A SEVEN-YEAR REVIEW OF SPINAL BIOPSY RESULTS AT A SINGLE ACADEMIC CENTER IN SOUTH AFRICA

A. Kelly, FC Neurosurgery (SA) and **P. Seroto**, FC Neurosurgery (SA), Dr George Mukhari Academic Hospital, Sefako Makgatho Health Sciences University, Pretoria, South Africa

Correspondence to: Dr. Adrian Kelly, P.O. Box Medunsa, Pretoria, South Africa. Email: adriankelly1000@yahoo.co.uk

ABSTRACT

Background: The ability to perform a consistently effective spinal biopsy that yields adequate specimen to make a diagnosis, without incurring complications, is an essential skill required by a spinal surgeon.
Objective: To provide an institutional review of the spinal biopsy results, collected over a 7-year period, in 126 patients.
Methods: We performed a retrospective review of the laboratory results of 126 patients who had spinal biopsies performed at our institution over a 7-year period. The data collected and analyzed in this study included age, gender, type of biopsy performed, microbiology results, and histology results.
Results: Of the 126 spinal biopsies performed, 55/126 (44%) were performed for neoplastic disease, and 71/126 (56%) were performed for tuberculosis. High statistical significance was demonstrated between subject age and neoplastic/tuberculous diagnosis ($p<0.001$). In this study, 106/126 (84%) subjects had open biopsies and 20/126 (16%) subjects had percutaneous core needle biopsies. In our tuberculosis group we report that in 50/71 (70%) subjects the Zeels' Nielsen (ZN) stain was negative and in 40/71 (56%) subjects the tuberculosis culture result was negative. Hence in approximately 50% of our 71 tuberculosis cases the diagnosis was made by histopathological diagnosis where in 34/71 (48%) subjects tuberculosis was confirmed by the presence of caseating granulomas, and in 37/71 (52%) subjects tuberculosis was suggested by granulomatous inflammation without caseation being present.
Conclusion: While an adequate spinal biopsy more reliably provides a useful histology result in neoplastic disease, in spinal tuberculosis there is only an approximately 50% yield on Zeels Nielsen staining and tuberculosis culture. Our study confirms the importance of the indirect histopathological evidence of tuberculosis, which we found to often be all that was available to make the diagnosis.

Key words: Spinal tuberculosis, Spinal metastases, Biopsy results

INTRODUCTION

Performing spinal biopsies for microbiological and histological assessment to direct patient management is a fundamental procedure regularly performed by the spine unit at Dr. George Mukhari Academic Hospital in Pretoria, South Africa. In fact, from the 1st January 2012 to 31st December 2018, the unit performed 127 spinal biopsies, the results of which can largely be divided into neoplastic and tuberculous groups. While essential in the diagnosis of extramedullary neoplastic disease, a South African study labelled spinal biopsy as "mandatory" in spinal tuberculosis, not only to confirm a suspected radiological diagnosis, but importantly to establish sensitivity to anti-tubercular medication (1). Another more recent South African study confirmed core needle biopsy as a fundamental intervention to confirm suspected spinal tuberculosis and determine drug sensitivity in patients that do not require open surgery (2).

MATERIALS AND METHODS

A retrospective review of all spinal biopsy laboratory results, performed by the Spine unit at Dr. George Mukhari Academic Hospital, in Pretoria, South Africa, from 1st January 2012 to 31st December 2018 was performed. Data collected and analyzed in this study included subject age, gender, suspected diagnosis, whether an open or percutaneous biopsy was performed, microbiology results, and histology results. These results were divided into neoplastic and tuberculous groups and were compared using inferential statistics to look for significant differences. All statistical procedures were done on SAS (SAS Institute Inc, NC, USA), Release 9.4 or higher, running under Microsoft Windows on a personal computer.

