patients who responded positively with 'ticks'. We consider that this figure remains an accurate reflection of the overall prevalence of upper-limb pain in this group of patients.

When compared with the existing literature, this study confirms that the prevalence of upper-limb pain in long-term poliomyelitis patients is high, and appears to have increased over the last two decades.^{1,2,7} There has been a five-fold increase in the prevalence of upper-limb pain in these patients (from 10.4% to 64%) if we compare our findings with the study by Perry and Fleming, whose subjects were surveyed approximately 15 years earlier.⁷ Our patients also appear to have developed their upper-limb pain relatively recently—the time between mean onset of symptoms after initial infection (41.7 years) and the post-polio interval at this review (49.8 years) being only 8 years. This period represents the mean duration of upper-limb pain in our 'polio survivors' and is in keeping with a recent increase in the prevalence of upper-limb pain in this group.

As previously reported by Perry and Fleming, the shoulder was the commonest site of upper-limb pain among our patients (55%).⁷ This is also compatible with the prevalence described by Klein *et al.* (46%) in their population of poliomyelitis patients.⁸ However, high rates of chronic shoulder pain have also been observed in the community by Badcock *et al.*, who found a 'point prevalence' (current shoulder pain and disability) of 20% in a random group of patients surveyed from a general practice register in the UK.¹²

In the distal upper limb, we found the prevalence of hand pain (34%) to be somewhat lower than that reported by Werner *et al.*, who found higher rates of pain and other problems about the wrist and hand. Their high prevalence rates with regard to hand osteoarthritis may in part be attributed to more detailed enquiry undertaken in the study, and reliance on radiographic findings rather than

symptoms.^{9,10} As with shoulder pain in the community, a high rate of symptomatic hand OA (23%) has previously been reported in a population of elderly (65 years and older), disabled women.¹³ We found only an 11% higher rate of hand pain in our slightly younger, polio-disabled population. When considering the prevalence rates found by Werner *et al.* with regard to wrist pain (49%) and median mononeuropathy (22%), in addition to this high background rate of hand OA, the relatively low rate of hand pain in our patients is a little surprising.⁹ Irrespective of any discrepancy between our findings and those of Werner *et al.*, distal upper limb problems are clearly frequent in those with long-term poliomyelitis, with a prevalence of at least 34%.

In contrast to the proximal and distal upper-limb units, problems about the elbow in long-term poliomyelitis are infrequently reported in the literature. In our study, the prevalence of elbow pain was high (31%), and comparable to that of hand pain in our patient group. Apart from specific populations, such as the 'occupationally-at-risk' and certain professional athletes, elbow pain does not appear to be a common problem in the general community. The absence of information in the literature relating to elbow problems in the long-term poliomyelitis population is significant and may indicate that this joint is being under-assessed by clinicians. Long-term poliomyelitis patients may also be identified as another 'at-risk' population for elbow pain.

Daylan *et al.* reported a similar prevalence rate and pattern of upper extremity (UE) pain in a group of patients with spinal cord injury (SCI) in 1999: 58.5% of these patients experienced UE pain, with 71% reporting shoulder pain, 53% and 43% having wrist and hand pain respectively, and 35% reporting elbow pain.¹⁴ Subbarao *et al.* also reported that chronic wrist and shoulder pain was common in another group of patients with SCI who were surveyed four years earlier, wheelchair propulsion and transfers causing most pain in this population.¹⁵ As patients with SCI have similar mobility issues to many patients with paralytic poliomyelitis, the high rates of upper-limb pain in this study are not unexpected. While proximal and distal upper limb problems are common in the general population, the findings in our patients and those with spinal cord injury also suggest that upper limbs are significantly affected by impaired mobility.

With regard to the risk factors for upper-limb pain, 'work related' physical factors such as repetitive work movements, gripping force demands and non-neutral posture have been associated with the four commonest work-related upper-limb

disorders—rotator cuff tendinitis, lateral epicondylitis, wrist and forearm tenosynovitis and carpal tunnel syndrome. Higher 'physical load factor' intensity, frequency and/or duration is associated with an increased risk of one or more of these upper-limb disorders, although quantitative limits for physical loading have not been determined. 'Individual' factors such as age, systemic disease and aberrant anatomy have also been shown to be significant.¹⁶

In the post-polio population, authors of other studies have also attributed the onset of upper-limb problems to increased mechanical loading or strain on the joints and soft tissues of the upper limb.^{7,9,10} In addition, Klein *et al.* demonstrated that lower-limb weakness was associated with the development of shoulder overuse symptoms, including pain.⁸ This study supports their findings and the hypothesis that increased mechanical loading results in upper-limb deterioration. Our patients were heavily dependent on mobility aids, with 75% of patients using one or more, and 71% of these patients reporting upper-limb pain. The use of crutch and/or stick mobility aids is associated with an increased risk of pain in the upper limbs of our patients. The short mean duration of upper-limb pain in our patients (8 years), compared to the longer mean duration of mobility aid use (18.3 years), suggests that development of symptoms may follow a period of mobility-aid dependence.

Our study has expanded on the findings of Werner *et al.* regarding the association between mobility aid use and increased hand and wrist problems, to include the other functional units of the upper limb.^{9,10} This finding has not previously been demonstrated in the upper limb overall, or in the more proximal regions. We also found that 'polio-affected' limbs were at reduced risk of upper limb pain, although this was not confirmed on individual analysis of the upper-limb regions. While this finding has not been reported previously, the 'sparing' effect of neurological diseases, including poliomyelitis, on arthropathic joints has been described.¹⁷

Our findings are significant for the further management of those with long-term poliomyelitis, as upper- and lower-limb regions appear to be at different stages of musculoskeletal decline, and may therefore require individual exercise prescriptions.¹⁸ The development of new symptoms, such as upper-limb pain, is also associated with reduced ability to perform daily activities, and may result in decreased 'satisfaction with life'.¹⁹ While shoulder and hand problems in the poliomyelitis population have been well-documented, we found that the elbow was also commonly affected. Elbow

problems have been infrequently described, and this region may be neglected in 'polio survivors'.

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