RESULTS

A total of 126 spinal biopsies were performed over the study period, of which 55/126 (44%) were performed for neoplastic disease, and 71/126 (56%) were performed for tuberculosis. Considering age distribution in the neoplastic group the mean age was 54.1 (±14.5) years while the mean age in the tuberculous group was 40.5 (±16.8) years. The age difference between the two groups demonstrated high statistical significance ($p<0.001$). Considering gender in the neoplastic group there were 28/55 (51%) females

and 27/55 (49%) males, and in the tuberculous group there was 27/71 (38%) females and 44/71 (62%) males. While a clinical trend was demonstrated in the tuberculous group towards increased males being afflicted this was not statistically significant (p=0.15). In terms of biopsy type 106/126 (84%) were performed as open biopsies and 20/126 (16%) were percutaneous core needle biopsies.

Considering the microbiological results in the tuberculous group, in 50/71 (70%) subjects the Zeels' Nielsen (ZN) stain was negative and in 21/71 (30%) subjects this was positive for mycobacterium tuberculosis. Considering the culture results in the tuberculous group, in 31/71 (44%) this was positive and in 40/71 (56%) the culture was negative. Considering the histology results in the tuberculous group of 71 subjects, in 34/71 (48%) subjects, tuberculosis was confirmed by the presence of caseating granulomas, and in 37/71 (52%) subjects, tuberculosis was suggested by granulomatous inflammation without caseation being present.

Considering the histology results in the neoplastic group, the most common cancers were metastatic lung adenocarcinoma in 12/55 (22%) subjects, metastatic breast carcinoma in 10/55 (18%) subjects, metastatic prostatic carcinoma in 8/55 (15%) subjects, metastatic squamous cell carcinoma in 5/55 (9%) subjects, B-cell lymphoma in 4/55 (7%) subjects, and multiple myeloma in 4/55 (7%) subjects, and the remainder was comprised of a miscellaneous group of neoplastic diagnoses in 7/55 (13%) subjects, and was inconclusive in 5/55 (9%) subjects.

DISCUSSION

In this study the mean age of subjects who underwent spinal biopsy for neoplastic disease was 54.1 ±14.5 years, and the mean age of subjects who underwent spinal biopsy for tuberculous was 40.5 ± 16.8 years. High significance was demonstrated between subject age and whether they had a neoplastic or tuberculous diagnosis ($p<0.001$). The findings of this study is similar, to that reported by the American Cancer Society's Department of Epidemiology and Surveillance Research, that noted spinal metastases are commonly diagnosed in adults between the age of 55 and 60 years (3). Regarding the mean age of subjects with spinal tuberculosis another South African study that considered 125 patients, noted the mean age of their subjects to be 27 years (4), which is younger than the mean age of the subjects with spinal tuberculosis in our study.

This study showed that 106/126 (84%) of our biopsies were performed open (Figure 1), and 20/126 (16%) were percutaneous core needle biopsies (Figure 2).

Figure 1

Illustrative intra-operative photograph of one of our cases where we used a tubular retractor to perform an open spinal biopsy

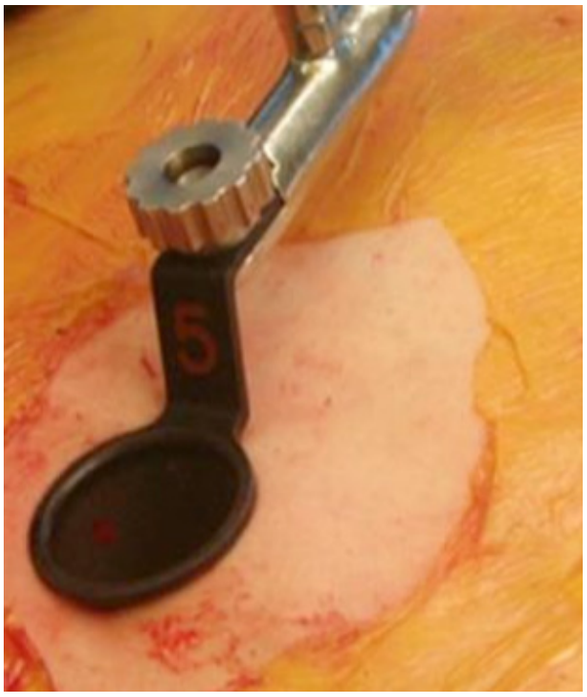

Figure 2

Illustrative intra-operative photograph of one of our cases where we used a Tuohy needle to perform a percutaneous core needle spinal biopsy under fluoroscopic guidance

Regarding open biopsies performed to address spinal lesions, several studies report a significant risk of complications (5,6). Percutaneous needle biopsies are regarded as safer, cheaper, incur less blood loss, and can even be done as an out-patient procedure (7). Several studies report that CT guided percutaneous needle biopsies for spinal lesions improves accuracy and reduces complications and has therefore become the technique of choice (8-10). Other studies report that while percutaneous spinal biopsy is generally safe, when complications do occur, they can be devastating. Complications reported include pneumothorax (11), paravertebral haematomas (12), and paraplegia (13). The reason for approximately 80% of our biopsies having been performed open is explained firstly by the fact that we routinely perform all our spinal biopsies in the operating room where CT facilities are not available. We perceive there to be unacceptably substantial risk of complications when performing a percutaneous needle biopsy using only C-arm fluoroscopy and hence, albeit incurring a longer operating time with more blood loss, we have found open biopsy to be a safer alternative. Our practice is supported by a meta-analysis that considered 25 studies and reported a complication rate, for percutaneous needle biopsy of spinal lesions under fluoroscopic guidance, of 5.3% (14). The second reason explaining why approximately 80% of our spinal biopsies were performed open is that in approximately 60% of our subjects the biopsies were performed for spinal tuberculosis. In our spinal tuberculosis cases the spinal biopsy commonly formed part of a combined mini-costotransversectomy procedure to drain a paravertebral tubercular abscess, as well as obtain a biopsy specimen, and as such the biopsy was recorded as an open procedure (Figure 3).

Figure 3

Illustrative intra-operative photograph showing the typical caseous material of tuberculosis. In this illustrative case we performed a mini-costotransversectomy to simultaneously perform an open biopsy as well as drain a paravertebral tuberculous collection

Considering the microbiological results, in our tuberculous group of subjects, the tuberculosis culture was positive in 31/71 (44%) subjects. This yield of our institutional microbiological culture results is lower, but comparable, to that put forward in another study where the tuberculosis culture result was positive in 52% of subjects (1). Other studies report the positive yield from culture of biopsy material in spinal tuberculosis to be between 11 and 53% (15,16).

Considering the tuberculosis group of 71 subjects, in our study histological caseating granulomas were diagnosed in 34/71 (48%) subjects. This is lower than the incidence of caseating granulomas found in another study where the reported incidence was 59% (1). Our result is also lower than the 71-97% histopathological accuracy in the diagnosis of osteo-articular tuberculosis as put forward in another study (17).

CONCLUSION

Performing an effective spinal biopsy is the first pillar in the accurate diagnosis of suspected spinal pathology. The other two pillars are firstly your institutional microbiological and secondly your institutional histopathological services. Our series demonstrated the importance that these two services play in the process and highlighted several areas. Newer technologies such as PCR amplification currently in use at our institution were intentionally excluded from the study results as they were implemented after the data collection began and as such would confound the results. Their importance cannot be understated and in fact the low yield of our ZN, culture, and histological diagnostic methods are the exact evidence underpinning their later implementation.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest statement: None of the authors listed above have any financial nor personal relationships with other people, or organizations, that could inappropriately influence (bias) their work, all within 3 years of the beginning the work submitted.

REFERENCES

1. Dunn, R. and Zondagh, I. Spinal tuberculosis: diagnostic biopsy is mandatory. *S Afr Med J*. 2008; **98**(5):360-362.
2. Watt, J. and Davis, J. Percutaneous core needle biopsies: The yield in spinal tuberculosis. *S Afr Med J*. 2014; **104**:29-32.

3. Greenlee, C.A., Murray, T., Bolden, S. and Wingo, P.A. Cancer statistics, 2000. *Cancer J Clin.* 2000; **50**(1):7-33.
4. Held, M., Hoppe, S., Laubscher, M., Mears, S., Dix-Peek, S., Zar, H. and Dunn, R. Epidemiology of musculoskeletal tuberculosis in an area with high disease prevalence. *Asian Spine J.* 2017; **11**(3):405-411.
5. Mankin, H.J., Mankin, C.J. and Simon, M.A. The hazards of biopsy, revisited. *J Bone Joint Surg Am*. 1996; **78**(5):656–663.
6. Mankin, H.J., Lange, T.E. and Spanier, S.S. The hazards of biopsy in patients with malignant primary bone and soft-tissue tumors. *J Bone Joint Surg.* 1982; **64**(8):1121–27.
7. Rimondi, E., Staals, E.L., Errani, C., Bianchi, G., Casadei, R., Alberghini, M. and Cristina, M. Percutaneous CT-guided biopsy of the spine: results of 430 biopsies. *Eur Spine J*. 2008; **17**:975–981.
8. Hau, M.A., Kim, J.I., Kattapuram, S., Hornicek, F.J., Rosenberg, A.E., Gebhardt, M.C. and Mankin, H.J. Accuracy of CT-guided biopsies in 359 patients with musculoskeletal lesions. *Skeletal Radiol*. 2002; **31**(6):349–353.
9. Lis, E., Bilsky, M.H., Pisinski, L., Boland, P., Healey, J.H., O'Malley, B. and Krol, G. Percutaneous CT-guided biopsy of osseous lesion of the spine in patients with known or suspected malignancy. *Am J Neuroradiol*. 2004; **25**(9):1583–88.
10. Puri, A., Shingade, V., Agarwal, M., Anchan, C., Juvekar, S., Desai, S. and Jambhekar, N.A. CT-guided percutaneous core needle biopsy in deep seated musculoskeletal lesions: a prospective study of 128 cases. *Skeletal Radiol*. 2006; **35**(3):138–143.
11. Murphy, W.A., Destouet, J.M. and Gilula, L.A. Percutaneous skeletal biopsy in 1981: a procedure for radiologists. Results, review and recommendations. *Radiology.* 1981; **139**:545–549.
12. Ottolenghi, C.E. Diagnosis of orthopaedic lesions by aspiration biopsy: results of 1061 punctures. *J Bone Joint Surg Am*. 1955; **58**:1167–68.
13. Nagel, D.A., Albright, J.A., Keggi, K.J., *et al.* Closer look at spinal lesions: open biopsy of vertebral lesions. *JAMA*. 1965; **191**:975–978.
14. Nourbakhsh, A., Grady, J.J. and Garges, K.J. Percutaneous spine biopsy: a meta-analysis. *Bone Joint Surg Am*. 2008; **90**(8):1722-25. doi: 10.2106/JBJS.G.00646
15. Polley, P. and Dunn, R. Non-contiguous spinal tuberculosis: incidence and management. *Eur Spine J*. 2009; **18**:1096-1101.
16. Maipala, J., Rajuc, R., Vishnampetai, G. and Ka, S. Comparison of culture and nucleic acid amplification methods for diagnosis of tuberculosis of the dorsal spine. *Curr Orthop Pract.* 2010; **21**:171-176.
17. Lakhanpal, V., Tuli, S., Singh, H. and Sen, P. The value of histology, culture and guinea pig inoculation examination in osteo-articular tuberculosis. *Acta Orthop Scand*. 1974; **45**:36-42.